TT 66-62416

HEADQUARTERS, DEPARTMENT OF THE ARMY OFFICE, ASSISTANT CHIEF OF STAFF FOR INTELLIGENCE WASHINGTON 25, D. C.	TRANSLATION NO. J-0203	TD NO.

REQUESTER	CONTROL NO.	TRANSLATOR'S INITIALS	DATE COMPLETED
FTSC		RLB	Aug 1, 1966

LANGUAGE	GEOGRAPHIC AREA (If different from place of publication)
Russian	USSR

ENGLISH TITLE OF TRANSLATION	PAGE NUMBERS TRANSLATED FROM ORIGINAL DOCUMENT
Technology and Armament	1-95

FOREIGN TITLE OF TRANSLATION

Tekhnika i Vooruzheniye

AUTHOR(S)	FOREIGN TITLE OF DOCUMENT (Complete only if different from title of translation)
various	

PUBLISHER	DATE AND PLACE OF PUBLICATION
	Number 4 Moscow, April 1966

COMMENTS

TRANSLATION

Table of Contents

Best
Available
Copy

TT 66-62416

AD640235

HEADQUARTERS, DEPARTMENT OF THE ARMY
OFFICE, ASSISTANT CHIEF OF STAFF FOR INTELLIGENCE
WASHINGTON 25, D. C.

TRANSLATION NO.: J-0203

REQUESTER: FTSC
CONTROL NO.:
TRANSLATOR'S INITIALS: RLB
DATE COMPLETED: Aug 1, 1966

LANGUAGE: Russian
GEOGRAPHIC AREA (If different from place of publication): USSR

ENGLISH TITLE OF TRANSLATION: Technology and Armament
PAGE NUMBERS TRANSLATED FROM ORIGINAL DOCUMENT: 1-95

FOREIGN TITLE OF TRANSLATION: Tekhnika i Vooruzheniye

AUTHOR(S): various
FOREIGN TITLE OF DOCUMENT (Complete only if different from title of translation):

PUBLISHER:
DATE AND PLACE OF PUBLICATION: Number 4, Moscow, April 1966

COMMENTS:

TRANSLATION

Table of Contents

Table Of Contents Cont. Page 2

MIGHTY STEP

Marshal of the Soviet Union M. Zakharov

Delegate to the XXIII Congress of the CPSU

The Soviet people and their armed defenders have followed the work of the XXIII Congress of the CPSU with unabated attention and understandable interest. At the center of the delegates' attention were the most important problems of policy, economics and ideology and organizational activity of the Party, which were raised by life itself, by the very practice of building communism. The XXIII Congress will be judged to occupy a lasting place in the history of Party and country. It demonstrated convincingly the monolithic unity of the Party, its high and lofty maturity, political wisdom and organizational strength.

During these years the entire activity of the Party has been directed toward fulfillment of the CPSU Program, creation of an economic-technological base for communism, further increase in the economic well-being of the people, improvement of public relations and nurturing the Soviet people in a spirit of communist conscientiousness. The Party has done everything to insure peaceful conditions for the work of the Soviet people; it has fought actively for preservation of peace in the entire world.

The XXIII Congress approved completely the political and practical activity of the CC CPSU; it approved the proposals and conclusions contained in the CC CPSU Report, which was presented by Comrade L. I. Brezhnev. The Congress examined and ratified the Directives For the Five-Year Plan For Economic Development of the USSR For 1966-1970, about which Comrade A. N. Kosygin reported. A Decree concerning partial changes in the CPSU Rules was made at the Congress. A Declaration in regard to US aggression in Vietnam was made. The central organs of the Party were elected unaminously.

Unaminous approval of the decrees of the October and September (1964) and March and September (1965) Plenums of the CC CPSU, which turned out to be a great influence on the life of Party and State, resounded during the speeches of the plenipotentiaries for the twelve-million army of communists. Their exceptionally important significance in confirmation of the business-like, realistic, Lenin style of work was emphasized. A genuine Lenin style also predominated at the Congress itself. Bolshevik principled, proper exactingness, sober evaluation of successes and insufficiencies and creative approach to the solution of problems were characteristic traits of the Congress.

Guided by the decisions of the XX to the XXII Congresses and their Programs, the Party unflinchingly led the Soviet people along the path of building communism. During the past seven-year period the economy has grown significantly. The Country of Soviets is still more virile; it has become a mightier power in economic, political and military respects. The political basis of the socialist system (the union of working class and collective-farm peasants), the amity of a multinational country and the solidarity of all workers around the native Party have become stronger. Each day the Soviet people satisfy themselves that the Party policy is the only correct policy, that the road by which the Party leads the people is the only correct Lenin road.

The XXIII Congress directives for the new five-year period were worked out by the Party with a truely scientific depth and an accurate calculation. Each line of these directives, each meaningful character in them is evidence of the very strongest unity of Party and people and of the complete, organic agreement of their interests.

The main economic goal of the five-year plan was formulated precisely. It is to insure a further significant growth of industry and high steady trends of agricultural development by taking complete advantage of the achievements of science and technology and of industrial development of the entire social production and by increasing its effectiveness and labor productivity. Consequently, an essential rise in the people's standard of living and a more complete satisfaction of the economic and cultural demands of all Soviet people will be achieved. The five-year plan contains a goal for quick technological re-priming of the economy, progressive change of its structure and timely exchange of outdated production for new, more modern production.

The XXIII Congress showed the Party and the people a truely broad and inspiring program of remarkable labor accomplishments. Thus, the national income will increase by 38-41 percent. The general production of all branches of economic production will grow each year on an average of more than seven percent. An increase in the volume of industrial production by one-half is projected during the five-year period. The average yearly volume of agricultural production during 1966-1970 will grow by 25 percent in comparison with the average yearly volume of this production in the preceding five-year period. The actual income of the population will be increased by approximately 1.3 times.

An important peculiarity of the new five-year period consists of an essential drawing together of the growth rate of the output means of production (group "A") and the articles of consumption (group "B"). Henceforth the Communist Party will pursue a policy of outstripping development of heavy industry and of a faster growth in the production of the means of production. Along with that, the successes achieved in the development of heavy industry permit us now to direct significantly greater resources toward development of the branches which produce consumer articles.

The tasks for the new five-year period show the whole world the simple truth that the main objective of socialism is the welfare of man, his all-around development. The Country of Soviets will make a great step toward the solution of such important social problems as surmounting essential differences between the city and country, between intellectual and physical labor. The union of working class and peasants, the brotherly amity of the peoples of the USSR will be strengthened even more.

We, the people of the older generation who saw the process of creating an economic status for the first state of workers and peasants in the world, well remember with what exceptional effort the Soviet metal industry approached six million tons of yearly steel smelting during the years of the first five-year period and 18 million tons on the eve of the Great Patriotic War. The figures which characterized the production of important types of industrial products sounded to us like the best poetic lines. At that very time we saw distinctly that our class enemies, who had prepared for war against us, were seriously counting on the weakness of the Soviet economy. In 1940 military actions were already unfolding in western Europe and from all appearances the events indicated that, to insure the security of the socialist Fatherland, a great number of guns and tanks, aircraft and ships, ammunition and most varied equipment would be necessary.

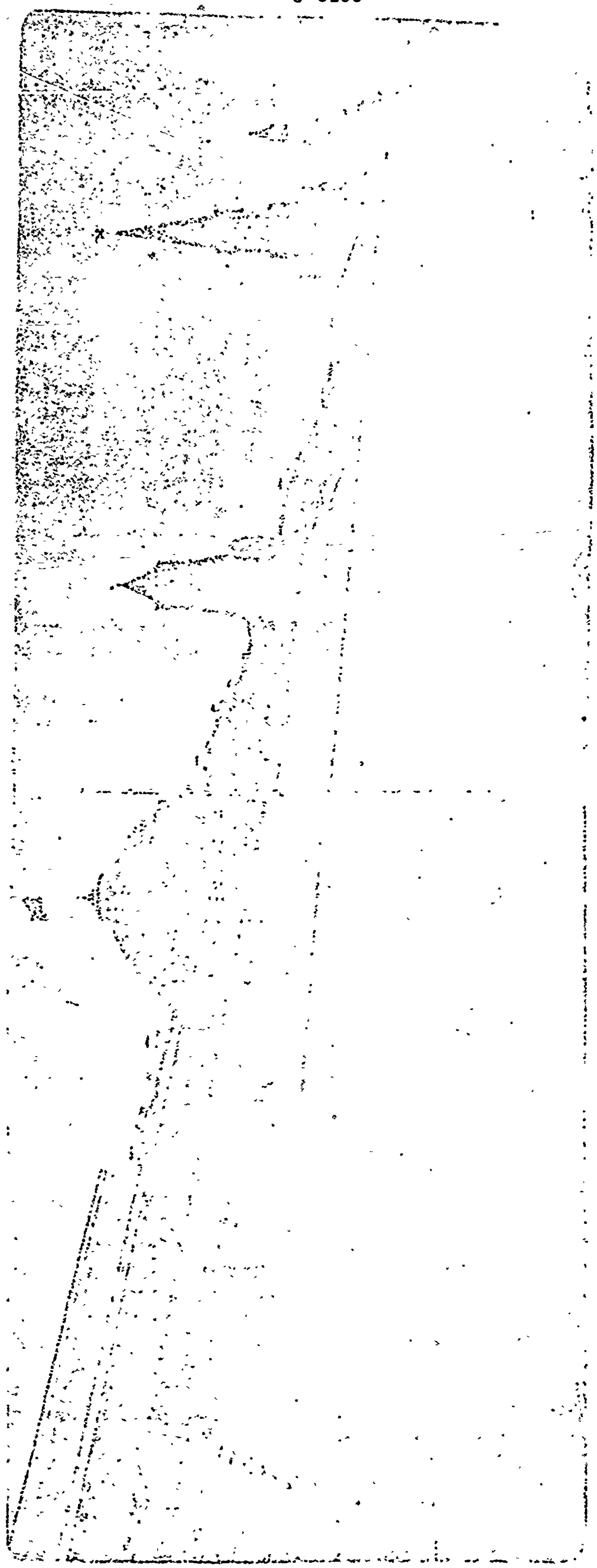
Thus, the economic preparation of the country, metal production in particular, had a decisive significance. Thanks to the far-sightedness of the Communist Party and its wise leadership, quantitative and qualitative superiority of the Soviet Armed Forces over the Fascist armies in tanks, artillery, aircraft and other types of weapons was insured in the years of the Great Patriotic War. The worldwide, historical victory of the Soviet Union in the past war was dependent upon its economic industrial strength.

If you think over the decisions of the XXIII Congress, there arises before your eyes the amazing, mighty step of our movement ahead. One-hundred million tons of yearly steel smelting -- this is already in our immediate future. By 1970, by the end of the five-year period, 124-129 million tons will be produced. The other figures of the five-year plan are no less exciting. By 1970 the country will receive 840-850 million kilowatt-hours of electricity, it will reach 345-355 million tons of petroleum, 665-675 million tons of coal. All this is an excellent premise for insuring the further steady growth of the economic and defensive might of the Soviet State.

It must be expected that the different systems and weapon models will improve steadily; the technical equiping of the Troops will be increased.

The Soviet people can not but salute such goals in industrial development which express the most important trends of the modern scientific-technological revolution and bear witness concerning the high degree of economic and military might of the country. The talk has been primarily about the development of machine-building. It plays an exclusive role in the technical re-priming of the economy, in the increase of labor production, in the providing of army and navy with the most modern equipment.

GRAPHIC NOT REPRODUCIBLE



It is difficult to overestimate the attention given to production expansion of computer equipment, to its broad use in research, calculation, planning and production control. One could say frankly that, along with the state of power equipment, the production of metals and the machine-building, creation and use of this equipment is a bright indicator of the economic potentials of the country, its capability to satisfy completely the requirements of the Armed Forces, also. Computor equipment -- this is a unique nerve which facilitates effective production control.

The economic growth of the Soviet Union and the strengthening of its defensive capability are served also by other measures outlined by the Congress. These are the acceleration of scientific development (primarily its leading branches), the strengthening of its associations with production and with the entire social order, the time-saving introduction of scientific discoveries into production and the military, the rational investment of production forces with a calculation of the truely inexhaustible potentials of Siberia and the Far East, the cooperation also in specialization of the economy within the framework of the Soviet of Economic Mutual Assistance, and so forth.

The XXIII Congress emphasized with special forcefulness that the economy and defense of the Soviet Union and the whole socialist cooperative will grow even more with the transition to new methods of planning and control of the economy, with full use of all the advantages inherent in the very nature of socialism. The socialist system of economy is devoid of the organic defects inherent in capitalism. It insures a high rate of economic development and permits one to mobilize and to use the resources much more completely in the interests of an armed defense of socialist achievements.

The enormous potentials of our society to solve the problems of creating communism and of its armed defense are qualified further by the fact that, depending on the conditions, the Soviet people can provide additional resources for defense requirements. For example, the State budget of the USSR for 1966 allocated for defense was 13,430,000 rubles, which was five percent more than last year. These resources undoubtedly permitted us to raise the technical equipping of the army and navy to a new level. The Congress called upon all communists, workers, collective farmers and Soviet intellectuals to celebrate the great date -- the 50th anniversary of the Great October Socialist Revolution and the 100th aniversary of the birth date of Vladimir Il'yich Lenin -- with widespread openings of socialist competitions and a movement for communist endeavor, with new achievements in the building of communism, with a worthy contribution of our country to the work of strengthening the power of world socialism and triumphant development of the international revolutionary movement.

The new five-year plan will undoubtedly be fulfilled. This optimism, this confidence is based on the fact that the experienced vanguard of the Soviet people -- the Lenin Party -- is at its head and that our people have always examined the Party plans as their own vital business. As a result of realizing the tasks of the five-year period, the USSR will attain higher limits in its economic competition with capitalism. This undoubtedly will increase the attractive force of the ideals of socialism even more and it will be a greater influence on the intensification of the revolutionary process.

The significance of the XXIII Congress goes far beyond the framework of the internal life of our country. A very important result of its work is the clear definition of the foreign-policy course of the Communist Party and the Soviet State. This course will be directed in the future toward creation of the most favorable conditions for building communism, toward strengthening the might of the world system of socialism and all-out support of the peoples' fight for national and social liberation and toward strengthening the Lenin principles of peaceful co-existence of states with different social orders.

All the work of the Congress was permeated by a spirit of proletarian internationalism. Participation in the work of the XXIII Congress of the CPSU by delegations from 86 Communist and Workers Parties and also from National-Democratic and Socialist Parties of the world was an impressive demonstration of the ever strengthening unity and proletarian solidarity of all revolutionary forces.

It is mentioned in the documents of the Congress that this world-wide development confirmed the conclusion of our Party and the entire communist movement that the main direction of historical development in the modern era is determined by the world-wide socialist system, by the forces which fight against imperialism for a socialist reorganization of society. The correlation of forces on the world arena continues to change in the use of socialism and workers and national-liberation movements.

At the same time, the past years have been characterized by an intensification of imperialist aggression and a more active reaction. The main reactionary force, which has come into the role of a world gendarme, is at present American imperialism. It interferes crudely in the internal affairs of many countries of Africa, Asia, and Latin America; it scorns their sovereignty; it strives to strangle the national-liberation movement by the force of weapons and to set up a colonial order; it does not cease its provocations against revolutionary Cuba. The American aggressors expose the peaceful cities and settlements of the DRV to their barbarian bombers. They use napalm bombs, toxic gas and other barbarian means of destruction of the South Vietnam population. West Germany, where the forces of revanchism and militarism encouraged by American imperialism are growing, has become a dangerous hotbed of international tension. These forces persistently strive to get access to nuclear missile weapons to use for their revanchist aggressive goals.

We must not for a moment forget about the possibility of an approaching trial which could again be placed on the shoulders of the Soviet people. It is said in the Resolution of the Congress on the Report of the CC CPSU: "In conditions, when the aggressive forces of imperialism aggravate the international tension and create a hotbed of war, the CPSU will increase henceforth the alertness of the Soviet people and strengthen the defensive might of our Homeland so that the Armed Forces of the USSR are ready always to defend the achievements of socialism reliably and to deal a crushing blow to any imperialist aggressor."

In the period between the XXII and the XXIII Congresses of the CPSU, significant work has been done for further strengthening of the defensive capability of the country, especially for increasing the amount of nuclear weapons for various purposes.

The Missile Forces of Strategic Designation -- the main means for containment and complete destruction of an aggressor -- remains in the center of attention, as in the past. Soviet scientists and construction workers, engineers and laborers have created a whole complex of the most varied means for armed conflict, which include mainly new missiles and launchers (mobile ones among them). Nuclear charges with a TNT equivalent in the order of 100 megatons permit us to achieve decisive results in the shortest time. Let us note that, with an explosion of only one ten-megaton hydrogen bomb, the energy discharged exceeds the energy of explosives produced in the entire world for all the years of the Second World War.

The ground Troops are handled in complete accordance with the requirements of a modern war. Now they are deploying with their missile units of tactical operations designation, concentrating an enormous fire-power in themselves. The strike and maneuver capabilities of the tank and motorized-rifle command-units have grown by far. As was mentioned at the Congress, Soviet tanks surpass the latest models of foreign tanks according to a number of most important indicators. They are equipped with more perfect weapons and instruments, which insure that a target is hit with the first firing; they have powerful engines and excellent road qualities.

Motorized rifle sub-units equipped with armored vehicles with good roadability, which protect personnel from the destructive factors of nuclear weapons reliably, now are capable of following behind tanks relentlessly and waging a battle successfully in any season of the year and any time of the day, in any weather and on any terrain. All this permits them to contend that the rates of advance which were only in individual cases 100 kilometers per day during the years of past wars (Yassy-Kishinev operation, Wisla-Oder operation, Berlin operation) would be achieved, as a rule, in a modern war if it is unleashed by an aggressor.

The current status of the Ground Troops is not, of course comparable in any way with their status as it was in the years of the Great Patriotic War. May of 1945 is recalled involuntarily when the First and Second Ukraine Fronts concentrated their efforts to help the rebellious capital of Czechoslovakia, Prague. Located in the area of Dresden and south of Berlin, the First Ukraine Front required three days to cover a distance of 200 kilometers to the attack position. It began the 6th of May. The first Soviet tanks entered Prague the 9th of May. It is not difficult to picture how the action would have unfolded if a similar assignment were given to our airborne command-units at the present time. Now the members of a landing force are capable of grouping in the rear of an enemy with all the things necessary for battle up to medium tanks and missiles. They are capable of handling independently not only operations assignments, but also those that are strategic.

The delegates to the Congress greeted with satisfaction the announcement that the Soviet submarine fleet -- the basis of the Naval Forces -- was ready to carry out independent strategic missions to destroy enemy objectives both at sea and on land. At the present time submarines are equipped with long-range ballistic missiles, which have an underwater-launch capability, newest radio-electronic apparatus and atomic-power plants. This permits them to operate confidently in the ocean vastness from the Arctic to the Antarctic and to complete long, around-the-world cruises similar to those which the submariners of Rear Admiral A. Sorokin dedicated to the XXIII Congress.

Submarines have taken on new qualities, having been armed with torpedoes with nuclear charges. In the past war the probability of hitting and the strike force of torpedoes were not, as is known, very high. To sink the battleship Bismark, for example, it was necessary to fire 70 torpedoes, only eight of which reached the target. It is certainly apparent that one nuclear torpedo is sufficient to destroy any ship now.

The nuclear power of long-range, missile-carrier aviation, which is armed with qualitatively new aircraft, has grown. A significant part of the pool of combat aircraft of front aviation, naval aviation, missile-carrier aviation and especially military-transport aviation has been made as good as new. The latter can transfer personnel and combat equipment to any area of primary theaters of military action. Its aircraft have great speed, a great radius of operation and great load capacity. Its personnel are trained to pilot the aircraft in complex weather conditions and at different altitudes; they are prepared to accomplish precise dropping and landing of troops both by day and by night in a short period of time.

The Troops of Air and Missile Defense are a reliable shield for the Homeland. They are capable of insuring the destruction of any aircraft and many types of enemy missiles. New highly-effective anti-aircraft missile systems and complexes of fighter-aircraft form the foundation of their armament. The military might of our Armed Forces is characterized not only by first-class equipment. The power of personnel morale, their selfless devotion to their people (the native Communist Party), excellent combat training and constant readiness to carry out their sacred duty in defense of the Homeland are factors in our defensive might.

The golden font of the Armed Forces is the group of officers, generals and admirals who are thoroughly trained, highly qualified specialists and who, by knowing what they are doing, are able to lead the troops both under peaceful and under wartime conditions. At the present time every fourth officer has a higher education, either military or special. The number of engineers and technicians steadily grows in the army and the navy. More and more the command posts have commanders with engineering educations.

Remarkable qualities are inherent to our soldiers, sailors, sergeants and first sergeants. Politically conscientious, true patriots of their Fatherland, they spend day after day on sustained military work and tirelessly increase their mastery in the combat application of equipment and weapons. In the days of training for a worthy greeting to the XXIII Congress of the CPSU, many of them became first-class specialists and brought pleasure with their new successes in combat and political training.

During the past years the ties of friendship of the Soviet Armed Forces with the armies of socialist countries -- partners in the Warsaw Pact -- have broadened and strengthened still more. Joint exercises of the GDR National People's Army, the Polish Troops, the Soviet Army and Czechoslovakian People's Army took place in the fall of last year. The purpose of the exercises was to sum up the operations and combat training of troops and staffs. The exercises unfolded under conditions which approached combat conditions to the maximum. Motorized-rifle, tank, aviation and parachute-landing command-units and units were drawn into them. The exercises demonstrated the increased military strength of the brother countries, their moral and political unity. If it becomes necessary, the tight-knit family of the Warsaw Pact will become a formidable force for the defense of socialist achievements and our peoples' freedom and will deal a crushing blow to any aggressor.

The main requirement for our Armed Forces is, as in the past, a high combat readiness and a persistent struggle for achievement of the highest results in studies. With each day combat training takes on an ever newer, higher tempo. Its success depends completely on the co-ordination of army and navy organisms, on exact fulfillment of all orders and instructions. Education work has a still greater significance in modern conditions. Commanders and political workers, Party and Komsomol organizations must devote unabating attention to the man and soldier. For on his discipline, ability, persistence and bravery will depend the basics -- how the weapons hold up and what the results of their use are.

The Soviet people and their armed protectors devote their best achievements in work and combat studies to the Congress of the native Party. Outstanding events occurred during the working days of the Congress -- for the first time in the world the Soviet automatic station "Luna-10" was injected successfully into a near-lunar orbit and became the first artificial satellite of the moon. One must not forget the stirring moments when the standing delegates and guests at the Congress listened to the melody of the Party hymn "International" which was transmitted from on board the "Luna-10." All this inspires and fills one with pride for our Homeland; it forces one to work even better for the good of our glorious Fatherland.

As did all our people, the Soviet soldiers approved unaminously the decisions of the XXIII Congress of the CPSU. They are completely aware of the fact that their selfless fulfillment of the soldier's duty, the struggle for strengthening the military might and increasing the combat readiness of the army and navy makes up their ponderous contribution to the great work of building communism.

V. I. LENIN AND MILITARY EQUIPMENT

Colonel S. Tyushkevich

Candidate of Philosophical Sciences

Working people of all continents of the earth are solemnly preparing themselves to mark the century since the birth of Vladimir Il'ich Lenin as the brightest and most joyous holiday. Because their love is immeasurable and their respect is unbounded for the leader and teacher who gave his universal genius and titanic energy to the struggle for the restoration of the public life of our country on communist principles, for the freedom and happiness of all mankind.

The Great October Victory, the creation of the most just society on earth, the strengthening of the might and solidarity of the peaceful system of socialism -- the main revolutionary power of the modern era -- the successes of peoples coming forward against the colonial yoke for independence and progress, the growth of the spread of class struggles in capitalistic countries, the strengthening of the international communist movement -- all of this is the personification and confirmation of the extreme truth of Lenin's eternal ideas.

The founder of the Communist Party and the Soviet State, V. I. Lenin, showed unsurpassed examples of the theoretical and practical solution of many fundamental problems of the development of the Socialist revolution and the construction of a new society. As it was emphasized in the Report of the Central Committee of the CPSU to the XXIII Congress, Lenin's ideas and plans even at the present time lend inestimable influence to our spiritual, socio-political and economic life. The Soviet people and their tried avangard -- the Communist Party -- have undeviatingly followed and are following the true Lenin road.

Military problems occupy a prominent place in the rich storehouse of Lenin's ideological legacy. Namely, these problems were in that new field in which the history of the revolutionary past did not gather any sufficient experience.

V. I. Lenin disclosed the conditions and reasons for the rise of wars in the era of imperialism and showed their classical character; he developed the position of two types of war -- just and unjust -- and the relationship of the working masses to them; he created the orderly theory of armed defense of the socialist fatherland; he introduced and substantiated the idea of the creation of a regular army of the Soviet State; he laid the foundations of Soviet military science, which proved its indisputable supremacy over bourgeois military science.

Strategist and nourisher of the Socialist Revolution, V. I. Lenin stood at the head of the defense for the Land of the Soviets in the most perilous years of foreign military intervention and civil war. He directed the work of the Communist Party in the building of the Red Army, constantly kept in view the numerous fronts, determined the development of strategic military plans and methods for their realization, supervised the activities of the REVVOENSOVET (Revolyutsionnyy Voennyy Sovet; Revolutionary Military Council) and the supreme command; he deeply investigated the matter of overall provision of military operations of the troops; he looked after the training of command, engineer-technical and political cadre. He showed a lively interest in everything which concerned the organization of victory over the aggressors. And today the military might of our native country, the high military capability and constant military preparedness of the army and navy are brightened by the genius of V. I. Lenin.

It is well known that contemporary nuclear armaments were created on the basis of fundamental discoveries made in the beginning of the 20th century in the field of physics. The most important of them, V. I. Lenin gave the only true philosophical explanation. For example, in the changing of the mass of an electron during the changing of its speed, he saw not the disappearance of matter, but the inexhaustibleness of its properties. New principle methods for obtaining nuclear energy confirmed this inexhaustibleness.

Lenin's philosophical ideas, formulated in connection with the analysis of the revolution in phyics and the clarification of the reasons for a crises in it, continue to play an important role in the solution of theoretical and practical problems concerning the equipment of our armed forces.

V. I. Lenin developed further the position of F. Engels on the dependence of forms and methods of armed conflict on the level of development of military equipment and revealed the interaction of man and military equipment in armed conflicts. For example, in 1906 in the article "Lessons of the Moscow Uprising," he wrote, "Military tactics depend on the level of military technology-Engels chewed this truth and placed it in the mouths of Maxists." In war, ". . .he gets the upper hand who has the greatest technology, organization, discipline and the best machines," ". . .without machines, without discipline, it is impossible to live in modern society; it is necessary to either surmount higher technology or be crushed," said V. I. Lenin at the IV Extra-ordinary All-Russian Congress of Soviets in 1918. In the same year in the article "On Business Grounds", he recorded, "the best army, the most devoted people to the revolution will be immediately destroyed by the enemy if they are not armed, supplied and trained to a sufficient level."

The wisdom of Lenin's ideas is confirmed by the entire course of the historical development of the Soviet State. Even today they retain great theoretical and practical significance. It should be noted that V. I. Lenin, stressing the established influence of military equipment on the organization of troops and the development of tactics, on the course and outcome of wars, never contrasted it to man. On the contrary, he always kept people in mind -- both those who create military equipment and those who use it. He understood, as no one else, that equipment without man is dead, and man without equipment is impotent.

V. I. Lenin proved the law of the dependence of military action on the economic and moral resources of the country. In his many public speeches, articles, remarks, letters and telegrams concerning the time of foreign military intervention and civil war, like a red thread goes the thought, expressed by him even at the dawn of our century, "The contact between the military organizations of the country and all of its economic and cultural systems was never as close as at the present time."

The material and technical base of those years, as is known, was extremely weak. The Soviet State inherited a national economy exhausted by the imperialistic war and a depleted, insufficient military technology. V. I. Lenin and the Communist Party had to apply truly colossal efforts in order to, in a situation of the most drastic ruin, mobilize and rationally use the economic resources of the country, organize the output of technical means of struggle in quantities calculated for a long war.

V. I. Lenin absolutely truly considered that Soviet power gives more advantages in the organization of production in the interests of an armed struggle. He founded the principle of impact, the realization of which permitted the raising of the military economy and, with this, the saving of the first socialist state in the world from ruin. "Impact," according to the words of V. I. Lenin, "is the preference of one production out of all the necessary productions in the name of its greatest urgency."

According to V. I. Lenin's order, a special Commission of the People's Commissariat for Military Affairs was created to unite all of the tasks connected with providing the army with military equipment and ammunition; the Commission worked out a plan for military technical supply in the beginning of 1918. This plan provided for significant broadening of the production of artillery, machine guns and rifles; the development of works in the creation of new models of armaments; re-equipping individual enterprises for the output of military production. Besides this, the plan determined the character and inventory of army supply items, considering the placement of plants and factories in relation to the areas of military operations. At the end of 1918 the Soviet government adopted the decree, "Concerning Measures For the Improvement of Supplying the Red Army," in which the necessity for maximum approach to military and non-military industry and for mobilization of non-military plants and factories for fulfillment of orders from the front was shown.

V. I. Lenin's glance penetrated everywhere; his endeavor and effective interest were felt everywhere. He carefully followed the work of military enterprises, took an interest in providing them with raw materials, workers and food and in the distribution of finished products. For example, when a lack of workers was discovered at a number of military plants, the Council of Defense, which V. I. Lenin led, adopted a number of resolutions. "To commission the Central Committee of Metallurgists and the Department of Registration and Allocation of Workers of the Commissariat of Labor," reads a resolution of 1 August 1919, "to immediately provide the necessary number of workers to the ammunition factories of Simbirsk, Kovrov and Podol'sk. . .". In a resolution of 6 August 1919, signed by V. I. Lenin, it was pointed out ". . .send the number of workers from Petrograd necessary for work at the ammunition plants, since the defense of the Soviet Republic is impossible without ammunition."

The great expert on military affairs, V. I. Lenin, showed an example of how, in the interest of achieving victory, the mechanism of one of the most important laws should be used -- the law of the dependence of armed conflict and its forms and methods of conduct on the quantity and quality of military equipment. He gave great significance to the development of all those types of military equipment beyond which stood the future. Even during the preparations for and the course of the October armed uprising he appraised, according to their merit, the military properties of armored vehicles, from which the 1st Flying Armored Red Guards Detachment was formed.

In 1919 a resolution was made on the initative of V. I. Lenin to start the construction of Soviet tanks. In the following year the first tank, named "Fighter For Liberty, V. I. Lenin," left the gates of the Sormovsk Plant, In "A Short Statement On the Production of the First Tank in Russia," sent in the name of the leader, it was stated that "the tank completed the entire testing program and now is a reliable combat element." In the period 1920-1922 tanks were built which, by their combat qualities, yielded to nothing to better foreign models, and in many construction characteristics even surpassed them.

Often stressing that "without science it is impossible to build a modern army," V. I. Lenin did everything to attract well known scientists and specialists to participate in strengthening the defensive capabilities of the country. He, for example, clearly recognized the exceptional importance of research in the field of aero-hydrodynamics and missile technology and highly valued the activities of such outstanding scientists as N. E. Zhukovskiy and K. Eh. Tsiolkovskiy. V. I. Lenin enthusiastically supported the proposal of N. E. Zhukovskiy and his students for the creation of the Central Aero-Hydrodynamic Institute (TsAGI; Tsentral'nyy aehrogidrodinamicheskiy institut). In a short period this institute became the largest center of Soviet aviation science and technology.

The attention of V. I. Lenin extended itself to inventors who worked on the creation of new military equipment. Thus, at the end of 1919 he visited the Artillery Committee of the Chief Artillery Directorate of the Red Army where he familiarized himself with an instrument for the correction of firing on air targets and listened to the explanation of the constructor, A. M. Ignat'yev, concerning the operation of the instrument. Professor E. V. Agokas, who was present, recollects, "We judge in detail the merits of the instrument, the perspectives for its use in the troops . . . . It was also amazing that Vladimiv Il'ich freely analyzed the technical questions which were accessible only, as it seemed to us, to specialists."

Many of Lenin's documents of the period of foreign military intervention and civil war contain concrete recommendations for the use of military equipment. For example, in 1919 when the enemy succeeded in breaking through on the Southern Front with the cavalry forces, V. I. Lenin directed the attention of the REVVOENSOVET to the possibility of the use of aircraft operating at low altitudes against it. In connection with an attempt by the enemy to seize the Crimea, V. I. Lenin advised Eh. M. Sklyanskiy in a telegram, "to prepare naval weapons (mines, underwater weapons, etc.) and a possible attack from Taman' . . . ."

During the impending threat of attack of the Entente on Baku, V. I. Lenin telegraphed, "rapidly consider and prepare measures for reinforcing the land and sea approaches to Baku, the supply of artillery and so on."

V. I. Lenin constantly took interest in the problems of the operational use of the Naval Fleet. If the situation building up on the sea theaters demanded participation of warships in the armed struggle, he introduced suggestions for their transfer from one sea to another, and the measures for their combat supply. The problems in restoration of the combat capabilities of ships also occupied him. Thus, an edict signed by him to the Navy General Staff reads:

> 20 May 1919
>
> In view of the military situation created in the past days in the Finish Gulf and the necessity to deal an immediate repulse to the enemy, the Council for Workers and Peasants Defense decreed: to order the Petrograd and Kronshtadt ports to carry out operations for the repair of military ships in the most rapid, energetic order, without any limitation of time, by no means suspending overtime work, and to immediately introduce night work.

Lenin's deep understanding of the dialectics of armed conflict was expressed in that he thoroughly examined the problems of technically equipping the army and the navy. Not permitting underrating of military equipment, V. I. Lenin stressed that the advantage in war will be on that side which has new technical equipment and the know-how to use it properly in the course of military action. He noted that modern wars, as modern military equipment, demands high-quality manpower. "Without initiative, conscientious soldiers and sailors," wrote V. I. Lenin, "success in a modern war is impossible."

V. I. Lenin willed us to look after the defensive capability of the country as the apple of our eye, to always be on guard. The Communist Party and the Soviet State sacredly fulfilled this, his will. The technical equipment of our armed forces is on the level of the demands of time. Reinforcement of the might of the army and the navy, which exist for the protection of socialism, for guarding the peaceful labor of the Soviet people, will, as in the past, remain the most important task. The XXIII Congress of the CPSU stressed this with new vigor.

STEERING CONTROL

Engineer-Major I. Chaykovskyy

Candidate of Technical Science

Successfully conducting the combat activities of the troops depends to a great degree on the maneuverability of combat vehicles, which can be insured by increasing their horsepower, improving their gears and increasing their mobility. But, if the driver of the vehicle must often perform complex manipulations and expend great physical effort in doing so, it can be expected that he will not be able to fully utilize the advantages of a vehicle with high horsepower. For example, during a turn or while moving at high speed when the air pressure in the tires of the steered wheels is low, the force on the steering wheel reaches 65-85 kilograms. To maintain control of the machine, the driver not only will expend less muscle power but will have an opportunity to devote more attention to the road. Safety will increase and the average speed will be higher.

To increase the maneuvering quality of the wheels of vehicles, the designers strive to increase the angle of turn and the number of steered wheels. But the angle of turn is limited by the universal joints. In addition, it is advisable to turn the wheels only to a certain angle, beyond which skidding will occur, lead to loss of control, an unwarranted waste of fuel and wear on tires.

Increasing the number of steerable axles is a very effective means of reducing the turn radius and mobility of wheeled vehicles. The minimum radius, i.e., the distance from th. center of the turn to the middle of the outside front wheel in the maximum angle of turn of the latter, depends on base L, the width of the vehicle and the size of angle of turn a of the steered wheels (Figure 1).

In a turn, vehicles with one steered axle (Figure 1, a) make four tracks and vehicles wit' dual wheels for which additional power is expended, make six. When all wheels are steered, the turn radius is cut approximately in half (Figure 1, b) and only makes two tracks in a turn. This decreases the resistance to movement, helps to increase the mobility on soft ground and lessens the power necessary for a turn. However, with such an arrangement of wheels, the steering gear is more complex and it is more difficult for the vehicle to move away from a wall or tree. Free play in the gear is increased, which adversely affects stability of movement. To eliminate these deficiencies, an interlocking of the rear wheels is provided.

So that the turn radius of a four-axle vehicle becomes minimal, the side-slipping is reduced and the power wasted on a turn is lowered, it is desirable to have all the wheels on it steered (Figure 1, c). But then the steering gear becomes very complex. To overcome the wide gap, the middle axles should be placed closer together and the front and rear axles made steerable to reduce the turn radius (Figure 1, d). A vehicle which has two pairs of steerable front wheels makes six tracks, but its steering gear is greatly simplified and there is no interlocking mechanism (Figure 1, e). Sometimes, to increase the maneuverability, two steering columns are installed. In this case a mechanism for the reversal of the transmission is needed and, consequently, makes the contruction of the vehicle much more complex.

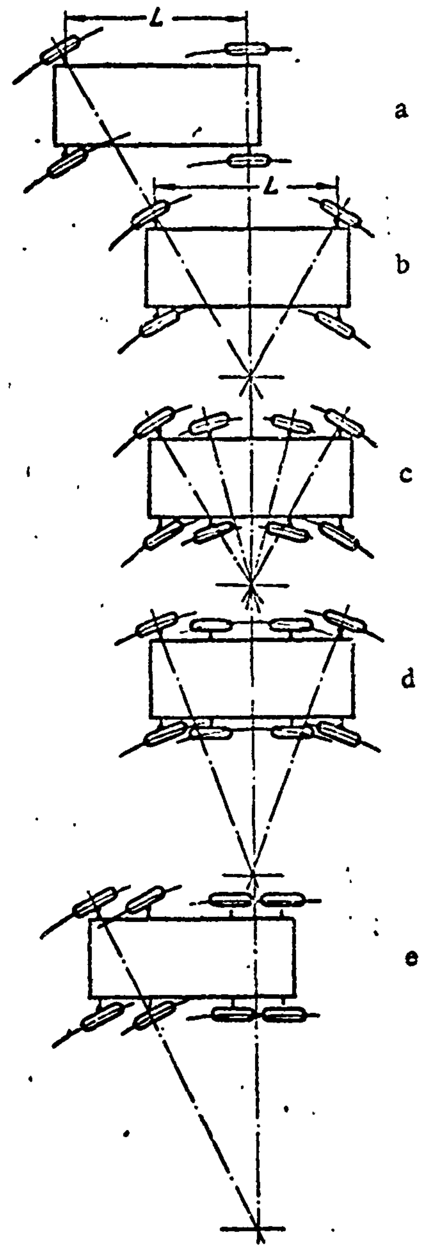


Figure 1

Methods of Turning Dual-Axle and Four-Axle Vehicles

Note that when the angle of turn and th   ber of steered axles increases, the effort required to steer the vehicle also increases. This can be lessened by increasing the gear ratio of the steering gear, but then maneuvering will be difficult on a minumum turn radius. Therefore, the gear ratio has definite limitations.

Steering systems with hydraulic boosters have received wide dissemination. They have many advantages. The hydraulic drive lasts 10 times longer than the pneumatic one. The simplicity of control harmonizes with the reliable protection from overload and with the great power per unit of volume and weight. Such boosters more effectively absorb the shock of the wheels on uneven roads and insure the steady movement of the vehicle in rugged areas and with damaged tires. The hydraulic boosters are sufficiently safe, long-lasting and simple to service, since they do not need lubrication or a change of fluid. It is true that the viscosity of the fluid in them can change or a leak can occur, but as a whole such devices are more perspective than the pneumatic ones.

The construction of any mechanized steering control with a booster consists of three mechanisms: the steering gear, a distributor and a booster system. There are three variations in the arrangement. all the mechanisms are arranged either in one housing, separately or the distributor and slave cylinder are together and the steering gear is separate. Each arrangement has its advantages and disadvantages.

The location of all the mechanisms in one housing provides compactness, minimum length of lines, better sensitivity to the steering signal (ZIL-111, ZIL-130). A diagram of such a component is complex and is used mostly on light automobiles.

On the MAZ-502 and ZIL-127 the distributor and slave cylinder are mounted together and the steering mechanism is separate. Because of this, standard equipment can be used. But, an increase in free play in the device leads to a worsening of steering-control sensitivity.

In multi-axle, wheeled vehicles, all mechanisms as a rule are positioned separately. Such an arrangement allows the use of a standard steering gear, frees the components from the strong force of the wheels and insures sufficient sensitivity. A steering gear built in this manner is shown in Figure 2.

REMEMBER THAT . . .

in an armored transport, to correct the free play in the steering wheel, it is necessary to start the left (facing in the direction of motion) motor, since the fluid in chamber "a" and "b" is under pressure. Therefore the free play increases slightly even if the steering wheel mechanism is correctly adjusted. Chambers "a" and "b" fill the role of dampers of vibration which arises at the moment the wheels or the distributor housing is shifted. That is why a leak in the seal of the chamber or wear on the valve-housing combination causes the vehicle to vibrate and leave its given direction of motion.

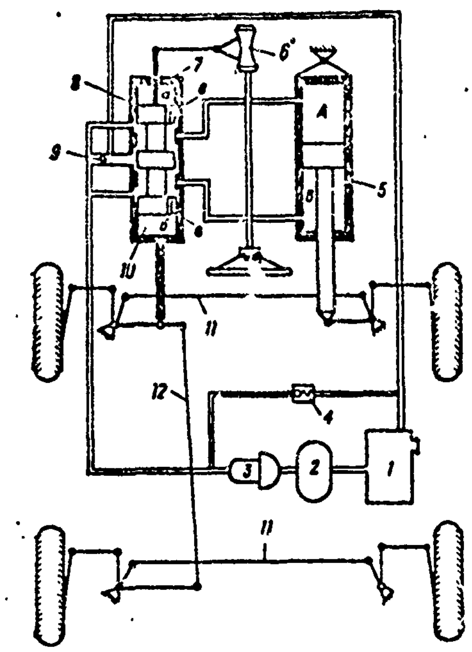


Figure 2

Diagram of a Steering Gear
With Separately Located Mechanisms

1 - tank; 2 - pump; 3 - filter; 4 - safety valve; 5 - slave cylinder; 6 - steering mechanism; 7 - distributor housing; 8 - valve; 9 - by-pass valve; 10 - reaction-damping chamber; 11, 12 - tie-rods.

A steering gear with booster can be examined as a servo-system with negative mechanical feedback. The principle on which it works consits of the following: the driver, by use of the steering mechanism, exerts force on valve 8, which, by moving in the barrel of the distributor 7, operates the slave cylinder 5. Increased pressure is created in one of the apertures of the cylinder (the magnitude of which is proportional to the resistance of the turning of the wheels). The piston of the slave cylinder under the pressure of the fluid turns the steered wheels and through the steering gear moves the housing of the distributor. In this way the "follow-up" action is carried out. It ceases when the steering wheel (slide valve) stops. At that moment the slave cylinder 5 moves the wheels and the housing of distributor 7 just to the center position of the value of the position nearest to it, and then the pressure in the slave cylinder falls and piston 5, the steered wheels and the housing of the distributor stop. When the steered wheels deviate from a given position, movement of the distributor housing occurs. If the driver holds back valve 8 by the steering mechanism 6, then when the distributor housing moves, its ducts overlap the appropriate aperture of the slave cylinder 5. As a result of this, the pressure increases and the piston returns the wheels to the given position. The energy from the shock of the wheels is absorbed by the cylinder and transmitted to the body of the vehicle. This is why some components of the gear are not practical for standing up to overloads arising from rough roads.

When the automobile is moving in a straight line, value 8 is in center position and pump 2 lowers the fluid in tank 1 through the apertures in the distributor. The pump is at this time partially unloaded and this is the value of circulating distributors.

For the driver to be able to control the degree of wheel turn and resistance to the turn, the force on the steering wheel must change. This is especially important when driving on slippery roads and when getting out of a rut. Therefore, chamber 10 in the distributor is used, which through opening "c" connects with the corresponding apertures in the slave cylinder 5. If, for example, during a turn of the wheels the pressure increases in aperture "A" of the cylinder, approximately the same pressure is created in chamber "a." If the driver wishes to move the valve, he will have to force out part of the fluid from chamber "a" through opening "c," i.e, create a greater pressure than in the pressure line. In this way, the greater the movement of the valve and the pressure in apertures "A" and "a," the greater the force required to move the valve.

In bringing the vehicle out of a turn, the driver often releases the steering wheel. In this case, the stabilizing moments arising from the inclination of the king-pin and sideways elasticity of the tires, tend to return the steered wheels and the piston of cylinder 5 to a neutral position. The steered wheels can move if the valve is in center position, at which time the apertures open to drain the fluid from the aperture of the slave cylinder. Since the pressure in chambers "a" and "b" is different, the positioning of the valve is achieved comparatively easily and the steered wheels automatically return to a neutral position.

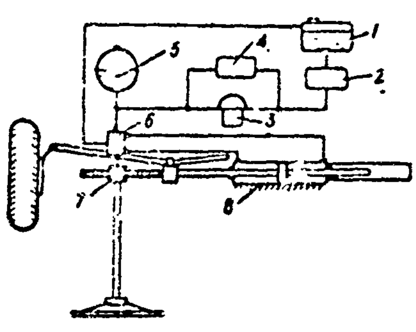


Figure 3

Diagram of a Steering Gear
With Hydro Pneumatic Accumulator

1 - tank; 2 - pump; 3 - filter; 4 - automatic relief pump; 5 - hydro-pneumatic accumulator; 6 - distributor; 7 - steering gear; 8 - slave cylinder.

Hydropneumatic accumulators can serve as one of the methods for increasing the reliability and stability of the work of a steering booster (Figure 3). They insure that the system will work when the engine runs at low revolutions or breaks down, and they relieve the pump to a certain degree. It is true that the construction of a power-steering system is somewhat complex. On vehicles with earlier types of boosters, steering gears are installed with a gear ratio of 20-25, which, to some degree, insures control over the vehicle when the engine is not operating. There are steering gears with variable gear ratios, but these are comparatively more complex.

Electro-hydraulic boosters (Figure 4) make it feasible to decrease the weight of the steering gear, the force needed to control the vehicle and the amount of maintenance. The distributor 7 is controlled by handle 4 through the control potentiometer, located in control block 5. The connection in the reverse direction is through potentiometer 9. When handle 4 is turned, the current falls in electro-magnet6, which moves the valve. The slave cylinder turns the wheels and the slide in potentiometer 9 to this or that side, depending on the direction of the flow of the fluid. The potentiometer reduces the strength of the signal given by the driver, i.e., it returns the valve to its original position, and the steered wheels remain in the given position. If they must be turned, handle 4 is placed in the appropriate position. In addition, special transducers introduce corrections into the steering signal caused by deformation of the tires, redistribution of the load on the wheels, change of speed and other factors which influence the optimum regime of control.

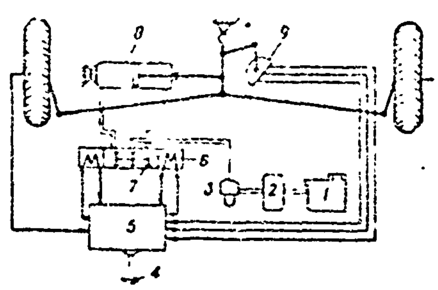


Figure 4

Diagram of a Steering Gear
With Electo-Hydraulic Booster

1 - tank; 2 - pump; 3 - filter; 4 - control handle; 5 - control block; 6 - electro-magnet; 7 - distributor; 8 - slave cylinder; 9 - potentiometer.

Steering gears of a similar type permit one to reduce the number of transmission elements, to take into account a number of factors the affect of which is significantly felt, especially when moving at high speed. However, such steering gears are still found primarily on race cars of high caliber.

REMEMBER THAT . . .

when approaching a turn, the transmission should not be disengaged and the revolutions of the engine should not be lowered, since, when this happens, the efficiency of the pump is lessened and it cannot maintain the necessary pressure in the slave cylinder. Turning the vehicle would require the application of much more force to the steering wheel. This may come as a surprise to the inexperienced driver and lead to an accident. This is why turns are made in a lower gear and increased engine revolutions. When maneuvering in a small area, the clutch may be disengaged and, when disengaging the transmission, the engine revolutions and, subsequently, the pump may be increased. For this, certain skills are needed which are perfected in the process of learning to drive.

STEAM POWER PLANTS

Engineer-Captain Second Rank L. Shapiro

The creation of powerful, highly economical energy plants with good weight and height indicators has always been a vital problem of military ship building since the time the mechanical engine arrived to replace the sail. During the past decades several types of ship energy plants have been created in all the navies in the world. Certain advantages and disadvantages are peculiar to each of them.

DIESEL POWER PLANTS (DU; dizel'naya ustanovka) are highly economical (specific fuel expenditure: 160-170 grams per horsepower-hour), are quickly started and can be automated. However, their power in one unit is limited: 25-30 thousand horsepower. Diesels make a lot of noise, work on fuel of a higher quality and require a considerable amount of oil. The specific energy of a DU is fairly high: 60-90 kg/hp.

GAS TURBINE POWER PLANTS (GTU; gazoturbinnaya ustanovka) are characterized by their low specific energy (1-9 kg/hp), are quickly started, simple in construction, but have a considerably small reserve power and require high-quality fuel. Characteristic for them are advanced air-intake and gas-exhaust systems of large dimensions. The salts contained in the sea water get into the compressors along with the air and accumulate on the blades.

ATOMIC POWER PLANTS (AU; atomnaya ustanovka) can develop tremendous power in one unit. The navigational range of a ship equipped with such a plant is practically unlimited. However, as is considered abroad, they are heavy and complex, and expensive not only in their construction, but also in their operation.

STEAM POWER PLANTS (PSU; parosilovaya turbinnaya ustanovka) permit the concentration of any amount of power in one unit. They are highly maneuverable, work on cheap fuel, have satisfactory weight structures, but they are always complex, which makes their automation difficult. Much time is required in preparing and starting a PSU. Nevertheless, the overwhelming majority of surface ships of great water-displacement in the navies of all countries are equipped with them.

What are the basic characteristics of contemporary PSU and in what directions are they being developed?

Rankine's heat cycle, which had been realized at an early stage of development of shipborne steam power plants, has not undergone substantial changes to the present day. At the same time, stationary PSU began to be perfected intensively as early as the thirties and forties. And that is entirely explainable. They are counted upon for large unit power, their turbines work without reversals or maneuvering. There are no rigid limitations of weight or size and, consequently, no obstacles to making their thermal configuration more complex. In stationary conditions one can utilize any engineering innovations to improve the basic indicator: specific fuel expenditure.

To realize the achievements of stationary thermal engineering in mobile PSU is very difficult. To some extent they are adopted in commercial vessels. The complexity of the thermal configuration is not an insurmountable obstacle for them in striving to obtain the least specific expenditure of fuel. Thus, the majority of modern PSU in commercial vessels have comparatively small specific expenditures of fuel (230-250 g/hp-hr) with, it is true, significant specific energies of the power plants (50-70 kg/hp-hr). Recently, highly economical PSU with high parameters of steam, multi-stage regeneration and intermediate superheating of steam have been created abroad. The specific expenditure of fuel in them is 190-200 kg/hp-hr.

What are the characteristics of PSU in military ships?

In contrast to commercial vessels, the energy plants of which are relied upon to provide maximum economy at full speed (cruising speed), the military ship runs on only 15-50% of full power about 80% of its overall travel time. This is occasioned by the fact that the greatest navigational range of a ship is insured in exactly this designated range of power. The sailing speeds corresponding to them are called economical. As an example we will cite a diagram of the workload of one of the foreign minesweepers (see table). Considering these operation peculiarities of ship-borne PSU, designers strive to provide the maximal possible k.p.d. [koefitsient poleznogo dystviya; efficiency] within a defined range of power (20-40% of full power).

Sailing Speed (knots)	Workload of Power Plant (%)	Overall Length of Time at Rates Given (%)
0-12	0-5	7
12-15	5-10	10
15-18	10-18	36
18-20	18-24	22
20-25	24-47	22
25-30	47-82	2
30-32	82-100	1
		100%

The second and no less essential feature which lowers the economy of the power plant is the necessity to provide for the operation of various weapons and to maintain them in constant readiness, on which is expended a considerable quantity of fuel. The operation of powerful turbo-generators, of firing and cooling pumps, of ventilation and humidity-control systems for the air increases the expenditure of fuel.

One must not fail to note the fact that the tendency recently has been toward further growth of power for these ship-at-large consumers. As an example, a graph of the growth in power of electric power plants on American minesweepers is cited in Figure 1. Plant operation in a wide range of power and with considerable expenditure of energy for ship-at-large users are the basic reasons for the reduction of PSU economy in comparison with the plants on commercial vessels.

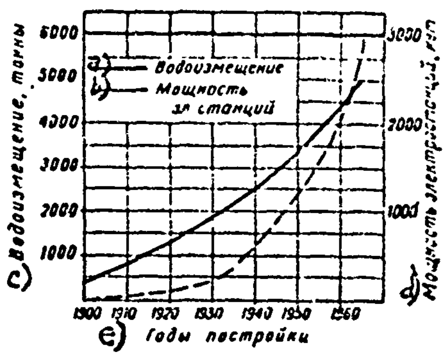


Figure 1

Graph of the Growth of Water Displacement of Minesweepers and the Power of Their Electric Power Plants

Wording used in Figure 1: a - water displacement; b - power of electric power plant; c - water displacement (tons); d - power of electric power plant (kilowatts); e - year of construction.

According to foreign specialists, at the present stage the problem of increasing the economy of the PSU and improving its weight and size profiles becomes more acute. New thermodynamic and construction decisions, which just yesterday were considered difficult to fulfill, can today be realized thanks to achievements in thermal engineering, metallurgy, automation and other branches of science and technology, which bear a relationship to shipbuilding.

We will remind you that the limit of economy of converting heat energy into mechanical energy has been established by the second law of thermodynamics, that the k.p.d. of any of the possible actual cycles can not exceed the efficiency of Carnot's ideal cycle ηk, which is determined only by the temperature of heat admission to a working substance T_2 (temperature of steam in the PSU) and the heat withdrawal from a working substance T_1 (temperature of water which cools the turbine condenser).

$$\eta k = \frac{T_1 - T_1}{T_2}$$

This expression shows that lowering the temperature of the water which cools the condenser and increasing the initial temperature of the steam are the determining factors in increasing thermal k.p.d.

LOWERING THE TEMPERATURE OF THE WATER which cools the turbine condenser is accompanied by a decrease in condenser pressure, i.e., by an increase in vacuum. Along with the increase in vacuum, the heat drop in the cycle increases, the power of the turbine is increased, and the thermal efficiency is raised. The temperature of the intake water varies between 0 and plus 32° Centigrade, depending on geographical conditions. The vacuum can be increased to a definite value if the area of the condenser's cooling surfaces is increased. However, this entails and increase in its weight and size. There is still another way. One can increase the power of the steam ejectors, which create rarefraction in the condenser, and of the circulating pump which delivers the intake water to the condenser. Increasing the power of these mechanisms naturally consumes additional amounts of fuel. It is most difficult to create a high vacuum at a PSU's full power when the greatest mass of steam must be condensed in the condenser. With less power, the vacuum will be higher, a fact which is favorable for obtaining maximum economy at cruising and economical speeds.

With the growth of the initial parameters of steam, the gain from raising the vacuum decreases. This circumstance may explain the noted tendency abroad toward not achieving too great a vacuum. The pressure in the condensers at full speed which reaches .12-.18 atmospheres is considered satisfactory (in commercial ships it is .05 atmospheres, in stationary thermal power plants: .03 atmospheres).

RAISING THE INITIAL TEMPERATURE OF THE STEAM is an effective means of increasing k.p.d. The temperature of steam in a PSU is limited by the durability of ferrous steel, out of which boiler pipes are made. It does not exceed 510-540° Centigrade. The use of steel of the austenitic type in boiler units allows an increase in the initial temperature to 650° Centigrade in stationary power plants.

Raising the initial pressure of steam (in the range of moderate pressures) also increases the economy of the cycle. This effect decreases proportionally with the transition to super-critical pressures (125 kilograms per square centimeter and higher). The properties of steam are such, that with an increase of the pressure at which steam is formed the temperature of vaporization also increases and, consequently, the mean temperature of heat supply to a working substance and thermal k.p.d. increase. Every initial temperature corresponds to a certain thermodynamically most-advantageous pressure. The higher it is, the highe the initial temperature of the steam. In choosing the pressure value, one must, of course, consider a number of structural considerations.

With an increase of the parameters of steam, its specific fuel expenditure in principal and auxiliary mechanisms is lowered, the cross-section of steam pipes, pipelines, and circulating parts of the turbine are reduced, as is the weight of the power plant as a whole. During the whole history of PSU development, steam parameters have been continually raised. Shown in Figure 2 is a graph of the growth of steam parameters in the American navy.

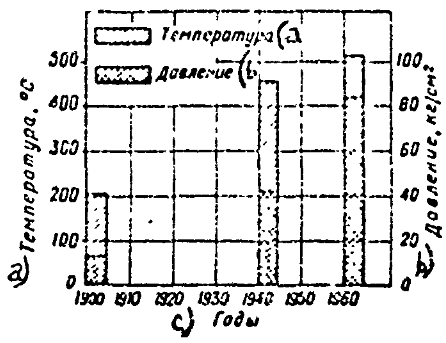


Figure 2

Graph of the Growth of Initial Steam Parameters

Wording used in Figure 2: a - temperature, C_2; b - pressure, kg/cm^2; c - year.

The choice of the initial parameters of steam is a very complicated problem, which is decided individually for each type of ship and is preceeded by a whole complex of structural and research work and calculations. An example of adopting high steam parameters in naval ships without sufficient technical foundation could be made of the ships of Germany, on which they began to adopt widely increased parameters of steam (72-120 kg/cm^2, 450-460° Centigrate) in the late thirties and early forties. For the sake of economy, the weight and size profiles were insignificantly improved, whereas the reliability of the PSU was reduced. In the opinion of the Germans themselves, their attempt to switch the fleet to increased steam parameters did not justify itself.

Recently, thanks to the further development of thermo-power plants and technique of power plant construction, the switch to increased steam parameters has become widely accepted. The influence of initial steam parameters on power plant k.p.d. is clearly seen in Figure 3.

It must be said that not only are the temperature and pressure of the steam increased, but also the thermal stress on the furnace, the velocity of the gases and other indices. The k.p.d. of ships' boilers now, as a rule, are 82-88%. There exists the opinion that the level of economy of boilers which has been reached is optimal and that one's basic attention should be concentrated on reducing their weights and sizes. Improvement of the weights and sizes of boilers is basically achieved by means of intensifying the combustion process, by increasing the pressure-feed of air into the furnace and by more complete insulation of the boiler walls. Recently, the pressure of the air-feed has increased considerably. To the rise of air-feed pressure corresponds an increase in the output of the furnace: $4.0 \cdot 10^6 \div 6.8 \cdot 10^6 \frac{\text{kilocalories}}{\text{m}^3\ \text{hour}}$ (instead of $2.0 \cdot 10^6 \div 2.3 \cdot 10^6 \frac{\text{kilocalories}}{\text{m}^3\ \text{hour}}$ in boilers of the past years).

The increase in output of the furnace permits a reduction in the size **of the boiler's furnace** by one and one half to two times.

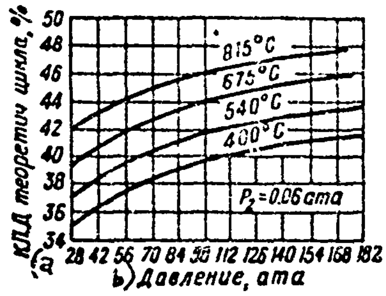


Figure 3

Influence of Initial Steam Parameters on K.P.D.

Wording used in Figure 3: a - k.p.d. of a theoretical cycle, %; b - pressure, atmospheres.

A significant step in the development of ship-borne thermal-power plants was the invention of high-pressure boilers (VNK; vysokonapornyy kotel) with gas-turbine air-feed. Of course, an air-feed of this type has been used for a long time in internal combustion engines to increase their power. Now, gas-turbine air-feed units have appeared in steam power plants. The large output of the furnace $\left(10 \cdot 10^6 \frac{\text{kilocalories}}{m^3 \text{ hour}}\right)$, the high k.p.d. which reaches 90-92%, the good maneuvering qualities, the very small weight and size -- all these have substantially improved the tactical, technical and operational profiles of the PSU.

In comparison with ordinary boilers, the weight of the VNK has been cut in half. How much the size has been reduced may be seen in Figure 4. The use of gas-turbine compressors has eliminated the boiler turbo-ventilators, which use 8-10% of the steam in an ordinary boiler, from the PSU. The high air-feed is provided by utilizing the heat of the exhaust gases in the gas-turbine which turns the compressor. The need for an air pre-heater is eliminated since its function is fulfilled by the compressor, which heats the air to 250° Centigrade in the process of compression.

The high pressure of the air, entering the furnace, makes it possible to use the increased velocity of gases and the large thermal output of the convective surfaces of the heater. The cylindrical shape of the boiler promotes a more complete combustion of the fuel and intensive heat emission by radiation. Due to the acute reduction of the amount of fire-resistant materials (by approximately ten times), and also the absence of an economizer and air pre-heater, the weight and size of the steam generator in comparison to the ordinary ship's boiler has been substantially reduced.

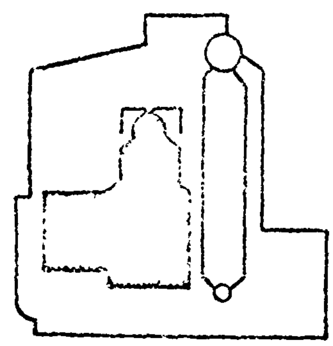


Figure 4

Sizes of High-Pressure (Shaded) and Ordinary Boilers

The steam generator power plant (Figure 5) of this type (USA) consists of a boiler, a turbine air-feed unit, and an automatic control system. This high-pressure boiler with natural circulation produces 55 tons of steam per hour (pressure is 84 atmospheres; temperature is 510° Centigrade.

Figure 5

High Pressure Steam
Boiler With Gas-Turbine Air-Feed

The turbine pressure-feed unit (Figure 6) is mounted over the steam generator and consists of gas-turbines, an axial compressor, an auxiliary steam turbine and an electric starting motor, all mounted on one axis.

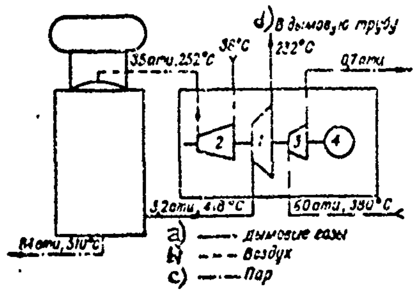


Figure 6

Turbo-Compressor Unit

Wording used in Figure 6: a - exhaust gases; b - air; c - steam; d - to exhaust pipe.

A two-stage jet gas-turbine with a power of 3,000 hp works on flue gases, having a maximal temperature of 450° Centigrade. The calculated k.p.d. of the turbine is 85%. The axial eleven-stage compressor connected to it is calculated for a maximal output of 81.6 tons per hour (pressure is 4.9 atmospheres; temperature is 254° Centigrade. The weight of the turbine pressure-feed unit is 5,080 kilograms.

With the transition to increased steam parameters, turbines of the active type, which have insignificant losses of steam in the circulating part, are being used more and more broadly. Thanks to the uniform expansion of the turbine rotor (disc construction) and stator, clearances in the circulating part have been decreased. Because of this, the economy of the cycle has been raised.

Much attention abroad is focused on refining the circulating parts and blades of the turbine. Just as a result of reducing the axial clearance from 3.0 to .5 mm, the degree of k.p.d. rises 5%. Milled nozzle arrays are replacing welded ones; instead of axial gaskets on working rims, radial ones are being used; the wire which fastens the blocks of blades of the last stages of low-pressure turbines are being rejected. The best of these turbines on the market has a k.p.d. of 80-85%.

Their high speed of revolution has considerably facilitated a reduction in the weight of turbines. An increase of revolutions of a low-pressure turbine from 4,800 rpm to 6,000-7,500 rpm and high-pressure turbines from 5,500-6,000 rpm to 8,000 rpm leads to a weight reduction in the turbine of 45%.

A number of [illegible] to reduce the weight of the GTZA (glavny [illegible] propulsion turbine) reduction gear by increasing [illegible] in the gear-teeth and increasing the strength of [illegible] American specialists consider it ver[illegible] profit[illegible] transmissions, which have good weight and size [illegible].

It is [illegible] turbines of auxiliary mechanisms is [illegible] turbines. The effective efficiency of [illegible] (in best cases it does not exceed 35-50%). [illegible] increase steam parameters, this problem has [illegible] in pressure contributes to a lowering of the [illegible] operation of turbo-mechanisms on steam [illegible] powerful driving-gears (cascade [illegible] the utilization of fresh throttle steam lowers the [illegible].

It is possible [illegible] of a PSU by converting low-power auxiliary [illegible] gears, which obtain fuel from a highly economical [illegible] This is especially tempting for a PSU with [illegible] the economy of low-power turbo-driving gears [illegible] electrification of auxiliary mechanisms permits [illegible] with the surpluses of exhaust steam, increase the [illegible] and, consequently, the k.p.d. of its driving [illegible] of steampipes and systems which serve the [illegible] the PSU as a whole.

There is [illegible] the economy of the turbo-mechanisms and [illegible] size profiles. If the number of revolutions [illegible] to 16,000-18,000 rpm, then the reduction [illegible] at full speed and 25-35% at economic [illegible] mechanisms need light and economical [illegible] axial transmissions worse [illegible] planetary reduction gears of small power can [illegible] to 50 (transmission k.p.d. is 94-.9[illegible]). [illegible] gears with planetary ones, according to foreign [illegible] decrease the weight of auxiliary mechanisms by [illegible] quite substantial.

In foreign [illegible] condensers have gained broad acceptance [illegible] stream of the water during movement of the ship [illegible] with self-circulators. This permits [illegible] circulating pumps by low-power compact [illegible] and reverse speeds).

As we see, the [illegible] size profiles of a ship PSU is [illegible] improved [illegible] According to speculations of foreign specialists, [illegible] the specific fuel expenditure will reach 225-[illegible] power ratio will be 4.3-11.2 kg/[illegible].

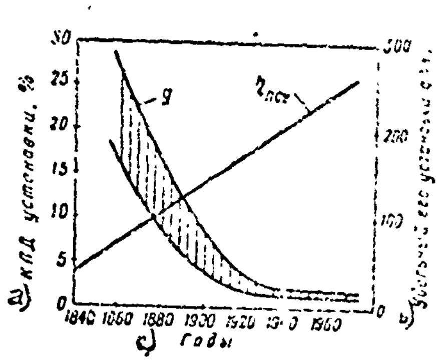


Figure 7

Graph of the Change in Economy and
Specific Energy of Ship Steam Power Plants

Wording used in Figure 7. a - k.p.d. of the plant (%); b - specific energy of the plant, (q^2/hp); c - year.

In conclusion, it should be noted that we have touched on only several trends in the development of ship-borne steam power plants. However, even a fleeting acquaintance with the latest achievements in this field confirms that energy power plants of this type are being perfected incessantly. Steam will not give up its position in naval shipbuilding.

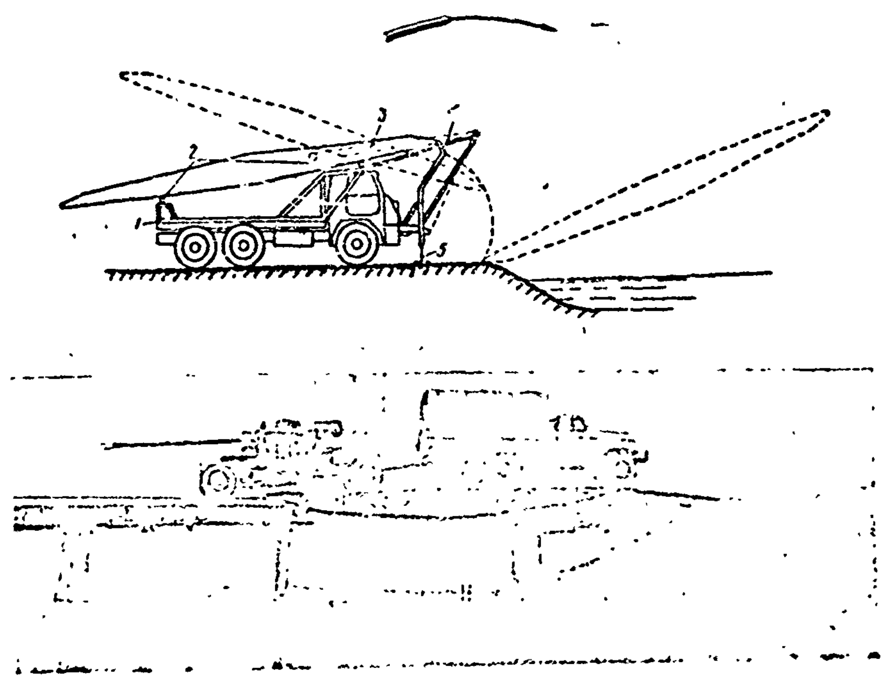
J-0203

WHEELED AND MECHANIZED

Engineer Coloner Waldemar Oldzeevskiy (Poland)

The wheeled, mechanized bridge model SMR-1 used in the Polish army allows the formation of crossings over obstacles up to 36.5 meters wide and 3.5 m deep. Military equipment up to 40 t, both wheeled and tracked, can be supported. The bridge set consists of four bridge units and three space supporters (see Figure and Table).

The vehicle used as a basis is the "Star-66" truck, with strengthened frame side members and front bumper. In order to avoid overloading the support of the front axle of the truck when traveling cross country, the frame side members carry an additional rubber buffer.



The equipment carried by the vehicle includes the carrying frame, the laying beam, the raising and lowering levers, the cable and winch system and the outriggers. During transporting, the bridge member 3 is carried on the rollers 2 of frame 1. The laying beam 4, the raising and lowering levers and the cable and winch system serve for installation or removal of the bridge member on an obstacle. The screw jack outriggers 5 increase the steadiness of the vehicle and lighten the load on the front axle; they also prevent the bridge layer from leaning during operation.

Dimensions of Bridge Layer, mm	
Length	11,970
Width	3,300
Height	3,150
Weight, Kg	9,600
Weight Distribution, kg:	
Front axle	4,000*
Rear Axle	5,600
Departure angles, Degrees	
Front	28
Rear	19
Road Clearance, mm	270
Top speed, km/hr	
Highway	50
Cross Country	4.8-20
Winch Traction, kg	4,500

The bridge span structure consists of two identical tracks, rigidly fastened together. Each track consists of four main ribs, connected by crossmembers, angle braces and a metal lattice. The load carrying elements are made of metal seamless pipe, the latticework of 20x4 mm section steel bands, placed on the rib and interconnected. This construction allowed a considerable reduction in weight of the load-bearing part. The bridge member weight 270 kg per running meter.

The raising and lowering levers are removed from the bridge layer and the bridge member is moved 300 mm to the rear before a long drive. With short movements (up to a few kilometers) this need not be done. The SMT-1 bridge set can be used to form single and multiple span bridges. The assembly time for a four span bridge with three supports is about 45 minutes. A single span can be installed in 3-[illegible] minutes.

J-0203

THE PHANTASTRON WORKS

Engineer-Major M. Smirnov

The phantastron -- a one-stage tube generator of linear-dropping voltage in a delay condition -- is being used widely in radio technology, automation, and telemechanics. Phantastrons create square or saw-toothed pulses of voltage, the duration of which is regulated within great limits. Pulses of voltage in the anode tube of the phantastron are linear (non-linearity ratio is 0.1%), their duration is stable (during a change of voltage of the power supply at ±10%, it changes to ±0.15%) and they depend little on temperature. Because of these qualities, they often use the phantastron to get a pulse delay which is regulated exactly in time and to determine the time interval between pulses and generation of saw-toothed voltage in circuits of automatic frequency alignment.

They use multielectrode tubes-pentodes and pentagrids in phantastron circuits as active amplifying elements. There are two basic hook-ups for the phantastron generator: with connection via a screen grid and with a cathode connection.

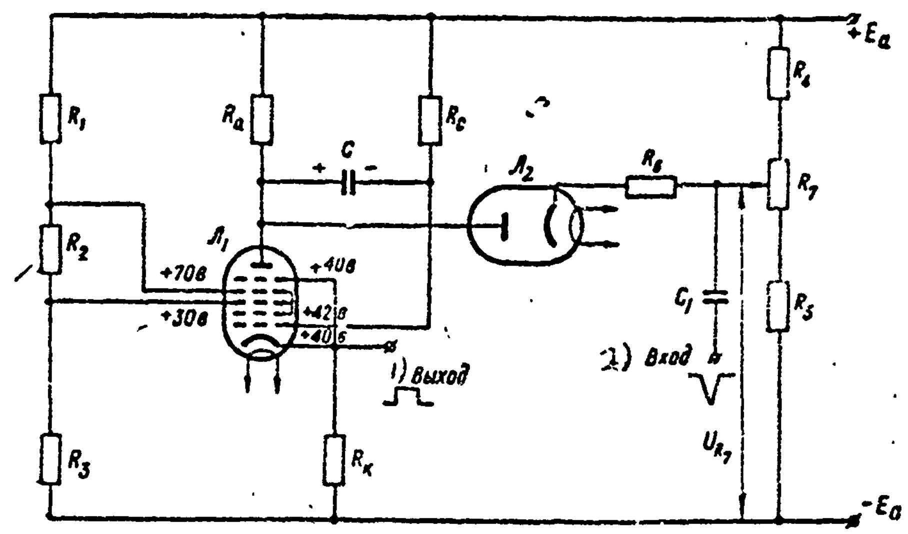


Figure 1

Basic Schematic of a Phantastron

Wording used in Figure 1: 1 - output; 2 - input;

Let us take a look at the performance of the phantastron with a cathode connection (Figure 1). Conditionally, we will divide the tube L_1 into two parts -- triode and pentode. The triode part consists of the cathode and the first, second, and forth grid connected to it. The second grid fulfills the role of an anode. The pentode part contains as the cathode, the third and fifth grids and the anode. The role of a control is carried out by the third grid. Thus, there are two control grids in the tube: the first and the third.

Capacitor C, which is included between the anode and the first grid, forms a ci-cuit of inverse negative connection of voltage between the pentode and the triode parts of the tube.

Tube L_2 (diode) in the schematic serves to pass the trigger pulse and, subsequently, to cut off the phantastron from the triggering circuit. Capacitor C_1 together with the resistor R_6 forms a transitional circuit for the trigger pulses. With the help of resistors R_4, R_5, and R_7, the voltage reaches the cathode of the diode L_2, the potential of which determines, in the final analysis, the pulse duration. To smoothly regulate the constant voltage value in the cathode, they use the precision potentiometer R_7.

Complex interaction between the triode and pentode parts of the tube L_1 is realized during the operation of the phantastron. So that it is easier to understand the processes which take place in the phantastron, we will divide its operation into the following stages: the initial status, the forced reversal of the circuit, the pulse formation, the spontaneous reversal of the circuit and the restoration of the initial status. For this purpose, we will use specific voltage values on the electrodes of the tube.

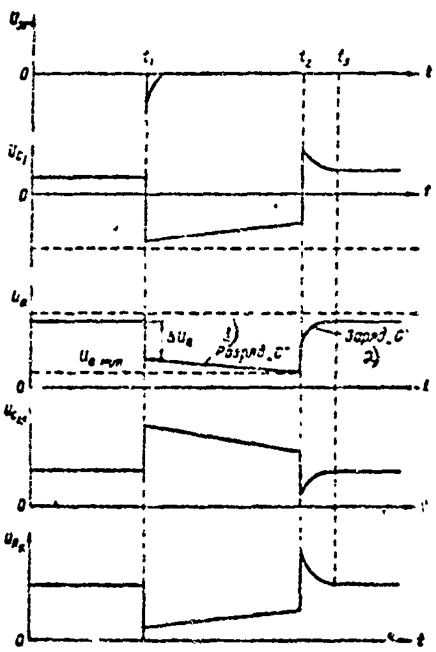


Figure 2

Diagrams of Electrode Voltages of the Phantastron Tube

Wording used in Figure 2: 1 - discharge; 2 - charge.

The Initial Status (Figure 2). As soon as the power supply is turned on, a current will go through the divider R_1-R_3, and the grids of tube L_1 will be under the influence of voltage which is positive in relation to the casing. The potential of the second and fourth grids will be equal, e.g., 70 volts the third 30 volts and the first 42 volts. At the resistor R_k, the cathode current I_k which is equal to the total current passing through the screen-grid and the first grid will create a voltage of 40, the positive symbol of which will be affixed to the fifth grid.

Since the potential of the first grid is two volts higher than the potential of the cathode and the potential of the third grid is 10 volts lower, the pentode part of the tube will be closed and the triode part open. All of the electrons which depart from the cathode are intercepted by the first and second grids, as a consequence of which the grid current reaches a significant value. At the third grid and, moreover, at the anode of tube L_1, the electrons will not drop. Consequently, the anode current in the pentode part of the tube is absent.

It can be shown that, because the anode current does not pass through the resistor R_a, the high voltage $U_{a_0} \approx E_a$ will be applied to the anode of tube L_1. In reality, its beginning value is determined by the status of diode L_2, to the cathode of which a voltage of less than $+E_a$ which is added from the pentiometer R_7. The diode is open and across it flows the current I_d. Because of this, the voltage $U_{a_0}=E_a-I_dR_a \approx U_{r7}$ is added to the anode of tube L_1.

The capacitor C is charged with current which passes over the circuit: $+E_a$, R_a, C, c_1-k, R_k, $-E_a$. One of its plates is below the potential U_{a_0} and the other below the potential U_{c_1}. The time constant of the capacitor charge is determined chiefly by the value of the resistor R_a.

Thus, in the initial status of the phantastron, the pentode part of tube L_1 is closed, the triode is open, capacitor C is charged and tube L_2 is open. In such a status, the phantastron, until then, comes over to tube L_1 and the negative trigger pulse does not enter from diode L_2.

The Forced Reversal of the Circuit. Let the negative trigger pulse U_{1ag} which enters the first grid of tube L_1 through the circuit C_1, R_6, L_2 and C be added at moment t_1 to the input of the phantastron. The voltage on it decreases sharply and the same happens with the cathode current I_k and voltage U_{r_k}. In relation to the cathode, the potential of the third grid becomes higher, and the potential of the first lower. In the pentode part of the tube appears current I_{a_0} small magnitude, as a result of which the potential of the anode becomes less in value U_{r_3}. An already lowered voltage of the anode will act on the first grid through the capacitor C, thus lowering the current of the screen grids, decreasing the voltage U_{r_3} still more and increasing the potential of the third grid. Voltage U_{r_2} is lowered still more. Consequently, the potential of the third grid in relation to the cathode becomes still higher and the potential of the first grid lower. The anode current of the pentode part of the tube increases. The drop of voltage U_{r_a} increases and the potential of the anode decreases. Under the action of the lowered voltage on the anode of the tube, the potential of the first grid again is lowered, the value of voltage U_{rk} is decreased and the potential of the third grid is increased. The current increases in the pentode part of tube L_1 and drops in the triode -- like an avalanche. Tube L_1 changes over to a new qualitative status: the pentode part of it is opened and the triode part is closed (it can not close completely because, in the opposite case, the anode current does not pass through the pentode part and the tube returns to the inital status).

At the end of the process, which lasts a part of a microsecond, the current in the pentode part of the tube increases considerably and the voltage in the anode and in the first grid is decreased to a value of ΔU_a. With an increase of anode current, the current in the triode part decreases. The currents of the screen grids cross resistor R_1 with a small value. The voltage on these grows in leaps and bounds. With a decrease of cathode current, the value of voltage U_{rk} decreases. The first forced reversal of the phantastron circuit occurs.

Thus, under the action of the negative trigger pulse, the avalanche-like process begins, being accompanied by a redistribution of the current in the tube. The anode current grows instantaneously and the current in the triode part decreases. The pentode part of the tube is opened and the triode part is closed. The anode current passes through the pentode part and the current of the screen grids is decreased to a very small value. At the moment of the reversal of the circuit, the diode is closed.

The Pulse Formation. After the surge of currents, the work of the phantastron is characterized by a discharge of capacitor C, the time constant of which is determined, chiefly, by the value of resistor R_c. In the given case, the constant time of the discharge is great and, because of this, the voltage in the capacitor diminishes slowly. The capacitor is discharged according to the linear law because the negative return connection in the circuit acts in accordance with the voltage between the anode and the control grid of the tube and recharges the capacitor. The negative return connection increases the time constant of the circuit of capacitor discharge.

Any decrease of discharge current leads to the increase of voltage in the first grid $U_{c_1} = E_a - I_c R_c$, to an increase of the anode current, and a lowering of voltage in the anode. The decrease of voltage in the anode is transferred to the grid. This hinders the decrease of current of the capacitor discharge. Any increase of current of the capacitor discharge leads to a decrease of anode current that hinders the increase of current of the capacitor discharge. In the discharge process, the potential of the right capacitor plate, which equals the potential of the first grid, is increased and the potential of the left capacitor is lowered. The discharge current remains constant. This means that the voltage in the capacitor is decreased at a constant rate, by linear law. By such a law, the voltage is decreased in the anode and slowly increases in the first grid and cathode of tube L_1.

In the course of time, when the voltage in the anode falls to a minimum value, the voltage on the first grid stops controlling the anode current. The action of the return contact between the anode and the grid is weakened sharply and the current of the capacitor C discharge, not being stabilized further, begins to fall sharply and the voltage on the control grid is increased. The current in the triod part of tube L_1 is increased and voltage U_{rk} is raised. The third grid becomes less positive in relation to the cathode, and the anode current of the pentode part is decreased. The increase of the current in the triode part and the decrease of the anode current, just as during the first reversal, occurs like an avalanche for a very short time.

The operation of the phantastron during the pulse formation is characterized by the fact that, from the moment of the pentode part of the tube opening, capacitor C begins to be discharged, the discharge linearity of which is provided by the return contact through the voltage between the anode and the control grid of the tube. The formation of the pulse is continued from t_1 to t_2, its duration is determined by the time of capacitor C discharge.

Spontaneouse Reversal of the Circuit. The redistribution of currents which were initiated at the end of the pulse formation flows like an avalanche. With a decrease of the anode current, the drop of voltage decreases in the resistor R_a and the voltage which is transferred through capacitor C to the first grid increases in the anode part of the tube. The negative potential of the first grid is decreased; the current of the screen grid grows. This current, passing over the resistor R_k causes the increase of voltage U_{rk}. With the increase of this voltage, the potential of the third grid, in relation to the cathode becomes more negative and the potential of the first grid more positive. The decrease of potential of the third grid causes a new lessening of anode current, that in it's turn leads to a growth of anode voltage. Subsequently, the process is repeated until the anode current begins to enter through the pentode part of the tube and its triode part is opened. The process takes place in an instant. Because of this, the voltage in the anode in the first grid and in the cathode grows in leaps and bounds. As long as the current of the screen grids grows, the drop of voltage is increased on the resistor R_1 and the voltage is decreased on the screen grids.

The operation of the phantastron during a spontaneous reversal is characterized by the fact that, having begun the end of the pulse formation, the process of decreasing the anode current and increasing the cathode current develops like an avalanche; the triode part of the tube L1 is opened and the pentode is closed.

Restoration of the Initial Circuit Status. The last step in the operation of the phantastron is restoration of the initial status. It is determined by the capacitor C charge at the circuit; $+E_a$, R_a, C_1, c_1-k, R_k, $-E_a$.

The time of capacitor charge is great and depends basically on: R_a : $t_3 \approx C \cdot R_a$. The phantastron slowly restores its initial status. By the moment t_3, capacitor C has time to fully charge almost to the value U_a, according to the exponential law. According to this law, the voltage in the first grid and at resistor R_k diminishes. The voltage in anode of tube L_1 is increased to such a value that the diode is opened. The current of the diode I_d flows through resistor R_a, creating on this resistor a drop of voltage equal to $I_d R_a$.

After the moment t_3, the circuit is in the initial status. The phantastron is ready for a new cycle of operation which will begin with the arrival of the next trigger pulse.

STAGES OF THE GREAT JOURNEY

M. Kroshkin
Candidate of Physical-Mathematical Sciences

V. Samarin
Senior Engineer

"Man will not stay on the earth eternally, but rather, in the chase for light and space, will at first penetrate beyond the limits of the atmosphere and then conquer for himself all of sub-solar space."

(K. Eh. Tsiolkovskiy)

12 April, 1966 marks five years from the day of the first manned flight into space. This feat became possible thanks to the vast contribution made by our people to the development of science and technology.

The flight was preceded by long preparatory work, the final stage of which was the launchings in 1960-61 of a series of satellite space ships with animals on board. These Soviet envoys made it possible to receive valuable scientific data on the possibility of prolonged space flight by living beings, on the radiation conditions along future space routes, and most important, they provided a solution to the problem of returning space apparatuses to Earth.

Likewise, prior to launching, satellite space ships, our scientists put into orbit artificial earth satellites. Of importance is the experiment with the dog, Layka, accomplished in the second Soviet "sputnik" in November of 1957. However, it should be noted that even this experiment had its precedent: they had already begun to launch dogs and other animals into space in high-altitude rockets at the end of the forties, shortly after the conclusion of the Great Patriotic War. Even then the first experimental data were obtained on the structure of the upper layers of the earth's atmosphere and on physical phenomena and processes which occur on the threshold of cosmic space.

The launchings of geophysical rockets were preceded by years of tenacious work by the first enthusiasts of space technology, the continuers of the pursuits of the great Russian scientists Konstantin Ehduardovich Tsiolkovskiy, who had been first to scientifically formulate and substantiate the basic principles and ideas of rocket flight, to work out constructive diagrams and even certain groupings of rocket systems. And therefore, however we register sucesses in the sphere of space accomplishments -- whether it be the flight of Yuri Gagarin, or the step into space of Aleksei Leonov, the launchings of multi-ton space laboratories, the soft landing of a space apparatus on the moon, or the delivery of the pennant onto Venus -- in all this we are indebted to Konstantin Ehduardovich.

Large-scale space exploration in the Soviet Union was first carried out during the program of the International Geophysical Year (1957-1958). The first artificial earth satellite in the world was put into orbit at this time. Three artificial earth satellites and a large number of meteorological and geophysical rockets were launched during the program of study of cosmic space in the Soviet Union. Based on the experiments performed, parameters of the earth's upper atmosphere, its density, temperature, ionnic composition, as well as characteristics of the ionosphere above the principal maximum. Besides this, the nature of radiowave scattering was studied. The research allowed us to discover the radiation belt of the earth, the measurement of cosmic rays beyond the limits of heavy atmosphere, and the discovery of a geomagnetic field at great distances from the earth.

Essentially new data about phenomena in cosmic space around the earth were obtained with the aid of the automatic interplanetary stations (AMS: avtomaticheskaya mezhplanetnaya stantsiya) "Luna-1," "Luna-2," and "Luna-3," which were launched in 1959. As a result of the experiments conducted by means of these stations, we discovered the so-called hydrogen geocorona, stretching to twenty thousand kilometers above the earth, and the corpuscular streams thrown off by the sun. Also obtained were the first data on a gaseous component of interplanetary space and on micrometeor particles. In addition, in the course of these launches it was established within the limits of measurable accuracy (100 gammas) that the moon had no magnetic field. In October, 1959, the back side of the moon was photographed with the AMS "Luna-3." Experiments in photographing the surface of the moon not visible from earth were brilliantly continued with the launch in July, 1965, of the automatic station "Zond-3," was photographed by this AMS. The quality of the moon photographs obtained by means of the film and television apparatuses proved to be so high that it was possible to see numerous details of the lunar landscape.

An event of vast importance was the reception on Earth on television pictures of the lunar surface, obtained by means of the automatic station "Luna-9" in February, 1966, as well as the insertion of the AMS "Luna-10" in a lunar orbit in April, 1966. The melody of the "Internationale" transmitted from the first artificial satellite of the moon was heard over the whole world during the days of the XXIII Congress of the CPSU. It should be noted that a multitude of measurements in cosmic space which have great scientific importance were carried out at great distances from the earth in automatic stations of the "Zond" and Luna" series.

Many new things for studying interplanetary space were also given by the AMS which were launched toward the planets Mars and Venus. New data on interplanetary space were successfully received during the course of these experiments. For example, the existence of a meteor stream, the orbit of which does not intersect the orbit of the earth, became known. A particularly large amount of data was received by means of station "Mars-1," with which two-way radio communications were maintained to a distance of 106 million kilometers. It was a great success in that, after three and one-half months of flight, the AMS "Venera-3" reached the planet Venus and delivered to its surface a streamer with the emblem of the USSR.

Data of geophysical and biological research in space permitted the transition to preparation for manned space flight. In this regard, the basic problem was developing all the systems of the space ship, right up to its landing on Earth in a prescribed area on the territory of the Soviet Union. The launchings of the satellite-spaceships in 1960-1961 had exceptional value. They were the precursors of the first space flight by Yuriy Alekseyevich Gagarin in the ship "Vostok," which was injected into orbit on 12 April 1961 by a multi-stage carrier rocket with six liquid-fuel rocket engines (total power was 20 million horse power). One turn of the flight in space brought assurance that later launchings of spacecrafts with cosmonauts aboard would proceed equally successfully.

More extensive investigations were conducted by G. S. Titov who accomplished the flight in the satellite-spaceship "Vostok-2" on 6-7 August 1961.

The several-day, group space flight of two satellite-spaceships simultaneously, "Vostok-3" and "Vostok-4," carried out by cosmonauts A. G. Nikolayev and P. R. Popovich was aimed at obtaining experimental data on the possibility of setting [illegible] communications between two ships and coordination of the cosmonauts' activities. In addition, in this flight research and experiments were carried out which were necessary for the solution of new [illegible] technical problems. This group flight of the craft [illegible] about 70 hours (distance covered was 1,975,200 [illegible] this time the ships approached each other to a distance [illegible] ters. This was the first space sighting to be [illegible].

The orbital spacecrafts "Vostok-5," [illegible] cosmonaut V. F. Bykovskiy, and "Vostok-6," piloted [illegible] Tereshkova were put into orbit by multi-stage rocket [illegible] six liquid-fueled rocket engines. During [illegible] of various factors on the organism of man were studied. In addition, broadened medico-biological research on conditions of prolonged space flight were carried out, and systems of piloting spaceships were worked out. Two-way radio communications were maintained between the ships.

The next stage of research was the launch of the three-man piloted craft "Voskhod," which was injected into orbit by a carrier rocket with a total maximum thrust of its jet engines of 650,000 kilograms. During the flight, the new multi-seat piloted craft was tested; the ability to work and co-operate in flight of a group of cosmonauts consisting of various specialists was investigated; and broadened medico-biological research was carried out. Making up the crew of the ship were: V. M. Komarov (commander), K. P. Feoktistov (scientific colleague) and B. B. Yegorov (physician).

The joint day flight in the ship "Voskhod-2" was completed by cosmonauts P. I. Belyayev and A. A. Leonov. On the second revolution during the flight of the orbiting craft, "Voskhod-2," cosmonaut Lieutenant Colonel A. A. Leonov, in a special suit which had an autonomous life-supporting system, stepped out into cosmic space, moved away from the ship at a distance up to 5 meters, successfully carried out a series of projected investigations and observations and safely returned to the cabin. While out-side of the ship, Leonov examined its external surface, turned on a movie camera and carried out a program of visual observation. The cosmonaut was located in conditions of cosmic space for about 20 minutes, during which time he was outside of the ship for 10 minutes.

K. Eh. Tsiolkovskiy wrote: "The Earth is the cradle of intelligence, but it is impossible to live forever in a cradle." The Soviet people and our courageous cosmonauts have shown with their exploits that man has already reached such a development, that the cradle has become cramped for him, and he has stepped into unexplored expanses. And, although it is only the first little step on the road to the stars, although they have become a little bit closer and there are many difficult obstacles ahead, it is an accomplished fact that man has torn himself away from the earth, he has overcome his age-old bondage to the earth's gravitation. The unfamiliar planets await him.

But in the meantime extensive work is in store for us. It is necessary to create new and powerful rocket systems, to develop the moon as a launch platform for further penetration into cosmic space, to devise and test reliable multi-seat ships which would be able to maneuver in space. It is necessary to solve the problem of absolute protection of cosmonauts from harmful cosmic rays, especially from the dangerous rays, which arise during chromospheric bursts on the sun. Before penetrating further into space "to make a home" of it, it is necessary to learn all about it so as to remove, if possible, all potential dangers in the path of man. With this aim ISZ (Istkusstvennyi Sputnik Zemlyi; Artificial Earth Satellite) of the "Kosmos" series, as well as the scientific stations "Elektron" and "Proton" are being launched. Physiological investigations, also, are being conducted under conditions of actual space flight. The flight of dogs Veterek and Ugolek in the ISZ "Kosmos-110" which took about 22 days was recently concluded. This experiment permitted the receipt of new data on the influence of weightlessness on a living organism. In the tables published in this issue of the magazine, detailed information has been cited on all space apparatuses launched into space from the Soviet Union.

At a press conference of the Academy of Science in Moscow on 23 August 1965, in honor of the launch of the AMS "Zond-3" and the photographing of the back side of the moon, the President of the Academy of Science of the USSR, academician M. V. Keldysh said in answer to questions: ". . .there are two general problems: further scientific information on the universe, and in particular, about the planetary system; and the second general problem is interplanetary communication.

The second problem is immense. It demands immense resources, scientific and technical efforts . . . ."

Man is gradually approaching the solution of this problem. The first steps have already been made. Man will become the master in space. It is forever entered in history that the one who was first in space was our Soviet man, Yuriy Alekseyevich Gagarin, who blazed a trail into space for subsequent conquerors of the universe. The first AMS to have perfected a soft landing on the moon also was a Soviet station, "Luna-9." We shall hope that the first one to set foot on the surface of the planets closest to the earth will be a citizen of the USSR. The guarantee of this is the success of the Soviet Union, its engineers and scientists and its astronauts, in whom the whole world now takes pride and delight.

Automatic Interplanetary Stations

Name Date of Launch	Weight kg	Remarks
Luna-1 2 January 1959	-	On 4 January 1959 approached the moon to a distance of 5-6 thousand km. On 7-8 January went into orbit around the sun and became its artificial satellite (planet).
Luna-2 12 September 1959	-	On 14 September 1959 at 00 hrs 02 min 24 sec, Moscow time, reached the surface of the moon in the area of the Sea of Serenity (800 km from the center of the visible disk of the moon).
Luna-3 4 October 1959	278.5	Photographed the surface of the moon (unseen from Earth). The survey was continued for about 40 min from a distance of 60-70 thousand km. A television apparatus provided the transmission of the semitone pictures of the moon to Earth with high resolution capability from a distance of about 470 thousand km, having passed by the moon and having become then an ISZ, completed 11-12 revolutions around the earth and in April of 1960 burned up in the heavy layers of the earth's atmosphere.
Venera-1 12 February 1961	643.5	Launched by a guided space rocket toward Venus, having started from a

		heavy ISZ which had been put into an intermediate orbit. On 19-20 May 1961 passed by the surface of Venus at a distance of 100 thousand km and then became a satellite of the sun.
Mars-1 1 November 1962	893.5	Launched by a space rocket toward Mars, having started from a heavy ISZ, which had been temporarily put into an intermediate orbit. By the 17th of May 1963 had moved away from the earth a distance of 195 million km and was located at a distance of 11 million km from Mars. At a distance of 106 million km, two-way radio communications were carried out successfully.
Luna-4 2 April 1962	1422	On 6 April at 4:24 this AMS passed over the surface of the moon at a distance of 8,500 km. Then it began to rotate about the earth in an elliptical orbit, having moved away from the earth approximately 700 thousand km (maximum).
Zond-1 2 April 1964	-	The last stage of an improved carrier rocket put a heavy ISZ into an intermediate orbit. At a prescribed point in space a rocket started from on board the ISZ, which, giving the automatic station "Zond-3" its escape velocity, put it in a trajectory of motion close to the calculated one.
Zond-2 30 November 1964	-	For the first time in actual space flight conditions, a test was conducted of the electro-jet plasmatic engines which had been set up on board the station and were used as control elements.
Luna-5 9 May 1965	1476	Launch was carried out from an ISZ. On 12 May at 22:10 hrs, Moscow time, it reached the surface of the moon in the area of the Sea of Clouds.
Luna-6 8 June 1965	144[illegible]	On 9 May 1965 during a correction of the flight trajectory, the command to switch off the engine was not carried out, as a result of which the trajectory of station "Luna-6" deviated from the calculated one.
Zond-3 18 July 1965	-	On 2 June 1965 at 4:24 hrs, Mc[illegible]w time, 1.5 days after launch, the "Zond-3" had begun photographing the moon

		when it was located at a distance of 11,600 km from the surface of the moon. It finished at 5:32 at a distance of about 10,000 km. That part of the moon not visible from earth, which had remained unfilmed during the survey carried out for the first time by Soviet AMS "Luna-3," was photographed for the first time from the station "Zond-3."
Luna-7 4 October 1965	1506	Toward evening on the 5th of October a correction of the first trajectory of station "Luna-7" was carried out. "Luna-7" reached the moon on 8 October at 1:08:24 hrs, Moscow time, in the area of the Sea of Storms to the west of the crater Kepler. During this flight to the moon, most of the operations necessary for accomplishing a soft landing were carried out.
Venera-2 12 November 1965	963	This station passed by Venus at a distance of 24,000 km, according to plan.
Venera-3 16 November 1965	960	Put into a heliocentric orbit. On 26 December 1965 a correction of the flight trajectory was carried out with the aid of a special correcting liquid-fueled engine.
Luna-8 3 December 1965	1552	At 22 hrs, Moscow time, on 4 December 1965 a correction in flight trajectory was carried out. On 7 December at 00:51:30, Moscow time, reached the surface of the moon. On the flight to the moon, a complex check of the working of all systems which provide for a soft landing was carried out. This check showed normal working of the AMS systems at all stages of the lunar landing except the last one.
Luna-9 31 January 1966	1583	On 3 February at 21:45:30 hrs, Moscow time, a soft landing was accomplished on the surface of the moon in the area of Sea of Storms to the west of craters Reiner and Marius. On 5 February from 1900 to 2000 hours the prescribed program of investigation of the moon was completed. The

		television pictures transmitted from the station "Luna-9" are unique.
Luna-10 31 March 1966	-	On 3 April at 21:44 hours, Moscow time, it was put into a selenocentric (about the moon) orbit and became the first artificial satellite of the moon.

Artificial Earth Satellites -- "Kosmos"

The ISZ Kosmos series was intended for continued research of the upper layers of atmosphere and cosmic space, according to the program announced by TASS on 16 March 1962.

In accordance with this program, the implementation of the following scientific investigations were envisaged:

1. A study of the concentration of charged particles in the ionosphere for an investigation of radio-wave scattering.

2. A study of the corpuscular stream and particles of little energy.

3. A study of the energy composition of the radiation belt of the earth for an evaluation of radiation dangers during prolonged space flights.

4. A study of the primary structure of rays and their variations in intensity.

5. A study of the magnetic field of the earth.

6. A study of the short-wave radiation of the sun and other cosmic bodies.

7. A study of the upper layers of the atomosphere.

8. A study of the influence of meteoric substanceson the construction elements of space objects.

9. A study of the distribution and formation of cloud systems in the earth's atmosphere.

In addition, the development of many design elements of cosmic apparatuses was specified by the program. For the implementation of research for this program, scientific apparatuses as well as radio receivers, radio systems for the exact measurement of the elements of the orbit and radio-telemetry systems for transmitting data on the working of instruments and scientific apparatuses to earth were mounted on board the ISZ Kosmos series.

Satellites of the Kosmos series were launched during the period 1962-1966. By 20 April 1966, 115 satellites of the "Kosmos" series had been launched.

Maneuverable Space Apparatuses

Name	"Polet-1"	"Polet-2"
Date of Launch	1 November 1963	12 April 1964
Apogee, km	1437	500
Perigee, km	343	310
Period of revolution, min	102.5	92.4
Angle of inclination to orbital plane	58°55'	58°06'

Remarks:

1. Initial orbital data of the maneuverable space apparatus "Polet-1": Apogee -- 592 km; Perigee -- 339 km.

2. Cited in the table are orbital data after numberous maneuvers in space.

3. For stabilization and subsequent performance of maneuvers of the space apparatuses, numerous ignitions of the engines were carried out.

Artificial Earth Satellites

Name	Date of launch	Payload (kg)	Initial orbital data				Date ceased to exist	Elapsed flight distance (millio-
			Apogee (km)	Perigee (km)	Period of revolution	Angle of inclination of the orbital plane		
First ISZ	4 Oct 1957	83.6	947	228	96.17	65°10'	4 Jan 1958	About 60
Second ISZ	3 Nov 1957	508.3	1671	225	103.75	65°30'	14 Apr 1958	More than 100
Third ISZ	15 May 1958	1327	1880	226	105.95	65°20'	6 Apr 1960	Over 448
Heavy ISZ	4 Feb 1961	6483	327.6	223.5	89.8	64°57'	Until 22 Feb 1961	-
Heavy ISZ	12 Feb 1961	-	280	222	89.6	65°	Up to 25 Feb 1961	-

Satellite-Spaceships

Name of satellite-spaceship	Date of Launch	Weight[1] (kg)	Initial Orbital Data				Date of landing
			Apogee (km)	Perigee (km)	Period of revolution	Angle of inclination of the orbital plane	
First	15 May 1960	4540[2]	369	312	91.2	65°	Not stipulated
Second	19 Aug 1960	4600	339	306	90.7	64°57'	20 Aug 1960 by command from earth
Third	1 Dec 1960	4563	265	187.3	88.6	65°	Ceased to exist on 2 Dec 1960
Fourth	9 Mar 1961	4700	248.8	183.5	88.6	64°56'	9 Mar 1961 by command from earth
Fifth	25 Mar 1961	4695	247	178.1	88.42	64°54'	25 Mar 1961 by command from earth

1. Without the last stage rocket booster.

2. Including the weight of the on-board apparatus with fuel source-1477 kg.

Scientific Space Stations

Name	Date of launch	Weight of payload (kg)	Initial orbital data				Remarks
			Apogee (km)	Perigee (km)	Period of revolution	Angle of inclination of the orbital plane	
Elektron-1	30 Jan 1964	-	7100	406	2 hrs 49 min	61°	The space stations "Elektron-1" and "Elektron-2," as well as the other pair, "Elektron-3" and "Elektron-4," were put into essentially different orbits by one rocket vehicle.
Elektron-2		-	68200	460	22 hrs 40 min	61°	
Elektron-3	11 Jul 1964	-	7040	405	2 hrs 48 min	60°52'	
Elektron-4		-	56235	459	21 hrs 54 min	60°52'	
Proton-1	16 Jul 1965	12.2	627	190	92.45 min	63°30'	The on-board scientific apparatus mounted in "Proton-1" and "Proton-2" are intended for execution of a complex research program of ultra-high-energy cosmic particles.
Proton-2	2 Nov 1965	[illegible].2	637	191	92.6 min	63°30'	

Communications Satellites

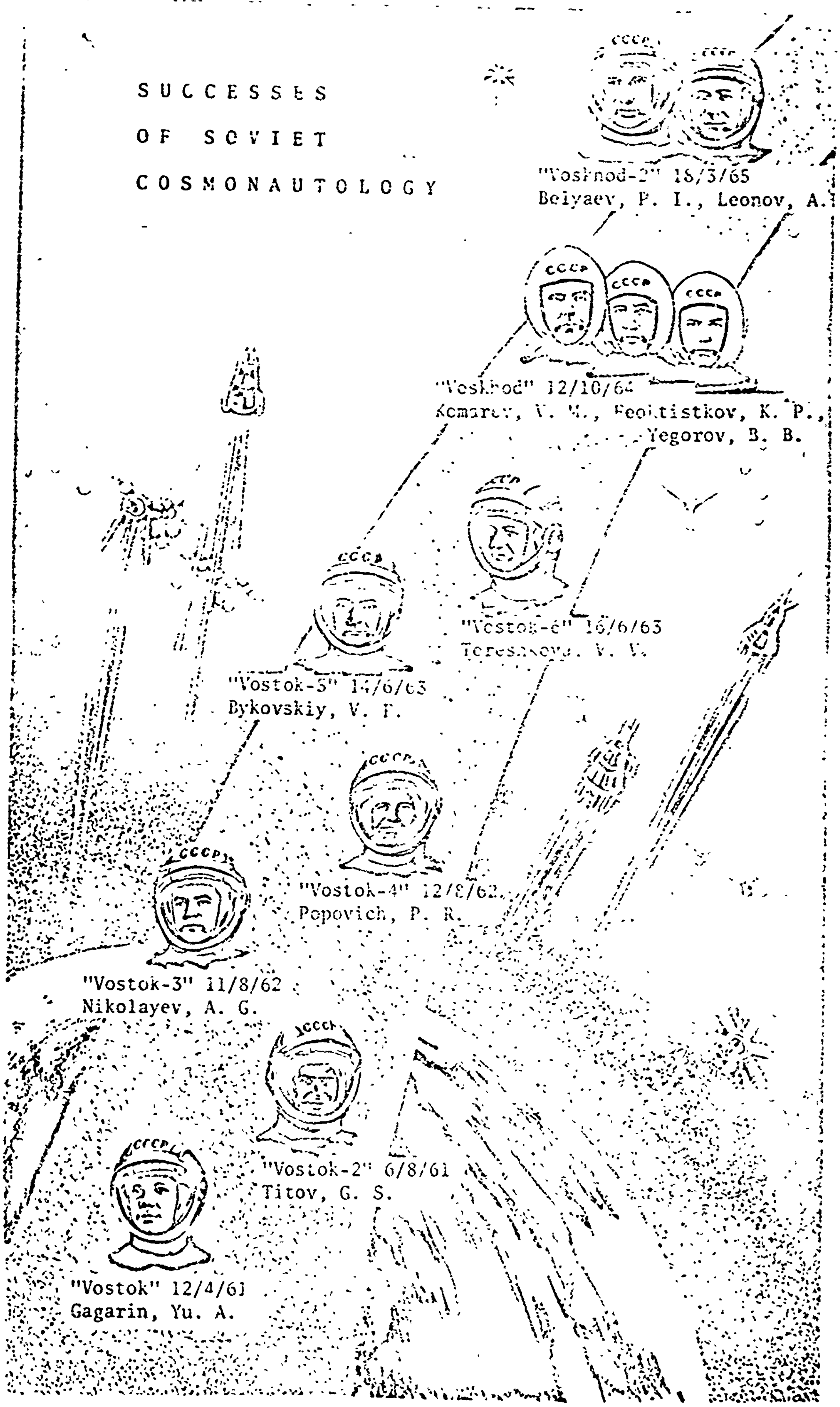
Name	Date of Launch	Initial Orbital Data				Remarks
		Apogee (km)	Perigee (km)	Period of revolution	Angle of inclination of the orbital plane	
Molniya-1 first satellite	23 Apr 1965	39380	497	11 hrs 48 min	65°	The satellites are intended for the transmission of television programs and for the realization of long-range two-way multichannel telephone, phototelegraph, and telegraph communications.
Molniya-1 second satellite	14 Oct 1965	40000	500	11 hrs 59 min	65°	

The Satellite-Spaceships
"Vostok" and "Voskhod"

Name of spaceship and cosmonaut	Date and time (Moscow) of blast-off and landing	Weight of ship (kg)	Initial orbital data				Landing Place
			Altitude of Apogee (km)	Altitude of Perigee (km)	Period of revolution	Angle of inclination of the orbit	
"Vostok" Yuriy Alekseyevich GAGARIN, Major	12 Apr 1961 0907 hrs 12 Apr 1961 1055 hrs	4725	327	181	89.1	64°57'	In the area of the village of Smelovok, Ternov Rayon, Saratov Oblast' (RSFSR)
"Vostok-2" German Stephanovich TITOV, Major	6 Aug 1961 0900 hrs 7 Aug 1961 1018 hrs	4731	244	183	88.46	64°56'	In the area of the settlement Krasnyy Kut, Saratov Oblast' (RSFSR)
"Vostok-3" Andrian Grigor'yevich NIKOLAYEV, Major	11 Aug 1962 1130 hrs 15 Aug 1962 0952 hrs	4722	234.6	180.7	88.33	64°58'50"	South of the city of Karaganda, Kazakh SSR.
"Vostok-4" Pavel Romanovich POPOVICH, Lt Col	12 Aug 1962 1102 hrs 15 Aug 1962 0959 hrs	4728	236.7	179.8	88.39	64°57'10"	South of the city of Karaganda, Kazakh SSR.

"Vostok-5" Valeriy Fedorovich BYKOVSKIY, Lt Col	14 Jun 1963 1558.58 hrs 19 Jun 1963 1359.59 hrs	4720	222.1	174.7	88.272	65°57'49"	Northwest of the city of Karaganda, Kazakh SSR.
"Vostok-6" Valentina Vladimirovna TERESHKOVA, Jr Lt	16 Jun 1963 0929.52 hrs 19 Jun 1963 1115:55 hrs	4713	231.1	180.9	88.304	64°57'20"	Northwest of the city of Karaganda, Kazakh SSR.
"Voskhod" Crew: Vladimir Mikhailovich KOMAROV, Eng-Col (commander of ship); Konstantin Petrovich FEOKTISTOV, Candidate of Technical Science Boris Borisovich YEGOROV, Physician (crew members)	12 Oct 1964 10:30:01 13 Oct 1964 10:47:04	5320	408	177.5	90.087	64°03'30"	Northeast of the city of Kustanay, Kazakh SSR.
"Voskhod-2" Crew:	18 Mar 1965 1000 hrs	About 6000	495	173	90.9	65°	In the area of the city of Perm'

Pavel Ivanovich BELYAYEV, Col (commander of ship); Aleksey Arkhipovich LEONOV, Lt Col	19 Mar 1965 1202 hrs							


SUCCESSES
OF SOVIET
COSMONAUTOLOGY
"Voskhod-2" 18/3/65
Belyaev, P. I., Leonov, A.
"Voskhod" 12/10/64
Komarov, V. M., Feoktistkov, K. P.,
Yegorov, B. B.
"Vostok-6" 16/6/63
Tereshkova, V. V.
"Vostok-5" 14/6/63
Bykovskiy, V. F.
"Vostok-4" 12/8/62
Popovich, P. R.
"Vostok-3" 11/8/62
Nikolayev, A. G.
"Vostok-2" 6/8/61
Titov, G. S.
"Vostok" 12/4/61
Gagarin, Yu. A.

TOWARD NEW SPACE TRIUMPHS

Colonel Yu. Gagarin
Pilot-Cosmonaut USSR
Hero of the Soviet Union

It is widely accepted that Soviet science today occupies the foremost position in the most important branches of knowledge, among them the study of the universe. Mankind justifiably calls the Country of Soviets the principal cosmodrome of our planet.

In the series of Soviet space triumphs, an extremely important place is occupied by the soft landing of an automatic laboratory in the waterless Ocean of Storms on the moon. The circular panorama of the lunar landscape and the various telemetric information transmitted with its aid to the Earth have exceptional scientific value. This truly great experiment marked the beginning of a qualitatively new stage of space mastery, the stage of first-hand inspection of heavenly bodies.

We, the Soviet people, are rightfully proud of the fact that the decisive steps which move Mankind forward in knowledge of the universe belong to us. Just as before, we will systematically and methodically continue the assault on space, to break ever-newer trails in interstellar expanses.

The task consists not only of uncovering the secrets of limitless space beyond the atmosphere. As approved in the decisions of the XXIII Congress of the CPSU, the results received in cosmic-space research will be used widely for perfecting radio communication, radio-navigation, television, weather services and other practical goals.

One thing is indisputable: the world will often be witness to our new space triumphs. The guarantee for this is the inexhaustible creative efforts of the Soviet people who are developing the industrial might of the Country of Soviets.

AUTOMATION AND CONTROL

Professor A. Leont'yev
Active Member of the Academy of
Pedagogical Science of the RSFSR;
Lenin Prize Laureate

Engineer-Lieutenant Colonel I. Yeremenko
Candidate of Technical Science

V. Zinchenko
Candidate of Pedagogical Science

Professor B. Lomov
Correspondent Member of the
Academy of Pedagogical Science of the RSFSR

Lieutenant Colonel V. Rubakhin
Candidate of Pedagogical Science

The modern scientific-technological revolution makes great demands on the management of production processes, power plants, transportation and military equipment. A need has arisen to process a large volume of information in a short time, to make and carry out decisions and to provide the necessary control over their execution. It is impossible to solve these problems with a simple increase in the number of people who are involved in management. This is why a large part of the functions of management is being taken over by automatic machines and electronic computers. The relationships between man and machine are undergoing essential changes and the psychological structure of man's activities is being altered.

Man's role in any system is determined first of all by the nature of that system (for example, supply or control) in which he functions, by his place in it, by the peculiarities of interaction with the objects being controlled. Man can influence the objects either directly through a chain of operators or, finally, remotely through technical devices. Everything depends on specific circumstances. It is important to strive for high effectiveness and reliability in the system of control and, for this, it is necessary to insure proper correlation of the functions of man and machine and the rational share of machine participation in the working out of controlled effects.

Is it possible to completely automate this or that activity of man in the process of control? The answer to this question depends on many factors. The most important of them are: the nature (content and form) and the completeness of information which is digested in the process of control; the purpose, importance and urgency of the information; the algorisms of its processing.

i

Let us examine, even if it is just in a general way, the process of treatment and use of the information in a control system. The following basic operations occur within it: reception and transmission of information, its formal encoding, processing (with the aim of excluding false information and exposing unnecessary information) and making decisions. Such a description gives only the general idea of the processing of information in one cycle. One must not fail to consider the fact that, in the process of solving problems when processing information, the separate criteria become more precisely defined, new algorisms are produced, the possibility of predicting the next decisions appear. So we see that a structural diagram of the processing of information has a dynamic rather than a static nature. Depending on the assignment of specific elements of control, on the functional responsibilities of each official and the problems solved by them, some of the operations enumerated above are omitted, others are shortened, others repeated at higher levels.

Automation is a powerful factor of technical progress in all spheres of man's activity, including the sphere of control. However, the separate operations submit to automation in various degrees.

THE RECEPTION OF INFORMATION is associated with the activity of analyzers of man (the organs of sight, hearing, etc.) and at present can be automated only partially. The complete automation of this operation requires a full investigation of the laws of perception and the identification by man of the manner of seeing and hearing and the creation of identifying, reading and talking automates. As experience shows, this problem is very complex. For, even learning the laws in man's actions technically would be difficult to accomplish. For example, a diagram has been made of a person's development of automatic recognition habits. At first he perceives the objects as a whole, then begins a period of comprehensive use of individual features and a gradual interconnection of them into larger operative units of perception -- "characteristics." Subsequently, the process is shortened, the objects are perceived almost instantaneously -- "through a hint." We still have not succeeded in formalizing such a complicated, transient process so that this function can be transferred later to a machine.

THE FORMAL ENCODING of information includes, in essence, a transition to some other code or language without changing its content. The simplest examples of such operations are: marking places on a map; deciphering telegraphic communications; drawing up programs for a computor according to a given algorism. The automation of encoding does not entail technical difficulties and even now quite modern algorisms of formal encoding have been worked out and the corresponding technical systems have been created.

THE PROCESSING OF INFORMATION is tied in with the estimate of the operational situation. It contains very complex logic operations. It is very difficult to automate it since we still know little about the powers of synthesizing information and its appraisal by man. It is obvious that the processing of information can be automated only partially. Basically, it lags behind man.

DECISION MAKING is directly coupled with the processing of information and with the appraisal of its content. If the volume of information is sufficient and an accurate system of criteria and algorisms is given, the making of decisions has a formal and logical nature and, in principle, can be automated with the aid, for example, of special information-logic machines (ILM; informatsionno-logicheskiye mashiny). This problem becomes more complex when decisions are made with too little or too much information, or in the absence of a given system of algorisms. As we know, man in his practical activities sometimes proceeds from a general goal and acts, so to speak, according to the circumstances, working out algorisms while appraising the situation, using not only knowledge but initiative and all his previous experience. It is natural that a certain operation cannot be completely automated, even considering the high level of technical development. The more important and significant decisions will undoubtedly be made by man in all cases.

THE EXECUTION OF DECISIONS MADE (accomplishment of definite actions or transmission of commands) depending on specific conditions, can be automized to various degrees.

As we see, the execution of many functions connected with the processing and evaluating of information and with the making of decisions demands the full participation of man. He has many advantages over machines, including the EhVM [ehlektronnaya vychislitel'naya mashina; electronic computer).

In this respect, interest is aroused by the comparable characteristics of the advantages and disadvantages of man and machine as presented by the American psychologist A. Chapanis (Table 1). The list of capabilities of man and machine cited in it is far from complete. However, the main advantage of man -- the ability to act creatively in complex, unexpected situations -- is shown quite plainly in the table.

Man	Machine
Able to work in unexpected (unforeseen) situations, has great versatility and adaptability to the changes in external influences, can work on many programs.	Noted for a great complexity of programming and can not easily foresee all eventualities. Characterized by a relative non-versatility, complexity and a great capacity for multiprogram work.
Can make use of insufficient information and make an accurate prediction of separate events.	This capability is very low when compared with its complex structure and programming.
Has a great ability to select various methods to do a job, can quickly use reserves and correct mistakes.	These abilities are limited; the ability to correct mistakes is very low.

Has limited "transmitting capability"; quantity of information which can be handled in a unit of time is little.	Has a very great capacity.
He tires easily, his attention wanders and the influence of emotional factors lowers his capacity for work in a comparatively short time.	Noted for an ability to work almost constantly while maintaining the required reliability
Does calculations comparatively slowly and inaccurately.	Works quickly and accurately.

Table 1

2

Thus, it is impossible to automate fully the process of handling information in a control system. The fact of the matter is that large control systems are systems of "man-machine." Their indispensable and most important element is the man-operator. In connection with this, a very important problem arises -- optimally coordinate the work of man and modern equipment.

When planning and using a control system, one must know the capacity of the operator to receive, process, store and transmit information as well as his working speed, accuracy and ability to overcome obstacles. The fact is that, although the human operator is the most important and versatile of the control system, he, as we already noted, is inferior to the machine in many characteristics. Consequently, his capabilities will frequently determine the effectiveness of the system as a whole.

The indicated characteristics depend first of all on the capabilities of man's sensors (the organs of sight, hearing, touch), on their threshold of sensitivity. Beyond the upper and lower limits of this threshold the signals can no longer be received. The duration of man's perception of elementary information and its processing usually is not less than .25 second. In Table 2 are shown the smallest values of average length of the dormant period* for a simple reaction to the influence of various stimuli. If the response to a signal is associated with the selection of one of the possible means of responding, then the reaction time increases in comparison with that shown on the table.

* By dormant period is meant the time from the instant of the appearance of the signal to the beginning of the reaction to it.

Sensor	Signal-Stimulus	Dormant period (average length in microseconds)
visual	light	150-220
aural	sound	120-180
tactile	touch	280-1600
olfactory	smell	310-390
vestibular	rotation	400

Table 2

The transmitting capacity of a sight analyzer is equal to several tens of binary units per second (for elementary information). When the transmitted information or the nature of the problem becomes more complex, or also in the presence of disturbances, it rises sharply. In addition, the transmitting capacity depends on the time of appearance of the signals, their meaning, and on the degree of fatigue and training of the operator. It must be mentioned that rational, qualitative evaluations of the transmitting capacity of the sight analyzers for complex occurrences in human activities have not yet been found.

In many cases man is inferior to machine in speed of response. The accuracy of the work of an operator depends on many physiological and psychological factors, and also on the nature of the signals and the rate of their arrival. Man remains the least accurate part, sometimes reducing the accuracy of the entire control system. He may not, however, be excluded from the system. Therefore, in order to reduce mistakes, more attention must be devoted to the training of the operators.

By the reliability of the system is meant its capability to successfully carry out its required functions in the course of a given interval of time. Man also has a determinate reliability in a control system. It depends, first of all, on his personal traits and physical fitness and on the degree of fatigue. Man's reliability can be determined by the average time of errorless work, by the distribution of mistakes made by him in the course of a day, by the endurance to extreme pressure, overexertion, etc. The difficulty of introducing quantitative criteria for the evaluation of the operator's reliability regarding all its characteristics is quite apparent. The number of mistakes made by the operator depends on his ability to cope with obstacles, i.e. on the capability to work with concentration in spite of distracting stimuli.

For several kinds of operator work, the capability of the operator to quickly and accurately go from a state of passive expectation to unforeseen actions has a great significance. It has been established that, for example, nearly 60% of the accidents on railroads occur due to a sharp decrease in the engineer's alertness. During the hours of work several periods of a sharp fall in alertness have been observed. The most dangerous of these is the last third of the duty day. On must never forget this fact.

The physiological and psychological characteristics of man enumerated above must be considered in the construction and operation of technical systems. The appropriate organization of the working area has a great significance, as does the selection of the most effective equipment for visual representation of information (UNO; Ustroystvo Naglyadnogo Otobrazheniya Informatsiyi) and the means for its optimum encoding, and, also, the selection and placement of the organs of control. The panels on which the UNO elements and organs of control are placed must be arranged so that the best conditions for readout of information and manipulation of the organs of control are provided. The working position must be comfortable and the least fatiguing. The latter is very important to operators who work in a condition of expectancy. Specialists in engineering psychology have worked out various types of consoles and work furniture with a consideration of the anthropometric characteristics of man.

The designers must make every effort to position the individual UNO elements comfortably. We know, for example, that the dials must be placed in the optimal parts of the field of vision of the operator, on the horizontal (50-60°) and vertical 30° up and 40° down) planes. Choosing the type of signal (visual, aural tactile, etc.) deserves special attention, as does establishing the signal index, and planning their structure as a whole (informational simulator).

All signals with which the operator deals can be divided into two large classes: representations and symbols. It has been proved experimentally that representation signals insure high speed and interference-free information reception, but are inferior to symbol signals in accuracy. Therefore, in choosing the type of signal, one must proceed from the specific functional responsibilities of the operator. A scientific approach is necessary in choosing the signal index. The creation of a dynamic index is, as we see it, perspective. We are speaking of those signals which could change their characteristics in connection with the logical operation of receiving and processing information.

These are some of the recommendations of engineering psychology. In science there are still many unsolved problems. But, unfortunately, this is not taken into consideration sufficiently in practice. Often annoying blunders are discovered in actual control systems. Sometimes the volume of information represented on the UNO is excessive, its surplus is great, various facilities are duplicated redundantly, etc. Many insufficiencies are found in the coding of information and in the selection of the position for the organs of control. They can be eliminated, if psychologists take an active part in working out technical facilities and if the level of psychological training of the military engineers is raised.

3

As was shown, the work of an operator demands high physiological and psychological qualities. Hence arises the problem of a professional selection of persons who have the required capabilities for a given activity.* Its successful solution in a situation of broad specialization of military operators is possible only if the selection is specialized (corresponding to a given type of activity) and if its methods are well-founded theoretically based on theory and statistical reliability of the results as well as a standardization of indices are insured. The method of selection, the tests which are used, should insure the selection of persons who not only can quickly acquire the necessary set of skills and habits, but also have definite psychological qualities, without which they could not act in complex situations without errors.

The special character of work in automation demands the perfection of operator training. We must work out new methods of developing sensory perception, memory and thinking, and specific psychological qualities; we must find rational methods of forming professionally important skills and habits. New equipment is needed for training (stands, trainers, including complex ones, etc.). In the process of training, it is advisable to use dynamic models of actual work situations, based on specialized EhVM. On the basis of machine models, there must be worked out complex training sets similar to an operator's work in actual situations. Training sets should be equipped with models of visual representation equipment, control and communications (commands and informative information is introduced through EhVM).

The effectiveness of the performance of people in a collective absolutely depends on the proper organization of their work, but this is a subject for a separate article. Here attention must be focused on two basic problems: the creation of satisfactory conditions for work and the election of optimal regime of labor, i.e., the length of the working day, the rational alternation of labor and rest, the distribution of the workload over the working hours, etc. The effectiveness of control in many ways, of course, depends on the interrelationships of the members of a collective, on the optimal interaction amoung them, both within each section and on different levels.

So we see that even a short analysis of engineering-psychological problems of control allow the drawing of conclusions concerning the necessity of developing a wide front of research work in this area.

* See Tekhnika i vooruzheniye [Equipment and Armament], No. 2, 1965.

HONORED RATIONALIZER

Reserve Colonel Ye. Arutinov

In the stormy year of 1941, when mortal danger hung over our native country, modest young Nikifor Ishchenko arrived at the artillery-technical school. In November 1942 the battalion artillery technician, Komsomol-member Nikifor Ishchenko, was in the ranks of a rifle division, which was attacking in the bend of the Don. Together with the battalion, he went along the great path of combat -- crossed the Dnepr in force, liberated Warsaw and took Berlin. During the war Ishchenko with his subordinates restored about 500 weapons of various caliber. Occasionally, artillery equipment which went out of order had to be repaired and restored utilizing anything which was on hand. Here natural resourcefulness, ingenuity and love of equipment -- the basic character traits of the young officer -- were useful.

We met Major of Technical Service N. Ishchenko in the workshop which he presently heads. Here, not only is faulty equipment restored to life, but new equipment is produced for firing ranges, artillery ranges, tank parks and training classes. Seventy percent of the workers and engineer-technical workers of the workshop are innovators. The collective is permeated with a spirit of creativeness and constant searching.

Nikifor Ivanovich speaks with pride of the successes of officer Poletayev, Master Sergeant on extended service Kulikov, Soviet Army worker Maksimov and many others, modestly saying nothing about his own innovation suggestions, which earned the high appraisal of the Okrug Command. Only in the past years Ishchenko made 18 suggestions, which found broad application.

Earlier, trolleys with moving targets traveled on rails at the shooting ranges. Many rails and ties were required for their equipment. Much time and manpower was needed to set up the railed path. Nikifor Ivanovich suggested that the rails be replaced with available rod-shaped steel. The expenditure of lumber was greatly reduced, and most important -- the road was easier to take apart and set up. Two soldiers can set it up in the course of two to four hours. Now there are such roads in all units of the Okrug.

The services of the innovator are indisputable. The Presidium of the Supreme Soviet, USSR [Ukrainskaya Sovetskaya Sotsialisticheskaya Respublik; Ukrainian Republic] was guided by just this, having awarded Nikifor Ivanovich Ishchenko the high title "Honored Rationalizer of the Ukrainian SSR."

PLANNING THE TRAINING PROCESS

Engineer-Colonel A. Ovchinnikov
Candidate of Technical Sciences

Engineer-Major V. Puginskiy

For development and application of the methods of flow charts (networks) to planning and organizing the training process, the Military Air Engineering Academy imeni Professor N. Ye. Zhukovskiy was awarded a first degree diploma from the VDNKh [Vystavka dostizheniy narodnogo Khozyaystvo; Exhibit on Achievements of the National Economy], USSR.

The authors of this article were adjudged worthy of Gold Medals from the VDNKh, USSR.

Training plans and programs usually are worked out on the basis of accumulated experience, with a follow-up on the conditions of training which have changed.

First drawing up training plans and then forming training programs according to them is characteristic of this.

Inherent in the existing method of planning the training process are the following shortcomings.

Selection of the training material which is necessary for study is not always determined by the requirements stated for the type of preparation of the specialists, but in many ways it depends on the qualification of teachers and the scientific interests of the professorial chair and even on individuals of the professor-instructor staff. The distribution of time among the training disciplines proceeds without a detailed analysis of the functions allotted to them in a system of preparation.

Formation and development of training programs proceeds, as a rule, with no consideration for its existing inter-relationships with other disciplines. As a result of the decrease in continuity in the study of related disciplines which consequently arises, training time is used insufficiently effectively.

The amount of time class auditors and cadets are to spend in independent work is not planned as it should be, which leads to the unevenness of their work load during their entire period of studying.

One may avoid the indicated shortcoming by applying methodology based on flow-chart planning.

In one of the departments of the VVIA [Voyenno-Vozdushnaya Inzhenernaya Akademiya; Military Air Engineering Academy] imeni Zhukovskiy in 1963 the training plans and programs then in effect were analyzed by the new method. On the basis of the results received, corrections were introduced into the programs for the 1964/65 school year. Shortcomings which did show up were partially avoided also when the transitional training plans were worked out in 1964. All programs for the 1965/66 school year were worked out with the help of flow-chart methods of planning and control. Also, all the professor-instructor personnel who provide the lessons in the department participated in a detailed analysis of the content of training courses. To a certain degree this permitted an improvement in continuity during the study of inter-related disciplines; an agreement on terminology and methodology for discussion of several questions; an elimination of duplication and interpretation of material without a proper theoretical basis; and also an exclusion of subjects which did not have real meaning in regard to understanding the material which followed and which did not have an effect on the development of a specialist.

The process of formulating new training plans and programs is realized in three basic stages.

The first stage is a preliminary determination of the catalog, content and scope of training disciplines and a preparation of initial data for the work of the chair.

The second is a more precise definition of the content and methodical structure of each of the disciplines and their place in the training plan.

The third, the concluding stage, is the formation and polishing of the training plan.

In the preliminary determination of the catalog, content and scope of the training disciplines, it is necessary to allow for the requirements stated for the type of preparation of a specialist and the accumulated experience of planning and to analyze objectively the level of preparation of the matriculants and the quality of the previous training plans and programs. A structural diagram of this process is shown in Figure 1.

Requirements for special technical, organizational-methodical, ideological-political and military preparation at a vuz [voyennoychebnoye zavedeniye; military educational institution] depend on the functional responsibilities of the primary duties to which, as a rule, the graduates are assigned. An analysis of these requirements allows us to determine groups of basic questions subject to study and, from the groups, to formulate typed, social and military disciplines. Special, general-engineering and general-scientific disciplines are formulated similarly. Such continuity in the preliminary determination of the catalog, content and scope of the disciplines in the training plan, with the use of the flow charts indicated below, insures the realization of all the most important requirements stated for the type of preparation of a specialist, as a whole, and also the necessary theoretical basis for the study of any discipline.

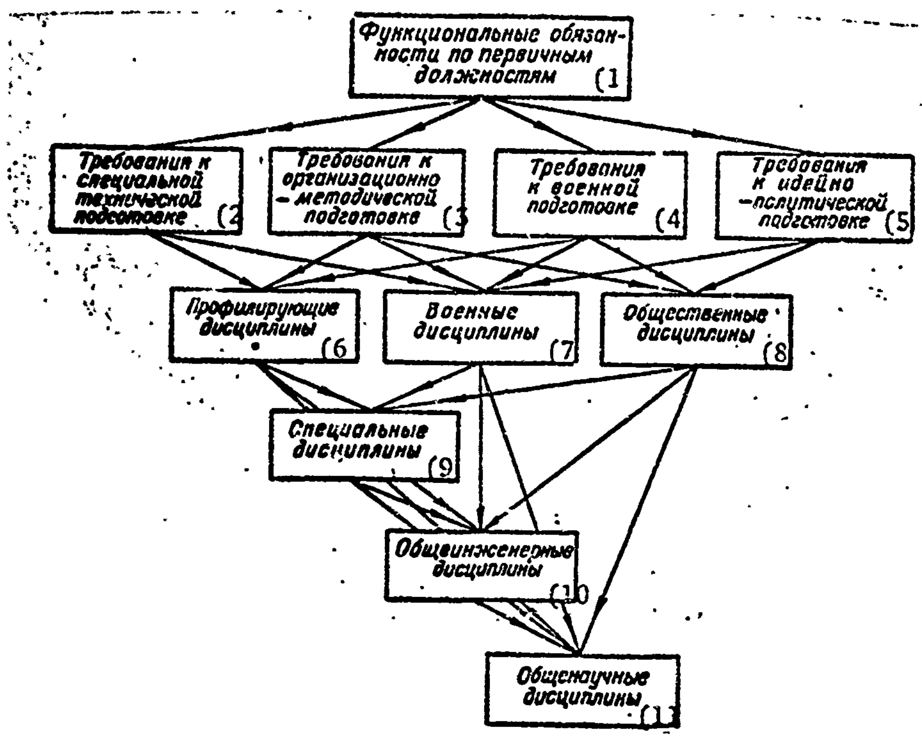


Figure 1

Structural Diagram of the Preliminary Determination of the Catalog, Content, and Scope of Disciplines in the Training Plan (associations which must be taken into account in the formulation of training courses are shown by arrows)

Wording used in Figure 1: 1 - functional responsibilities in primary duties; 2 - requirements for special technical preparation; 3 - requirements for organizational-methodical preparation; 4 - requirements for military preparation; 5 - requirements for ideological-political preparation; 6 - typed disciplines; 7 - military disciplines; 8 - social disciplines; 9 - special disciplines; 10 - general engineering disciplines; 11 - general scientific disciplines.

Then there are the general inter-relationships among courses. It is ascertained which disciplines must be made compatible in the future, both in content and in continuity of study.

The detailed polishing of the content and methodical structure of each discipline, and also the exact determination of the time to be devoted to its study is conducted with the help of the flow net (chart). The chart gives a visible conception of the continuity in the passage of discipline subjects and also their inter-relationship with the subjects of other courses (Figure 2). Disciplines which are bases for the given course are positioned higher and more to the left and those disciplines which use the material of the course under examination are lower and more to the right. The inter-related subjects of all disciplines are connected to each other by means of arrows.

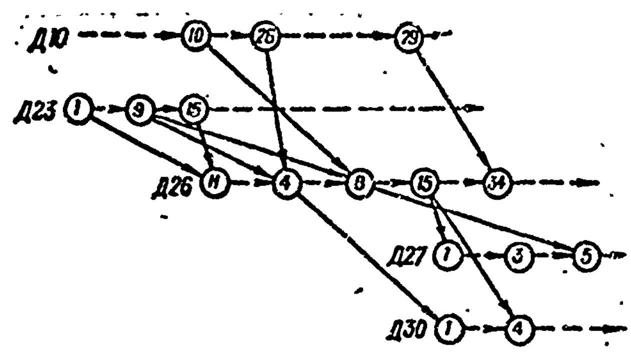


Figure 2

Flow Chart of Training Discipline D26

When formulating a flow chart of the discipline, the content of each subject is analyzed carefully and its relationships with other courses, for which, definite requirements are worked out, are revealed also.

The chart of a discipline, formulated in such a way, allows us to select the most necessary training material and to determine exactly how much time is required to study it. In addition, with the help of a chart, cases of parellelism, duplication and inclusion of questions in the program for which the necessary theoretical basis is lacking are revealed. The place of the discipline in the training plan is defined also.

Actually, lest the required flow-continuity in the study of training material be destroyed, the necessary information must be formulated earlier than it will be used in other courses. This superimposes the defined conditions on the disposition of inter-related disciplines. With a clarification of the indicated conditions, it is sufficient to consider only the extreme relationships, i.e., those, in which the subject which is the source of information (for such a subject, information is formulated) has the highest number, while the subject which serves as a channel of information (for such a subject, information formulated in another course is used) has the lowest.

So, for example, the conditions which determine the mutual disposition of disciplines D10, D23 and D26, may be written symbolically in such a way:

$$T(Д^{1}_{26}) > T(Д^{17}_{21}),$$
$$T(Д^{1}_{26}) > T(Д^{16}_{22}),$$

where T is the time reckoned from the beginning of study; D^{i}_{n} is an index conditionally designating that the given time relates to the beginning of the study of i subject of n in the catalog of the discipline. The conditions which determine the position of discipline D26 relative to the other courses are found similarly.

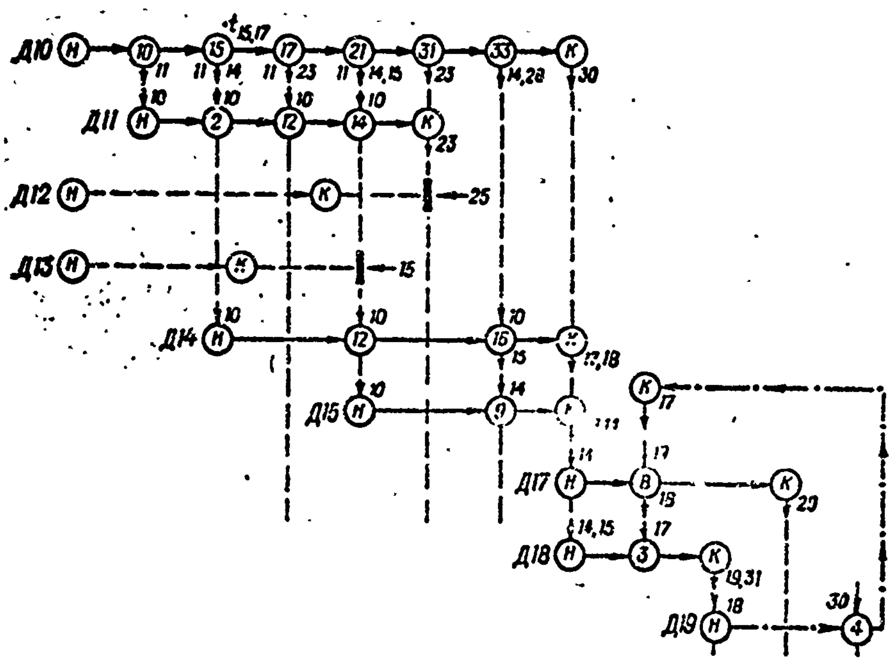


Figure 3

Flow Chart of the Training Plan

To establish the necessary logical continuity of study of all the disciplines, a flow net (chart) of the training plan is formulated. It defines the mutual disposition or the order of passage of disciplines (Figure 3). Circles designated the junctures (events), i.e., the beginning or end of this or that discipline or the beginning of a subject of the course. Junctures which relate to one and the same discipline are connected to each other by horizontal arrows according to the flow of study in the given course. Above the arrow the time devoted to the study of subjects which are contained between neighboring junctures is indicated. The inter-related junctures of different disciplines are arranged on one vertical dotted line. The source is designated by arrows proceeding down from the junctures, and the channel of information is designated by arrows which enter into the junctures. Near the arrows we fill in the number which corresponds to the number of the discipline, from the juncture (at the source) or to the juncture (at the channel) of which the information is transmitted.

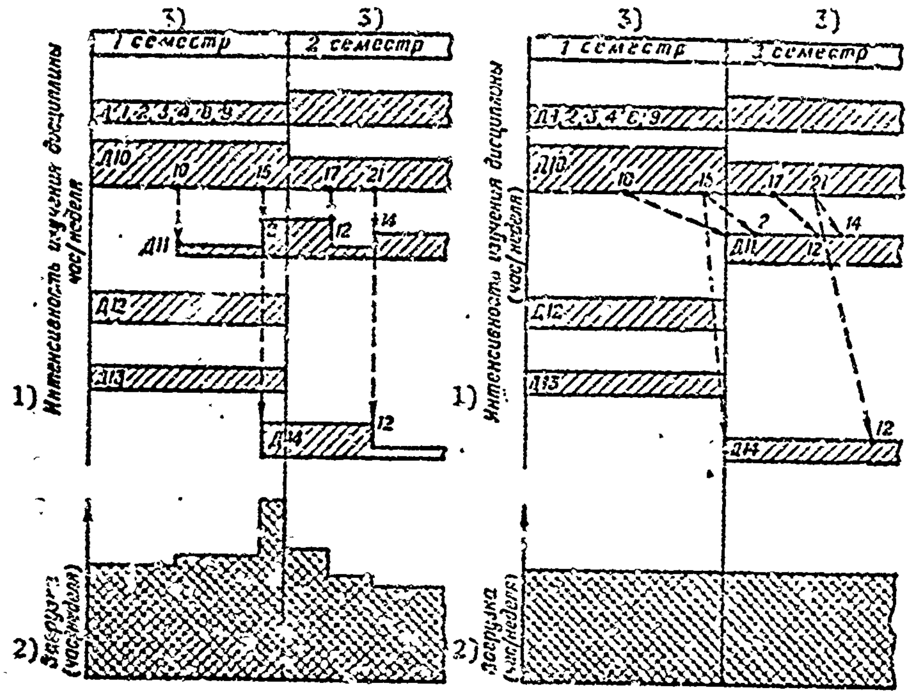
The selection of junctures is accomplished in such a way so that information for all interconnected subjects will be transmitted in a timely manner, without disrupting the required logical continuity and, as a rule, with a minimum gap between its formulation and its use. The dotted lines here will designate the limits of instant transmission of information from the junctures of some disciplines into others.

When using the flow chart, not only is a graphic depiction of the structure of the training plan achieved, but, to a significant degree, the problem of its final formulation is simplified since the number of relationships which underlie the calculations is decreased essentially. Besides that, the flow chart insures the exposure of cases of incompatibility in structure or content of separate disciplines to the flow of the training-plan structure as a whole. The conflicting situation with D19 is an example of such incompatibility. A loop has been formed in the flow chart, indicating that course D19 must end earlier than it was started.

After the content and structure of separate disciplines are corrected or their catologing is changed, the chart of the training plan is refined. Now one may proceed directly to the formulation of the plan. While completing this task, one should remember that the junctures which are only sources (arrows are positioned below the circles), may be moved to the left. Here also the information for corresponding junctures will be formulated in advance -- the gap between the formulation and the use of the information increases. However, their displacement to the right is possible only when we also transfer at the same time the junctures of the other disciplines, for which the given juncture is the source of the required information. Channels of information (arrows are positioned above the circles) allow the movement of junctures to the right -- here the gap also increases, but with a much later use of the information. When, however, one juncture is a source for some disciplines and a channel for others, then shifts are possible only under the condition that the junctures connected with it are transferred at the same time.

There are junctures in the chart which have no ties with junctures of other courses. So that this may be seen clearly, they are joined with the adjacent juncture of their discipline by a broken arrow. The free junctures allow significant shifts which are limited either by the expediency of studying a corresponding question which corresponds by a definite limit (for disciplines D12 and D13 such a situation is designated conditionally by an arrow pointed to the left; near it is indicated the number of the discipline in whose interests this is done) or by a reasonable intensity in the study of a discipline.

For the final formulation of the training plan we use linear diagrams which allow us to assess the passage of a discipline in a time frame while maintaining an acceptable intensity of study for each course and the required trainee work load per week and also insuring a continuity in the study of all the training material which was established by the graph.



a b

Figure 4

Linear Diagrams for the Construction of a Training Plan

a - before polishing
b - after polishing

Wording used in Figure 4: 1 - intensity of study for a discipline, hours per week; 2 - work load, hours per week; 3 - semester.

In the construction of linear diagrams, the time alloted to study is laid out along the horizontal axis, and the intensity of study for one or another (in hours per week) is on the vertical. One should begin construction from the disciplines which are studied in programs common to all vuz and at definite periods (for example, the social disciplines), and also from the disciplines, for which it is expedient to secure the even distribution of the intensity of study (Figure 4, a). Afterwards, the linear diagram of the basic discipline is constructed (in the example given, it is D10). Events corresponding to the limits of transmission of information are determined for it. In the given variant, it is presumed that information between the junctures is transmitted instantly. In accordance with the continuity of study for the discipline established by the chart, the required position of events for other courses is determined by the intersection of dotted lines -- of the boundaries with linear plots for the disciplines. To attain an even trainee work load and an acceptable intensity of study in individual disciplines, inter-connected junctures are shifted. Here one should strictly observe the rules for transfering junctures, which we already discussed. An example of such a polishing is depicted in Figure 4, b. Statistical material on the self-preparation of class auditors has a great meaning in the improvement of planning.

Plans represented in the form of flow charts and diagrams, thanks to their clarity, facilitate an evaluation of their quality, control of the training process and their management. Linear diagrams which contain all the necessary initial data for compilation of a lesson schedule help us to evaluate the structure of training plans in intensity and in logical continuity of study. The flow chart of a discipline affords us the possibility to work out beforehand the content of underlying questions. The inter-relationships which have become manifest to us help us to establish common terminology and designations for contiguous disciplines. Such a graph can be used by class auditors or cadets during their independent work as a unique guide, which indicates the general goal in study and suggests in a timely manner which material it is necessary to repeat.

And so, the application of the method just presented allows us to select training material rationally and to account for, at the same time, all the basic requirements for the type of preparation for a specialist. In addition, it gives us an opportunity to provide the necessary theoretical basis for the study of any discipline (in turn, this helps us to allot the time correctly among the disciplines). Control over the realization of training plans and programs is facilitated. The organization of the training process is improved.

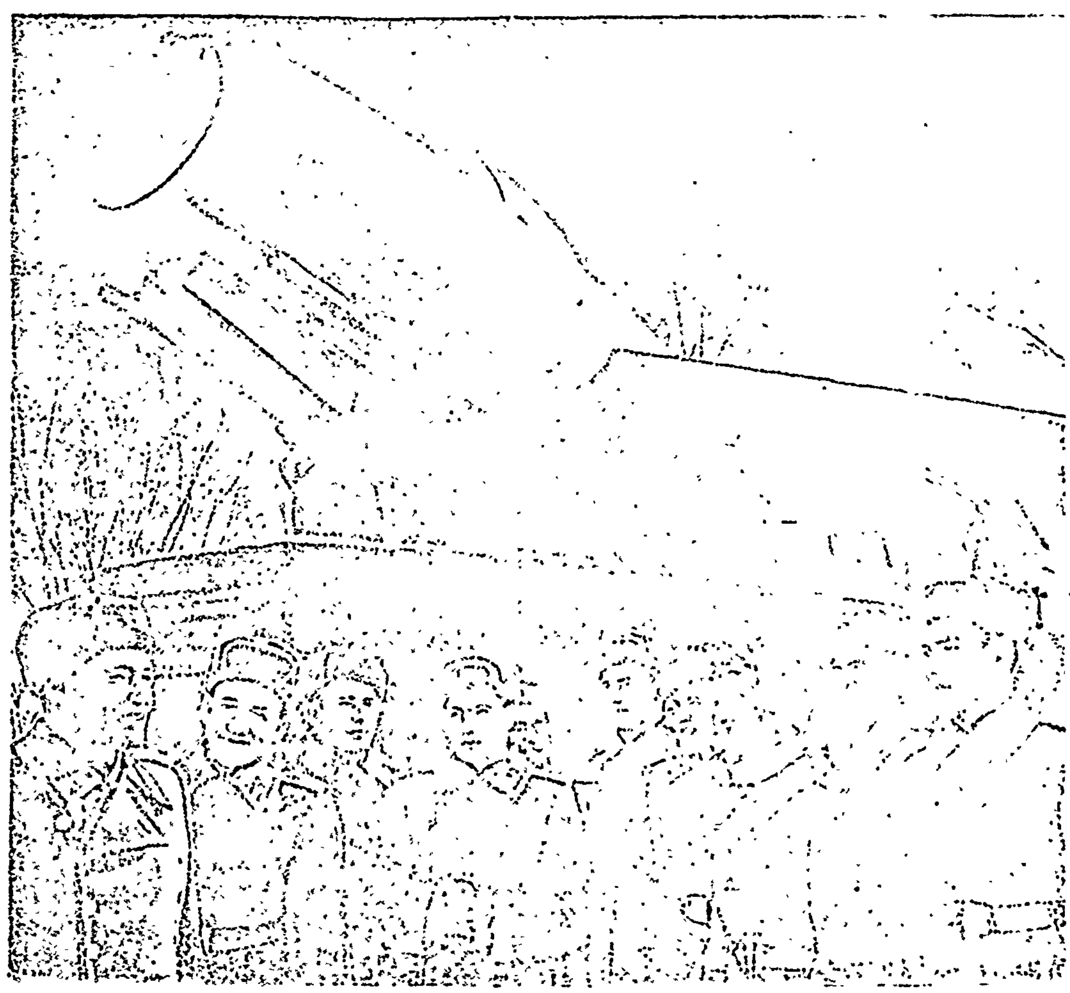
The reserve of time which comes about as a result of the application of network methods of planning and management gives us an opportunity to introduce into the programs actual training material or increase the time devoted to the study of the most important questions.

IN THE ORENBURG AVIATION SCHOOL

F. Levshina

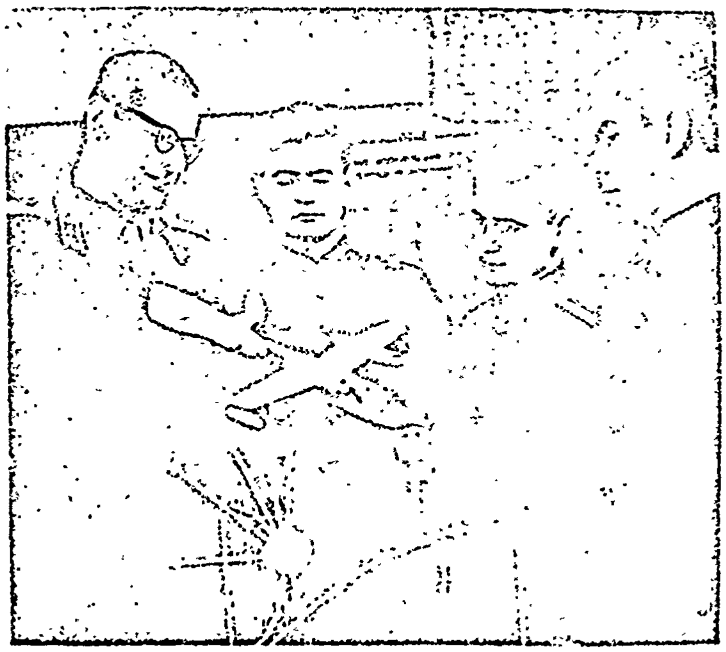
This school is one of the oldest educational institutions in the Soviet Army. It was organized in those years when our military air fleet was created, when the Lenin Komsomol, which took aviation under its wing, uttered the cry: "Youth, to the planes!"

The hundreds of students who responded to this call became the first cadets of the school. Many of the outstanding fliers who have brought glory to our Homeland grew up within its walls. Those who, in the dark years of the tribulations of war which fell to the lot of our Homeland did not spare their strength and even their lives to achieve victory over the enemy, studied here. For their heroic deeds during the war for the glory of the Homeland, 182 pupils of the Orenburg Higher Aviation School for Pilots merited the award, Hero of the Soviet Union. Among the graduates of this school we find such names as double Heroes of the Soviet Union S. Gritsevets, S. Luganskiy, I. Polbin, I. Pavlov, G. Begel'dinov, L. Beda and others.



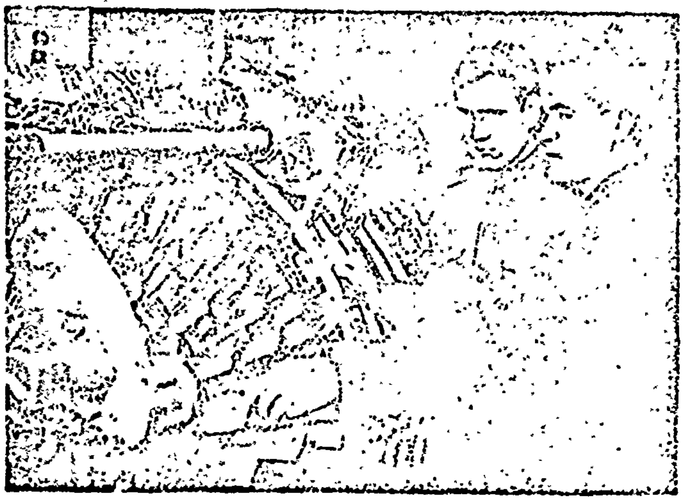
Here the first cosmonaut in the world, Yuriy Alekseyevich Gagarin received the military pilot specialty. The plane in which he flew now stands on a high base and future pilots often gather around it.

There is Engineer-Colonel B. Kouper chating with a group of students. It was under his tutelage that Yu. Gagarin studied jet engines. Following the example of their elder comrade, the young cadets study persistently to acquire proficiency in contemporary aviation technology and in these things they respond to the task of the Party and people to strengthen the Soviet Armed Forces, a task which received its greatest development in the decisions of the XXIII Congress of the CPSU.



Before sitting behind the control wheel, a pilot must study very thoroughly about everything that awaits him in the air. Only a deeply imbued knowledge of aerodynamics will allow the pilot to become master of the plane and pilot it in the right way.

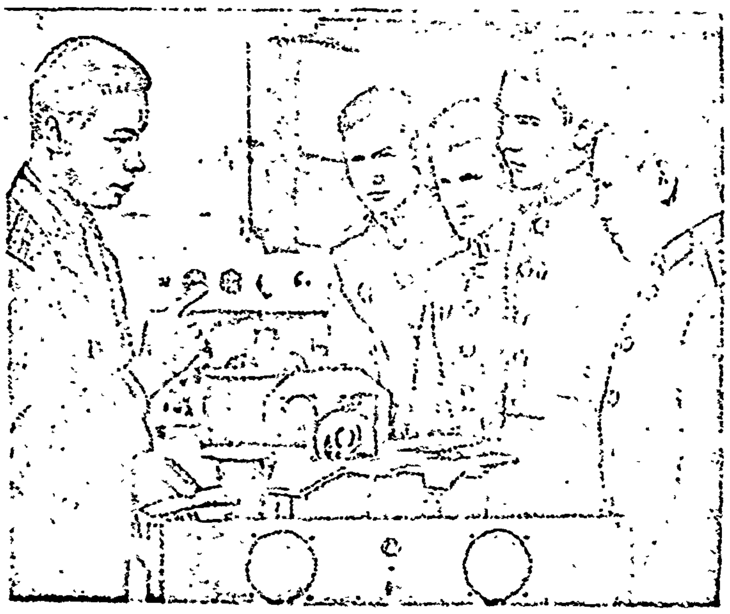
It is for that reason that so much of the attention of cadets is devoted to the study of aerodynamics. Not only during the lectures but even in those hours of self preparation more often than not side by side with the cadets will stand Engineer-Lieutenant Colonel V. Usik, instructor of aerodynamics, who has given many years of his life to the study and teaching of this discipline.



The engine is the heart of the plane. Developing great power, it lifts a multi-ton plane into the sky.

One must attend many lectures, go throught the practice of many exercises and training flights before the engine with all its assemblies and systems becomes familiar "to the smallest screw."

Of course, this is not easily done. But the cadets have an experienced instructor, Engineer-Captain L. Dudov and great assistance in training -- good visual aids.



Major V. Sorokin is a specialist in flight-navigation instruments. Under his tutelage in a laboratory especially created for the school, students master these instruments. Reliable aids for the pilot, they permit us to determine at any moment the position of the plane, to bring it right on course, to approach an airport in any weather and to make a landing. And the better the pilot knows the construction of these instruments and the peculiarities of their operation, the easier it will be for him when he is flying, the more confidently he will execute an assigned task.

One can not get into the air without having studied most thoroughly the equipment in the pilot's cabin. To correctly apportion one's attention in the air, one must train a great deal on the earth.

Already Cadet V. Oleynikov has executed many mock "take-offs" and "landings," but the pilot-instructor, Captain B. Dubrovskiy, still advises him to do these maneuvers again. Each cadet must perform his operations irreproachably. This requirement has become a law here and it relates to all kinds of cadet practical training. It is for that reason that highly-qualified officer-specialists exit from the walls of the school.

YaK MEANS YaKOVLEV

On 1 April 1966 our country observed the sixtieth birthday of General Designer Aleksandr Sergeyevich Yakovlev. During his forty years of creative activity, he created many planes of the most diverse type.

The first plane he designed was a small two seater which had a 60 horsepower engine. It first took to the air on 12 May 1927. Then he developed the training plane UT-2 and the two seater, short-range bomber BB-22(YaK-4). In 1940 the YaK-1 -- simple in design and easy to maneuver -- was tested and brought into production. In the same year he entered the field of armament. Also, the YaK-7 was put into series production. During the Great Patriotic War the collective led by Aleksandr Sergeyevich did a great deal of work which eventually resulted in the creation of the YaK-3 and the YaK-9. Their obvious superiority over enemy aircraft prompted Hitler's high command to give their fighter pilots a directive: "When encountering 'Yakovlev' fighters without air coolers and inclined antenna masts, do not engage in combat . . ." (the talk was about YaK-3 aircraft).

At that time the design bureau also conducted long-range experimentation. Already in the autumn of 1945, testing of the jet fighter YaK-15 began, and by the summer of 1946 it had already taken part in an air show at Tushino.

Under the leadership of A. S. Yakovlev, the heavy troop-landing glider YaK-14, the training planes YaK-11 and YaK-18, the giant helicopter YaK-24 and other planes were created and he places a part of his soul in each new design. Colonel-General of Technical-Engineering Service, correspondent-member of the AN USSR, twice a Hero of Socialist Labor, a deputy of the Supreme Soviet of the USSR, a laureate of State Prizes of the USSR -- Aleksandr Sergeyevich Yakovlev is full of creative strength, his reserve of new designs is inexhaustible.

TECHNICAL KNOWLEDGE OF AN OFFICER

The article by General-Major G. Mikhaylovskiy, "Technical Knowledge of an Officer," which was published in the January issue of this magazine, interested many readers. Officers of the various branches of the Armed Forces and types of troops are sending letters in which they discuss separate positions of the article, express their views on the organization and methods of technical training, share experience in mastering of new equipment and make interesting suggestions.

Closer To Practice

Engineer-Captain 3rd Rank Ye. Shcherbakov

The fate of combat equipment is, first of all, in the hands of the officer who is obligated to know all details about weapons and technical facilities and to insure their constant readiness for utilization and their high combat effectiveness. Thus speaks General-Major G. Mikhajlovskij in his article. And this is unquestionable. For the most part, whether new equipment will be quickly studied and mastered and reliable and effective in use, or if the mastering and development of its combat possibilities will be drawn out to an undeterminably long period depends on the officer-specialist -- the commander of a sub-unit.

Compare a ship built fifteen years ago with a ship recently launched. It immediately strikes the eye that equipment has become many times larger and significantly more complex; the size of a crew has decreased (the reason for this is automation). Naturally, the load on each specialist in servicing a maintaining the equipment has greatly increased. Also, it should not be forgotten that new, more complex equipment demands greater attention and more qualified control of its condition. At present a sailor must learn not one, but several models of arms and mechanisms. Of course, he cannot do this by himself in a short time. An officer who knows to perfection all of the equipment of his sub-unit and is able to operate it must help him.

Our training establishments graduate theoretically well trained specialists. But, unfortunately, they do not always have the necessary practical experience. In the training system still less attention is paid to servicing the equipment, repairing the equipment, and managing the sub-unit. Due to lack of training in the school and also careless regard of the chiefs for the work of a young officer in the first months of his service, the process of becoming a specialist on a ship sometimes stretches into several months.

We adhere to the opinion that a commander must clarify first of all the level of practical preparedness of the young officer and organize his training by the methods of individual assignments, conversations on chapters studied and planned lessons. In this period it is very important to develope his curiosity, and to gain his participation in all work which is carried out by his subordinates. For example, and engineer-mechanic must learn to measure bearings, cylinders, pistons and rings; to adjust them; to regulate the mixture distribution of the engines and the safety devices. Acquired experience is necessary for him in practical work.

In the first weeks an officer must learn to service all mechanisms of the sub-unit entrusted to him and, as we know, there are many of these. The engineer-mechanic is also obligated to master emergency devices: the motor pump, the electric fire pump, the magazine sprinkler and flooding systems, the diesel-generator and other mechanisms which insure the survival of the ship. This is vitally necessary for him. In battle, in an emergency situation, the officer not only commands. Faced with a fire or with water leaking into the compartment, he must start and engage the diesel-generator, supply power for the electric fire pump, connect it, create pressure in the fire hose and direct water to the location of the fire or to the water ejector pump. Otherwise, his knowledge of thermodynamics or theoreticaly electronics is not worth a farthing.

Academician A. N. Krylov said that knowledge is needed, first of all, for theory, but in practice, on top of this, ability is needed. We, engineer-mechanics of ships and ship command units, constantly recall this wise thought to those graduates of school, who excellently orient themselves in antimirs and mu-mesons, but do not know that one must not look for an 18-mm monkey wrench in a work bench, for, there is no such wrench.

The ability to operate mechanisms, to service and repair them, not only raises the technical preparation of the officer-specialist but also brings him closer to his subordinates, allows him to gain the experience necessary to use a basic principle of learning -- demonstration.

The officer who, in practice, is familiar with the responsibilities of a subordinate knows the possible periods for completion of one or another instruction given in battle or under way. This allows him to soberly evaluate the situation, teaches him to make sound decisions, raises his subordinates' confidence in the faultlessness of the chief's knowledge and the infallibility of his decisions.

Constant personal contact draws the officer close to his subordinates, gives their relations the correct tone and promotes a deep and comprehensive mastery of equipment. The officer who was embarassed in his first days of service to once more descend into the machine section and, together with the master sergeants and sailors, solve a technical problem which was not clear to him, in time loses faith in his powers. Thus begins the neglect in his special training.

The people say, "It is not shameful not to know -- it is shameful not to ask." The master sergeant or sailor does not judge the young officer if he asks assistance to learn even uncomplicated equipment, but he does not excuse the officer's insufficiencies in knowledge when he becomes an "old-timer" on the ship.

The fleet officer must be versatilely trained. But to what degree; how often do they demand this from him? Many training plans, which are compiled with a broad scope and sometimes with an intentional bias for a particular professionalism or with additions of "style," meet with surprise. The compilers of such plans apparently over-insure themselves.

For example, such an extent of knowledge is demanded from the watch officer, that he can acquire it in a least one year of uninterrupted study, if he is freed from other service responsibilities. But many of the sections of the documents to be studied do not concern the fulfillment of duties of the watch officer on the bridge. They only distract from the study of problems which he himself is required to solve. Under way or in battle the commander makes all of the most important decisions. Only in cases which will not tolerate a delay, and their total is not sc great, and only when the commander is absent from the bridge are these decisions made by the watch officer. It should not be forgotten that the watch officer is not the ship commander and not his senior assistant. His scope of responsibilities is considerably narrower. His training must be formed in accordance with this.

Do not let the reader formulate the opinion that the author of this article is against an officer having a broad military-technical outlook and varied sea knowledge. An officer is obligated to perfect his knowledge and experience constantly. We only seek that the extent of obligatory training at each stage is reasonably limited and, first of all, on questions of theory.

As a rule, young officers begin their ship service in the fall or or winter when many ships are in for repair, or have suspended navigation due to .ther conditions. During this time the possiblities for training on fucctioning equipment are limited. In such cases we use the base of the training sub-units or one of the ships with functioning equipment.

Experience shows that command habits are effectively developed during exercises at command posts. Here the officer not only developes commands but also learns to use his knowledge correctly. The supervisor easily notices and analyzes mistakes committed during the exercises. With us, for example, the participants in an exercise occupy places at their command posts, battle stations, where they intend to send data, to post watchmen who fix the time and content of instructions received and, according to secret data received earlier, report the data to the command posts (the officers report their decisions to the ship's main command post). The commander of the ship, who usually supervises the exercise, analyzes the actions of each participant according to the contents of all reports and notes received and conducts a detailed critique. Similar exercises are useful not only for the young officer. This is an effective method for elementary development of clear-cut cooperation of command posts and battle stations.

The service activity of a young officer and the demands presented to him were discussed previously. It is necessary to say that even his chief is no less charged. He must spend much time in preparation for lessons (selection of material for assignments, control of the quality of training) and in conducting them. Shamefully little time for technical training remains for him personally. Here, a control-instruction device which has proved itself outstanding on seperate topics and types of training may help. In our command unit, a class for mass training was established. For the time being we confine ourselves to automated control of the knowledge of officers. With the assistance of only one trainer it is possible in about one hour to test the knowledge of ten persons on ten to fifteen questions. With ten such trainers (we have twenty of them) it is possible to conduct a controlled examination of a group of 30 persons in 30 minutes. Programs are compiled earlier and may be used any number of times. Such control substantially saves the time of the one being taught and, especially, the supervisor.

I would like to express my opinion also c ncerning the extent of training for officers in nuclear physics. The author of the article "Technical Knowledge of an Officer," is absolutely right. Actually, is it worth-while to adhere to a mass of measures repeated from year to year even if these most dull seminars are on the theoretical bases of nuclear physics and the structure of dosimetric instruments, which the ship officer will never have to repair. It is not better (not decreasing the importance of theoretical bases) to use the training time for solution of assignments on the evaluation of a radiation situation and on training in the use of instruments. This is within the scope of an officer's responsibilities; this he must actually be aware of and know.

We have been discussing many methods here for training officers and have shared some pros and cons. But sharing opinions is not the only goal. Many articles appear on the pages of this journal with reasonable (or debatable) suggestions. It is a pity only that the readers frequently do not know the opinions of the Central Administration for Problems Under Consideration. As far as we understand, the Central Administrations must collect and correlate the grains of collective experience. Their appearances in the press, their recommendations and conclusions during discussions of one or another problem are needed. If the administration does n t give, as they say, the last word, then how can the question of expediency of adopting a suggested innovation in combat training be decided?

We, for example, think that it is necessary to differentiate strictly between volume and content of technical training for officers of various elements. Apparently, well developed tactical thinking and broad and many-sided military-technical knowledge is demanded from officers who have sufficient experience and occupy sufficiently high posts. Concerning officers of a lowery category, then, their attention must be concentrated on deep, specialized training. They should not be aimless, but they should concentrate their efforss mainly on the work upon which the combat readiness and reliability of the equipment of their sub-unit depends. In the plans and programs for training it is desirable to reduce to a minimum the study of problems not connected with the execution of a given specialist's direct duties.

We Are For Specialization

Captain K. Balats

The timeliness and importance of the problems raised in the article by General-Major G. Mikhaylovskiy should not be doubted. At present the troops are saturated with complicated combat equipment. It is practically impossible to supervise them without a profound technical knowledge. Because of this, the technical training of officers has paramount importance. Officers increase their knowledge independently and in the system of commanders' training, concerning the organization of which we would like to make some comments.

First of all, concerning the development according to plan and the concreteness of commanders' studies. In technical training, no matter where it is conducted, sometimes lessons are formed without considering the material studied earlier. With such an organization of studying, there may be no talk of the accumulation of knowledge. Fragmentary knowledge, acquired by the officers in the course of lessons, but not strengthened by practical experience, is quickly lost. In such an arrangement of studies not only those who planned the technical training but also those who examined the knowledge were guilty. Occasionally, complicated questions were given which were difficult for even the examiner to answer. Because of this, we tried to include as much varied material as possible in the plan for commanders' training now adopted is, absolutely, a notable step forward.

Technical training, in our view, must be specific and must help the officer to carry out his official duties. Because of this, the basic time spent on it must be planned for deepening the knowledge of equipment in his sub-unit, unit and in his type of troops. Studies should be differentiated as much as possible, depending on the duty and specialty of the officer. This is caused by the fact that not so much time is usually spent for planned commanders' training, but each commander tries to master, first of all, the problems, the solution of which would permit him to raise the combat readiness of the sub-unit entrusted to him.

At present the authority of the commander in many ways depends on the level of his technical training. For example, officers Ye. Shimanskiy and A. Lazarev make use of the deserved respect of their subordinates. They persistently increase their technical knowledge, know the equipment of the sub-unit well and skillfully organize work. Ye. Shimanskiy became a Specialist 1st Class last year. The sub-unit commanded by A. Lazarev repeatedly exceeded the established norms. It is the foremost in the unit. The commander himself is recommended for promotion.

Unfortunately, not all officers, especially the young ones, admit the necessity to persistently increase technical knowledge. We think that they will endeavor to study equipment if the knowledge obtained will help them to do their work better and if the knowledge and practical experience will be mutually benefitial.

A few words concerning the propagation of military-technical knowledge. Occasionally there is no purpose in it; generally, it is conducted without consideration of the sub-unit or unit. For some reason the opinion has been established that propagation of military-technical knowledge must be pursued only among soldiers and sergeant on a first enlistment. This is not true. Military-technical knowledge is needed first of all for the officers. Military-technical propagation must without fail supplement lessons in technical training. The headquarters, where the most erudite and experienced officers who posses broad knowledge on one or another question serve, can be of great help. It is difficult to overrate also the role of the group of lecturers in the units. Unfortunately, they least of all participate in the propagation of military-technical knowledge among our officers.

The methods of technical training must be perfected at all times. Here, it is difficult to do without a generalization of the rich experience of methodologists in other units. In this respect, the Military-Engineering Red-Banner Academy imeni V. V. Kuybyshev could accomplish much. There is no doubt that in the Academy there are methodical developments which would be useful also for the troops.

Thus, we are for concreteness in technical training, for its specialization.

THE PRIZE IS TIME

Engineer-Lieutenant Colonel A. Minkin

With the help of a new transporter, the cutter BMK-130 (with this apparatus it has the index BMK-130M) may be launched 10-30 times faster, regardless of soil condition or depth of the river. It consists of a truss, two supports (legs), and an attachment for launching (a pushing frame).

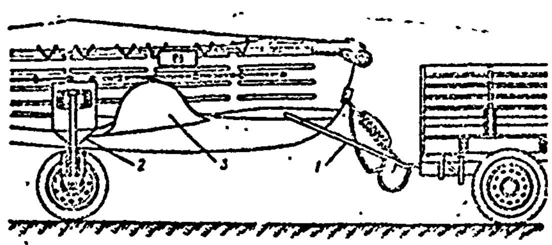
The welded tubular truss "1" (see drawing) serves to connect the cutter to the automobile. A special brace with the automobile shock absorber avoids striking and swaying of the cutter during towing along poor roads. The rib is connected with lugs to a pipe welded to the bow of the cutter. Thanks to the semi-circular grooves, the clamp fingers are always free which insures rapid disconnecting of the truss.

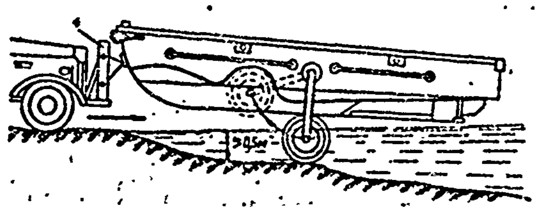
Each leg "2" of the transporter is a telescoping tubular construction consisting of a lower and upper block and a unit for connecting them to the side of the transporter. The lower block is basically the same as that of the cutter BMK-130; the upper block is much different from the upper block of the cutter BMK-130. It is simplified -- its pipe is somewhat extended. Besides this, it has a number of new parts.

The construction is strengthened, and provides for storing of the legs in the parrallel surface of the cutter's longitudinal axis.

The attachment for launching "4" is placed on the automobile's front bumper. Before launching the cutter, the fingers of the side catches are removed and one wedge each from the units connecting the suspension supports with the sides. The automobile moves the stern of the cutter to the edge of the water. The truss disconnects from the automobile, then from the cutter. The retaining cables are attached to the lower blocks of the suspension. This time the automobile starts up and the winch pulls the cutter to the frame, located on the bumper of the car. The automobile pushes the cutter into the water, until its depth is .5 m at the wheels. Then the wedges fastening the supports to the side are removed and the car continues its movement. The support rotates, situating itself paralled to the sides, the wheels go into the housings "3" and the cutter sits on the water. With the help of small winches, the wheels are drawn up to the upper facing of the housings and the trailer supports are fixed in this position. Such a positioning lowers the speed of free movement of the cutter about 3 km/hr, but it does not affect the speed of towing by ferry. If extended use of the cuttor is foreseen, the legs are disconnected, which increases the speed of free movement.

Before lifting the cutter from the water (when its depth is not less than 1.5m) the legs are lowered and fixed with wedges. The cutter advances to the shore under full speed. The cable of the automobile winch is attached to the eye located on the bow of the cutter. With the winch they tow the cutter to the shore, attach the transporter truss to it, and fix the side catches and wedges. The cutter is ready for transport on land. The entire operation takes a few minutes. In military conditions, the cutter BMK-130 may be equipped with a new transporter. The lower block of the support remains without change; the upper block is lengthened and then parts of a new transporter are welded to it. The manufacturing plant sends the units and parts necessary for this. It is necessary to submit an order in the established procedure to receive them. The cutter BMK-150M is equipped with a similiar device with several construction peculiarities. Its running qualities are the same as those of cutter BMK-130M.





IMPROVE THE ART OF RADIO MEASUREMENT

Engineer-Major N. Putintsev

Engineer-Lieutenant Colonel A. Kuznetsov

Engineer-Captain Yu. Osipov

Any deviation of parameters from established values becomes the cause of reduction in tactical-technical data from radiotechnical facilities. It pays, for example, for the power drop of radar sets to be decreased by several decibels in all, as the range of its action is notably reduced. Upon further lowering of this parameter by several decibels the set becomes inactive, since the range of its action is significantly reduced. Measuring devices are the basic means of parameter control of radiotechnical facilities. This is why unabated attention should be paid to questions of radio measurement and to the skillful use of measuring devices.

Special and built-in instruments in general use are employed for measurement of a large number of electrical characteristics of radiotechnical facilities. Because of these good technical characteristics, it is possible to measure any parameters. However, in practice these potentials are not always used: methods of measurement and instruments are incorrectly selected and inaccurate instruments are used. As a result, the parameters of radiotechnical facilities are incorrectly evaluated and, consequently, the tactical-technical data of combat equipment are lessened.

There was a case when a heterodyne wavemeter Ch4-1 (VG-526U), which had a measurement error equal to the permissible limits of frequency measurement of exciters, was used for tuning the exciter of a radiotransmitter. It could not provide the necessary accuracy of measurement. This was ascertained while conducting a control measurement with a more accurate instrument: the deflection of the frequency exceeded the norm more than two times, as a result of which the reliability of radio communications was reduced.

Here is another example. During the tuning of a receiver system of a radar set the regulation for using instrument GK4-3 (RT-10) was not observed. The error lay in the fact that, in calculating the measured value of receiver sensitivity, corrections for the output power of the instrument's generator were not taken into consideration. The range of action of the set was reduced significantly.

And here is another example. The navigation equipment on board an aircraft which was approaching an airfield was not receiving the signals of the long range radio station. It turned out that the radio set's frequency had been set with a Ch4-1, the accuracy of readings of which had not been checked in two years. It was established in the laboratory that the error of measurement exceeded the permitted values and, therefore, the radioset's frequency was incorrectly set.

To obtain the most reliable results from measurement of the parameters of radiotechnical facilities, it is necessary to observe a number of basic rules. First of all it is necessary to become familiar with the nature of future measurements and permissible deviations of the measured values, and then to select the equipment and methods which provide the required accuracy. The most responsible task is to correctly select the measuring device. In practice it has been accepted that the error ratio of the measured value and of the measuring instrument be no less than 1 : 3. The instrument must have the necessary measurement limits.

When assembling the measurement diagram, the resistance of the electrical circuit, the parameters of which are to be measured, must correspond to the input or output resistance of the instrument. Otherwise additional errors can arise. To match the resistance in ultra-high frequency circuits, attenuators, directional couplers, phase shifters and various transistors are used. On the correct choice of these elements largely depends the accuracy of measurements and the convenience of using the measuring instrument. The quality of the match of resistances can be checked with measurement lines or with measurements of full resistances, having included them in the schematic previously.

Before proceeding with measurements, it is necessary to ascertain through a form or a certificate that the instrument has been checked for accuracy of readings by checking devices. Otherwise, the reliability of the values obtained will be in doubt. The instruments are placed so that their scales are well illuminated and located in positions which exclude parallax.

Before switching on the instruments, the magnitude of power supply voltage is usually checked, a change of which above the allowed value leads to an increase in measurement errors. In the process of measuring, it is necessary to strive to reduce errors. As is known, they are divided into systematic, accidental and crude (blunder) errors. Systematic errors can be eliminated if corrections for readings, expressed in the form of graphs or tables attached to the instruments, are taken into consideration. Accidental errors, as systematic ones, are impossible to eliminate from the results of measurements, since the nature of their origination and the laws of correction are not known. However, conducting a series of measurements of this or that magnitude, might find a value close to the true one. No less than three measurements are taken, and their average arithmetic value is accepted as the result of the measurement.

The magnitude of crude (blunder) errors is, as a rule, greater than the magnitude of systematic and accidental ones. Therefore, blunders are especially dangerous in single measurements. The greater the number of repeated measurements, the easier it is to uncover a blunder. Reasons for their appearance are errors in observation, an unnoticed defect in the measuring device, a sharp change in the conditions of measurement. The result of a measurement which contains a blunder is discounted.

It is not recommended that observations which have been started be interrupted in the course of measurements, especially when the exclusion of systematic errors depend upon them. If doubts arise as to the correctness of the observations obtained, then the measurements should be repeated several times.

Engineer-Major N. Putintsev

The stability of the frequency of oscillations generated by the exciter of a transmitter and the first heterodyne of the receiver of an R-407 radio set should be such that contact is accomplished without a search for the correspondent and without manual tuning of the radio set. Frequency drift beyond allowable norms, caused by inaccurate installation or by an error in calibration of the transmitter and receiver, lead to a loss of communication. Therefore this parameter is periodically checked by means of a specialized quartz calibrator and an auxilliary radio receiver. Such a method of checking the receiver is insufficiently accurate, since an error in tuning its discriminator is included in the results of the measurement.

Great accuracy of measurements may be obtained if a more perfect method is applied -- checking the error of calibration and the frequency setting of the transmitter and receiver of the R-407 with the heterodyne frequency meter type Ch4-9. It is designed for operation in mobile workshops (on station), at repair bases, depots, in laboratories and factory workshops. At air temperatures near 25° Centigrade and a relative humidity up to 90% the instrument permits frequency measurement with an error no greater than $\pm 5 \cdot 10^{-6}$. It is powered by an alternating current system of 220 volts.

The method of measurement of error with this instrument is simple. The transmitter, installed in "duplex" mode and loaded on an antenna equivalent, is warmed up for 15 minutes. The antenna equivalent -- two resistors joined in parallel, e.g., type OMLT, 150 ohms each, each no less than .5 volt -- is hooked up to a clamp on the frame and to the set's antenna insulator by short cables. To provide the best electrical contact between the transmitter and the frequency meter to which its rod antenna is hooked, the R-407 is installed at a distance of 40 centimeters from the frequency meter so that their face panels are on the same level. Corrections are made on the set's calibrator before measuring the frequency of the transmitter.

The error Δfp is checked on any fixed frequencies, which are equally distant from each other. For this purpose, the true frequency of the transmitter fp is measured with the frequency meter. This is equal to twice the reading of the frequency meter's scale. From the value obtained, the nominal value of a given fixed frequency fn is computed.

The nominal frequency of the transmitter is determined according to the formula:

$$f_{n(kzu)} = f_{n_0} + \Delta f N,$$

where N -- the number of the fixed frequency;
f_{n_0} -- the true transmitter frequency, which corresponds in kilocycles to the zero fixed frequency;
Δf -- the dispersal of the fixed frequencies in kilocycles.

The magnitude of Δfp at any fixed frequency of the transmitter when the temperature of the surrounding air is 25, plus or minus 5° Centigrade, should not exceed the permissible norm. Otherwise the radio set must be sent for capital repair.

An error in the graduation and setting of the receiver's frequency is measured in the following manner. To the antenna insulator of the radio set and to the input/output socket of the Ch4-9 frequency meter are hooked their rod antennas. The set is located at a distance of 20 to 40 centimeters from the frequency meter. The set is shifted to the mode "stand-by reception-simplex" and is warmed up for 15 minutes. Afterward the receiver's frequency is first corrected on the set's calibrator, and then on the frequency meter with the APCh switched off the true frequency of the receiver's first heterodyne fig is determined. From the value obtained, the nominal value fng is calculated. It is determined by the formula:

$$f_{ng} = f_{ng_0} + \Delta f N,$$

where fng_0 -- the nominal frequency of the first heterodyne on the zero fixed frequency, in kilocycles.

The magnitude of frequency error of the receiver's heterodyne when the temperature of the surrounding air is 25 plus or minus 5° Centigrade on any fixed frequency should not exceed the permissible norm. The speed of checking the sets' frequency error can be increased if the fixed frequencies are selected in advance, the nominal frequencies and scale readings of the heterodyne frequency meter are calculated for them by the formulas (they are equal to the nominal frequency divided by two), and are placed together in a table, the form of which we introduce below.

Fixed Frequency	Nominal Frequency			
	Transmitter	Frequency Meter	Receiver Heterodyne	Frequency Meter

The frequency deviation of transmitters and receivers at any fixed frequency should not exceed the value established from the nominal frequency of the Ch4-9 shown in the table. This will correspond to the permissible error of frequency of the R-407.

Engineer-Lieutenant Colonel A. Kuznetsov

Modern means of communication are characterized by great frequency stability, frequency drift is in units of cycles. This parameter can be controlled by two methods: by test frequencies transmitted by the radio sets or with the aid of Ch1-5 device. However, sample frequencies are emitted according to a definite schedule and the quality of their reception depends on many factors. The Ch1-5 is large. It needs regular checking every 15 days and is powered from a stabilized circuit. Therefore, if the communications facilities are spread over a comparatively large area, it is impossible to use this instrument.

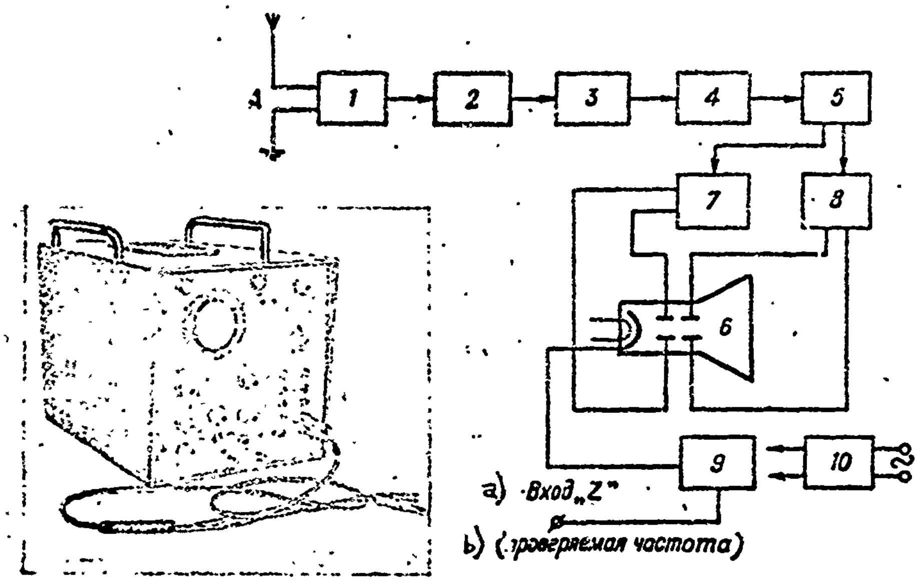


Figure 1

External View and Block Diagram of an Instrument
For Checking Frequencies of Modern Communications Facilities

1, 2 and 3 - frequency amplifiers feht = 100 kcs.;
4 - cathode follower;
5 - phase-shifting circuit;
6 - electron beam tube;
7, 8 and 9 - amplifiers x, y and z;
10 - rectifier.

Wording used in Figure 1: a - Input "Z"; b - Frequency being checked.

So that it is possible to regularly check the frequency stability of the quartz generators, we use a portable instrument which is simple in design and convienient to operate and which can be powered from unstabilized power sources (Figure 1). It is placed in a casing 200 x 200 x 300 millimeters in size and made from duraluminum three millimeters in thickness. Its surface is covered with hammered enamel. The basic units of the instrument are separated by a screen.

The principle of its operation is based upon the use of a test frequency of 100 kilocycles, transmitted by radio 24 hours a day. The stability of the test frequency is high -- $1 \cdot 10^{-9}$. This frequency is in a band where, as a rule, there is no strong interference from operating stations.

The instrument consists of a receiver of direct amplification tuned to a frequency of 100 kilocycles, an oscilloscope and a rectifier. In the receiver there are three cascades of amplifiers and a cathode follower. The amplifiers are assembled according to the diagram of a resonance amplifier with constant excitation. The cathode follower plays the role of a buffering cascade. The layout of the oscillograph device is the same as an ordinary oscillograph. There are three amplifiers in it. The first, "x," is designed to amplify the signals which act on the vertical beam-deflection grid, the second, "y." is to amplify the signals acting on the horizontal beam-deflection grid, and the third, "z," is for amplification of the signals which modulate the beam of the electon-beam tube for brilliance. Besides that, the phase shifting circuits are in this device. All of the circuits of the instrument are powered from the rectifier.

The 100 kilocycles signal received by the antenna is amplified by the receiver and through the phase shifting circuits is fed simultaneously to the vertical and horizontal inputs of the oscillograph device. The phase shifting circuits are selected so that a circle is obtained on the screen of the electron-beam tube.

The frequency being checked from the quartz generator of the receiver or from the excitor of the transmitter is fed through amplifier "z" to the cathode of the electron-beam tube for modulation of the beam in brilliance. If this frequency is a multiple of the standard (or equal to 100 kilocycles), then on the screen of the electron beam tube is formed a circle of dotted lines, the number of which equal the multiple factor of the frequencies. Upon conformance of the frequency being checked to its nominal value, the dotted lines remain fixed (in one period of standard oscillations is contained the entire number of periods of the oscillations being checked). When the frequency does not conform to the nominal value, the dotted circles revolve around the center of the screen of the tube on one side or the other. The speed of revolution of the dotted lines depends upon the magnitude of frequency drift and the direction depends on its sign.

An opportunity to check the frequencies according to Lissajous figures also is provided in the instrument. In this case a standard signal is fed, for example, to the vertical plate of the oscillograph device, and the one being checked is fed to the horizontal plate. On the screen of the tube appears one of Lissajous' figures, which corresponds to the multiple factor of the frequencies. The absolute error of a frequency is determined also according to the speed of rotation of the figures.

The instrument is installed in a special measurements point, a radio workshop or in any other place. Any antenna on hand is used as an antenna, or a temporarily tightened inclined beam 15-20 meters in length.

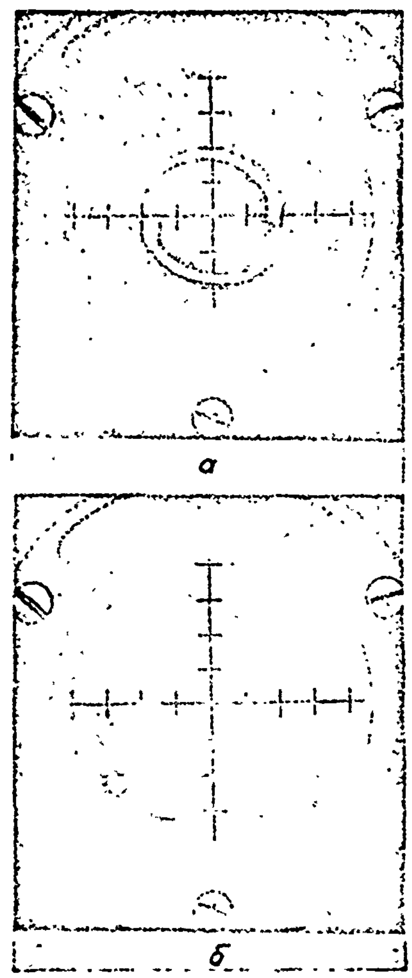


Figure 2

Image on an Oscillograph Screen

a - revolving points
b - dotted circle

Let us examine how to properly check, for example, the quartz generator at a frequency of 200 kilocycles, which is in a receiver of a distinct spectrum of frequencies. A signal of 200 kilocycles from a buffering cascade of a generator is fed by a cable to input "z" of the instrument. Since the multiple factor of the frequency being checked equals 2, then on the screen of the oscillograph there will appear two dotted lines (Figure 2). If the frequency of 200 kilocycles corresponds to the nominal value, then these dotted lines will not move. In the event of frequency drift, they will revolve. The amount of frequency drift is determined by the speed of rotation. If the dotted lines make 24 revolutions during 60 seconds, then the quantitative departure is:

$$\Delta f = \frac{24}{60} = 0{,}4\ гц.$$

In relative units, this error ($2 \cdot 10^{-6}$) corresponds to the technical conditions for quartz generators of receivers of a distinct spectrum of frequencies. If the error is larger than the norm, then the "correction" lever can be used to adjust the quartz generator and bring its frequency to the norm, which will be indicated by the minimal speed of rotation of the dotted lines.

The quartz generators of other radio devices are checked similarly, as are frequency meters-calibrators. In checking, for example, the frequency meter-calibrator Ch1-5, a frequency (1 megacycle) of a basic quartz generator is fed to input "z." On the screen appears a figure shown in Figure 2, b.

Servicing the instrument is simple. It is somewhat complicated when a set is operating on a frequency near 100 kilocycles, hampering reception of the standard signal.

Engineer-Captain Yu. Osipov

SEEK AND INCULCATE

Engineer-Lieutenant Colonel A. Lipin

Candidate of Chemical Sciences

Engineer N. Golovkina

Engineer N. Matveyeva

Anticorrosive Protection and Maintenance of Military Equipment

The natural oxide film which forms on the surface of metals under the influence of atmospheric oxygen, while serving as an inhibitor, is not a reliable defense against corrosion. Artificial phosphate films and also zinc and cadmium coatings significantly improve the anticorrosive durability of metals. These coatings called anodes, are notable in that, if for some reason the zinc film is damaged, then the coating and not the metal will begin to decompose (Figure 1), since in the formed galvanic couple, zinc is the anode and iron the cathode. The former, while in the process of decomposing, will for a period of time protect the article.

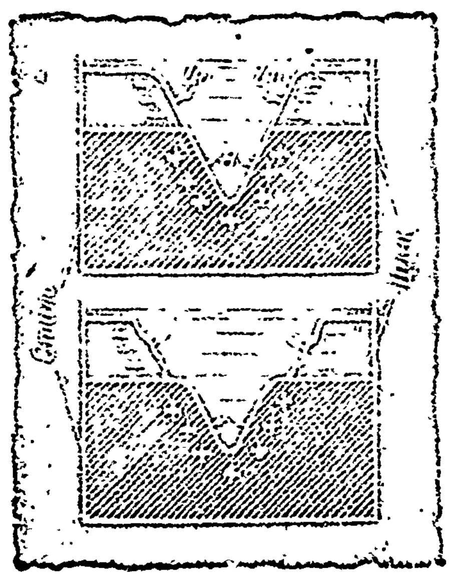


Figure 1

Anode Coating Operation

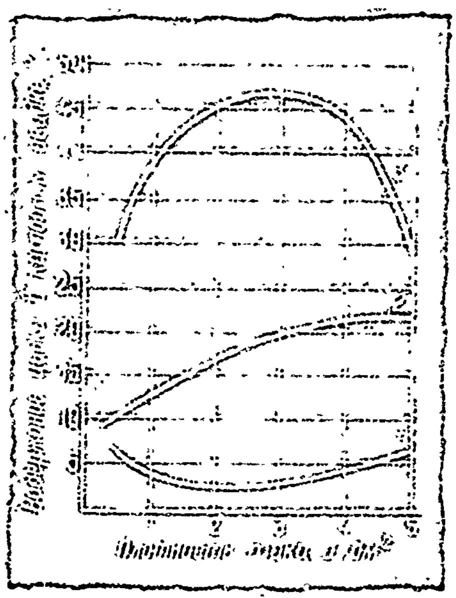
Wording used in Figure 1: a - steel; b - zinc.

Zinc-plated and cadmium-plated components, which during operation are exposed to the atmosphere, are to a considerable degree subject to corrosion and wear and tear. Thus on components having a cadmium coating, the depth of the corrosion can attain .5 milimeters. A similar picture is observed on oxidized components of arms. Depending upon the atmosphere in which the operation takes place, the speed of corrosion of zinc is .4 - 4 microns per year. Thus, a coating of maximum thickness (18-20 microns) develops more or less only after a period of 4-5 years. But the thickness of the layer usually does not exceed 8-10 microns, because the details are already beginning to decompose after two years of operation. Moreover, the mechanical durability of steel components is lowered during the process of anti-corrosive treatment.

The electrolytic plating of alloys provides a more effective protection fo steel components from corrosion and at the same time does not affect the mechanical durability of the basic material. The fact of the matter is that alloys of zinc with cadmium and zinc and cadmium with tin and other metals, have a high corrosion durability to the degree that the layers of such alloys have slight porosity, great plasticity and a thin crystalline structure.

During the plating of cadmium-zinc coatings, the best results will be obtained by an electrolyte which contains in one liter, 14 grams of zinc sulfate, 12 grams of cadmia sulfate, 55 grams of potassium hydroxide and 55 grams of Trilon A (nitrilotriacetic acid).

a)



(b

Figure 2

Graph of Proportions of Zinc and Cadmium Salts When Coating the Cathode

Wording used in Figure 2: a - percentage of zinc in the cathode deposit; b - current strength a/dm^2.

GRAPHIC NOT REPRODUCIBLE

The concentration of cadmium and zinc salts and also the current strength, significantly influence the quality of the coating (Figure 2). From the graph, it is evident that if there is an equal proportion of salts, an electrolytic alloy containing 30-45% zinc (curve 3), will be obtained. When the current strength is 2-3 a/dm^2, there will be 45% zinc in the deposit. When the concentration of zinc salt in the solution is lowered two and even three times (curves 1 and 2), the amount of zinc in the cathode deposit decreases sharphly.

It was established that the electrolyte for the deposit of cadmium alloy would be zinc, which according to its dispersibility, does not yield to cyanide of cadmium. Such a quality is especially important when coating components having complicated configuations.

The process of electrolytic plating of an alloy in a solution with Trilon A, occurs with a comparatively high current efficiency. Thus, the current efficiency reaches 98% -- this is very close to theoretical -- when the cathode current strength is 0.5 a/dm^2, the temperature of the solution is 50 C, and the pH value equals 12. As a result of increasing the cathode current strength and decreasing the importance of the pH and temperatures, the current efficiency fell substantially. For example, during 4 a/dm^2, pH=7 and a solution temperature of 30°C, it was 68% overall.

The stability of an electrolyte for a prolonged period of time is also an important property. It was established that after transmitting current (80 a-h/l) through the solution, there were no essential changes either in the structure of the electrolyte or in the contents of the coating (percentage wise). This permits one to draw the conclusion that, as regards current, the output of alloy by the anode is commensurate with that of the cathode.

The electrolytic properties of cadmium and zinc alloys, such as porosity, micro-hardness, cohesion with steel and the structure of deposits, were studied. It was noted that even when the thickness of the deposit was 3 microns, the alloy was non-porous. The micro-hardness was 30-40 kilograms per square millimeter and did not depend upon the current strength or temperature. The cadmium-zinc coating very firmly adhered to the steel even following the usual surface scouring. The pickling process (cleansing), after scouring, results in greater adhesion of the coating to the steel.

In the electrolytic process, under optimal conditions, deposits having a fine crystalline structure are formed. Increasing the current strength affects the structure positively, whereas the temperature does not noticeably influence the structure.

For a tin-zinc alloy, a pyro-phosphoric electrolyte was found to be the most stable, containing in one liter, nine grams of tin sulphate, eight grams of zinc sulphate, 190 grams of ammonium nitrite and one gram of citrate of ammonium. Still, even better results were achieved when the sulphate salts were replaced by chloride salts of tin. High-grade coatings, containing nearly 25% of zinc, were obtained when the current strength was 0.5 to 1 a/dm^2 and the temperature was 60°C. Under these conditions, the current efficiency was 50-75%.

Processes by Name	Structure of the solution and the Concentration of Components, g/1	Conditions of the Process	
		Temp. C°	Processing Time in Minutes
Two-cycle oxide coating with phosphate filling	a) caustic soda-500-600; nitrite of sodium-30-50; nitrate of sodium-30-50.	133-140	20
	b) caustic soda-750-850;	145-155	40
	c) carbonate of soda-3; manganese ferric phosphate preparation-30; nitrate of zinc-150	50-60	15
"Black" Parkerizing	a) phosporic acid (specific gravity 1.6) -50; carbon steel shaving-5; zinc oxide-8 carbonate of soda-1	92-97	10
	b) manganese ferric phosphate preparation-30; zinc nitrate-150; carbonate of soda-3.	50-60	15
Zinc phosphate Parkerizing	a) monophosphate of zinc-308-370 g; zinc nitrate-550-560 g; phosphoric acid (specific gravity 1.6)-140-150g; water-490-500g. b) solution A-9L; water-91L	92-98	15
Parkerizing by the Czech method	a) nitric acid (specific gravity 1.4)-200; phosphoric acid (specific gravity 1.6)-390; metallic zinc-130-170 b) solution A-1L water-10L	95	10
Parkerizing	monophosphate of zinc-40; hypophosphate of calcium-5	80	25
Oxide Parkerizing	monophosphate of zinc-10; barium nitrate-40; zinc nitrate-20	95	15
Oxide Parkerizing	zinc nitrate-4; barium nitrate-75; phosphoric acid (specific weight 1.6)-6.8; manganese peroxide-2.	95	25

A tin-cadmium alloy was obtained using alkali-cyanogen and trilon-pyrophosphoric electrolytes. Of these, the best was found to be the trilon-pyrophosphoric electrolyte which in one liter contained 12-45 grams of cadmium sulphate, 15 grams of tin chloride, 60 grams of pyrophosphate of sodium, 25-85 grams of trilon A, 10 grams of phenol and 5-8 milliliters of triethanolamine. The electrolysis is conducted at a temperature of 40-60°C, with a current strength of from .5 to 3.0 a/dm^2 and a pH = . The cathode deposit contains from 5-25% cadmium, the sharp lowering of current efficiency (from 96 to 53%) and an increase in current strength are characteristic peculiarities of this electrolyte. Moreover, it has a high throwing power, just as a fine crystalline structure which attracts deposits is explained by a high polarization which accompanies the process. The corrosive durability of the alloys which are obtained is compared with the passive zinc and cadmium coating. A cadmium-zinc coating, containing 18-20% zinc, showed the best results.

The mechanical durability of structural steel components was lowered significantly after applying coatings. Thus, if cadmium plating lowers the fatigue limit of steel 30XGSA by 8% and zinc plating by 20%, then a cadmium-zinc alloy (18% zinc) will lower it only by 5% and a tin-cadmium alloy by 6%.

The durability of steels 12XNZA, 38XA and 40XNMA, is lowered approximately to the same degree. It is interesting that the application of alloys does not influence the limit of durability of metal or its relative stretching or impact strength.

The work conducted by us showed that the electrolytic alloy of cadmium-zinc could be used as protection against the corrosion of steel components which produces fatigue (curve with rotation, static and multiple-static curves).

The most corrosion resistant oxides, phosphates and phosphate oxides are obtained by processing the steel components in solutions, the composition and operating conditions of which are set forth in the table.

However, the porosity of such coatings shows negatively in their protective properties. Therefore, parkerized or oxide-coated components are immersed in special solutions where the film pores are filled with metal. For example, we processed samples of 30XGSA steel in a solution consisting of 8-10 g/l of cadmium sulfate, 1-3 g/l of sodium cyanide and 10-15 g/l of sodium hydroxide. Initially, the cadmium sulfate was dissolved in a small amount of water and was then followed by the sodium hydroxide. The solution obtained was brought to a boil and then allowed to cool to room temperature. At this point, the sodium cyanide, having already been dissolved in water, was added to the solution. As a result of this treatment, a light grey compact cadmium coating formed on the surface of the parkerized steel sample. This development was more pronounced with increased temperatures. The protective properties of the phosphate film are raised significantly following the application of a .5 micron thick layer of cadmium. This process lasts 10-15 minutes in a solution heated 25-30°C.

Comparative corrosion tests showed that phosphate films, supplemented by cadmium, are several times more reliable than the more common phosphate coatings (Figure 3). Moreover, the mechanical strength of metal is lowered considerably less than that which occurs during the usual Parkerizing method.

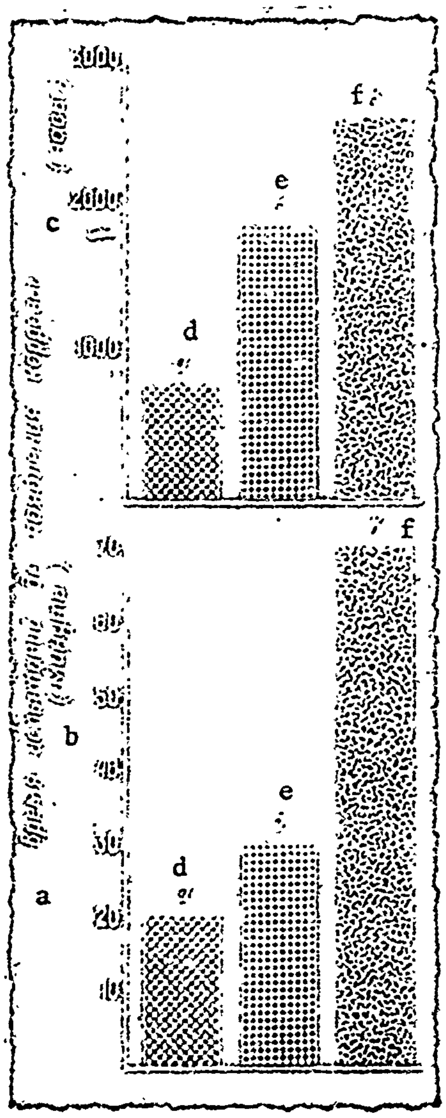


Figure 3

Diagram of Metal Tests

Wording used in Figure 3: a - duration of tests until the appearance of corrosion; b - minutes; c - hours; d - no coating; e - parkerizing (process); f - parkerizing, followed by cadmium plating.

ANODE COATINGS -- coatings which have a more negative electro-chemical potential, when compared with the basic metal, e.g., iron coated with zinc or cadmium.

HYDROGEN ION (H^+) -- hydrogen atom deprived of its only electron and, it follows, arrying one elementary positive charge which is equal to $1.6 \cdot 10^{-19}$ coulombs.

HYDROGEN INDEX (pH) -- decimal logarithm of the concentration of hydrogen ions (H^+), or rather, their activity taken with a reverse mark: $pH = -\lg(H^+)$.

ELECTROLYTIC METALLURGY -- the process of metal sedimentation on the surface of metalic and non-metalic articles, by means of electrolysis.

CATHODE COATINGS -- coatings which have, when compared with the basic metal, a more positive electro-chemical potential, e.g., steel covered with copper or tin.

MANGANESE FERRIC PHOSPHATE -- a preparation used in the USSR for Parkerizing. Its approximate composition: 46-52% P_2O_5, 14% Mn, up to 3% Fe, 22% moisture, and the remainder made up mainly of insoluble materials.

ELECTROLYSIS -- a chemical process which occurs when electric current passes through an electrolyte.

ELECTROLYTES -- chemical compounds and systems in which the transfer of electricity is carried out by a movement of positive and negative ions.

INSTEAD OF SODIUM HYDROXIDE

Engineer A. Rusina

For a long time, parts being repaired have been washed in a hot solution of sodium hydroxide, and later given a water rinse. However, even repeated rinsings have not fully succeeded in ridding the metal surface of aggressive alkalis which penetrate through the metal pores and cause corrosion. We employed another washing solution -- Emulsifier OP-7, which not only more effectively cleans ferrous and non-ferrous metal parts in one bath, but also prevents corrosion through the formation of a microfilm on the surface of the parts. The technological process was simplified -- it was no longer necessary to rinse the components in hot water. Expenses for chemical materials were reduced and the cost for cleaning was lowered six to seven times. The washing solution which we employed is harmless to humans and equipment, which can not be said about the water solution of sodium hydroxide.

Emulsifier OP-7 is a greasy, light-brown liquid which is obtained after processing high molecular monodiakilphenols and ethylene oxide. One kilogram of this synthetic material costs 33 kopecks and is used in small dosages. If .15-.3% Emulsifier OP-7 is added to a 1.5-2% water solution of soda ash, then it is possible, using the new solution during a period of 12-15 minutes (at a temperature of 75-80°C.), to clean the components using the usual portable washing machines. In order to remove excessive froth, sodium silicate (three to four grams per liter) should be added to the solution. For rinsing parts being repaired, pulp waste products produced at soap and chemical factories as a by-product of washing powder production can be employed. Three to four grams of a thick mass of "pulp" should be added to one liter of 1.5-2% solution of soda ash.

LEARN TO PROTECT THE EQUIPMENT

Engineer-Major A. Uvarov

The chemical industry, in order to protect machines and instruments, has produced a number of anti-corrosion oils and greases and also special paints. Practice indicates that oil NG-203V* has a high degree of protection effectiveness. We are employing this oil to protect specialized machines such as the ARS-12, AGV-3, BU-4, ADM-48 and the DDA-53.

We are covering the unpainted outer surfaces of special machines with PVK grease, which is gun grease supplemented by a 1% addition of MNI-7 (oxidized ceresin). The addition significantly raises its anti-corrosive, lubricating and adhesive qualities. Using this grease, we protect not only the unpainted surfaces of the special machines, but also the metal parts of rubber-metal hoses, instruments and decontamination and deactivation assemblies.

We are also widely employing AV-11 oil -- a AU mineral oil, supplemented by a 10% addition of MNI-5 (oxidized petrolatum). It protects against corrosion for several years. This oil proved very effective in protecting pumps, reducers and filter ventilation systems.

Dosimetric instruments are usually protected by a commercial vaseline, although such protection occurs only when absolute temperature and steady air moisture conditions are maintained in the warehouse. The troops are not always able to guarantee such conditions in the warehouse. Therefore, to preserve expensive instruments, we are now using the lubricating grease SKhK (agricultural). It has better protective properties than commercial vaseline.

We are widely using paints to protect instruments, assemblies and other articles. True, their effect is quickly lost due to the sun's rays, humidity and sharp changes in temperature.

Having briefly examined anti-corrosion greases used for protecting machines and appliances, we will now review some peculiarities of preparing to protect equipment and how it is carried out.

Before beginning protective measures, all malfunctions noted during inspection are eliminated, special equipment is completely assembled and faulty parts, instruments and equipment are either repaired or replaced. Thereafter, the deputy commander of the technical unit makes out a flow card for each type of machine. This card will list the

---

* Tekhnika i vooruzheniye [Equipment and Armament], No. 2, 1966

various types of work to be conducted on the machines and the order in which the work is to be conducted. Further, it will show the amount of materials needed to complete the work and the amount of time expended in completing each operation. The existence of flow cards and the study of them by personnel assists in carrying out high-quality maintenance of equipment. As experience shows, in small units where the work is well thought out and organized, maintenance of equipment takes place rapidly. For example, in a small unit commanded by Officer Kudinov, flow cards were made up for each type of machine before maintenance was begun. Thereafter, the brigade was assembled and all members spent some time studying the maintenance methods.

The brigade was split into two groups. The automobile specialists worked in one and the chemists in the other. Each group services one type of machine. This allows the personnel to become specialized and to fulfill all work in a highly skilled manner.

If machines, thanks to the application of special paints and oils, can be stored in open areas for a prolonged period of time, then the rubber articles which are a part of these machines will quickly break down. Therefore, rubber-fabric and rubber-metal hoses are stored disassembled on shelves in special spaces. Upon the expiration of a given period of time, the rubber-metal hoses must undergo hydraulic tests (once every two years), during which they must withstand pressure up to 10 Atm for ten minutes.

Gas masks and skin-protecting equipment, if they are to be stored for a prolonged period in the usual type of factory packaging and under overhangs, must also be protected. This is done usually in summer when the temperature of the surrounding air is no lower than 15° Centigrade and the relative humidity no higher than 65%. During the winter, gas masks and skin-protecting equipment must undergo a test in a special space at a specified temperature for 24 hours.

Before protective measures are taken, gas masks and skin-protecting equipment are carefully examined. Areas lacking paint are cleaned with emery paper, scoured with benzine B-70 and then covered with enamel. Bags are dried out and rubber articles are rubbed with talcum. Thereafter, using 200 micron thick polyethylene films, special packing covers are prepared.

The film can be fused using an electric soldering iron or a gas welding torch (alcohol lamp). This is the most suitable secondary method because personnel can master it more rapidly, it produces less scrap materials, and the welded seams are more durable.

The built up edge of the unit is pressed between two metal straightedges (plates) so that the film does not exceed three millimeters. Then, at a speed of 25-30 centimeters per minute, the flame of the gas welding torch or the alcohol lamp should follow along the straightedge and fuse the film. Finally, the cover should be fused after the article has been placed inside.

Gas-mask boxes, prepared for a prolonged period of storage, are sealed with rubber stoppers. The necks of bottles are sealed using caps with rubber gaskets. Shavings are placed in the bottom of the case (humidity not to exceed 20%) and lightproof paper is placed on the top and sides. The edges of the sheet should overlap one another. The covering made of polyethylene film is placed in the case and a sheet of inhibiting paper is inserted within the covering. Each box is wrapped in paper or packed in a cardboard container. The gas-mask carriers are placed between the rows of boxes. Connecting tubes are then placed in two rows on the wrapping paper. The metal parts of these tubes are covered with inhibiting paper. Each row of tubes is separated from the next by wrapping paper. On top of everything, the face-pieces are placed in such a manner as to preclude the eye-bands or valve boxes from touching one another. The valve boxes are covered and the eye-bands wrapped in inhibiting paper. The facial parts and the connecting tubes have zinc-plated components and so it is not recommended that they be wrapped in inhibiting paper. A sheet of wrapping paper should be placed over the face-pieces. A control list, showing the date on which preservation was carried out, is placed within the covering. The entire item is covered with lightproof paper and the case is closed.

In such a manner, gas-masks and skin-protecting equipment made of rubberized fabric and rubber, are packed. The use of inhibiting paper is not recommended for the preservation of skin-protecting equipment.

Protected articles can be stored under sheds for four to five years without loss of operating qualities.

During preservation work, particularly when working with inhibiting paper, gloves should be worn. Further, after the work has been completed and before consuming any food, the hands and face should be washed carefully with soap and water. All scrap paper should be burned. It is categorically forbidden to wrap food products and personal items in inhibiting paper.

Dosimetric devices are best stored in heated areas where the air temperature fluctuates between 5-30° Centigrade and the relative humidity does not exceed 80%. In the absence of these conditions, the devices should be stored in coverings or in moisture-absorbing cases. Cracks in the cases should be sealed shut with strips of polyethylene film and smeared with thick gun grease. Such a method is effective only under specific temperature conditions. If the temperature is more than 30° Centigrade, it is best to use a sticky layer of polyethylene tape. This tape should first be cooled to zero degrees Centigrade for three hours, before being glued to the case, the temperature of which should be higher than zero degrees Centigrade. In the absence of film, the packing cases can be hermetically sealed with a special putty (2.5 parts of gun grease, 1 part of rosin and 5% of natural wax). It should be applied along the perimiter of the case in a layer two to three millimeters thick in such a way that, when the lid is closed, the putty will not pulverize. Surplus putty can be removed from the outside of the case with old rags.

If there is a sufficient quantity of polyethylene film, a covering can be made out of it and the devices placed inside. It is recommended that the air be pumped out of the covering. The film will then cling closely to the case and the device, and the probability of its being damaged will be lessened. The air is removed from the covering using the pump from a PKhR instrument, having first opened the indicator tube at both ends. This is done as follows. When welding the covering, in which the instruments have been placed, leave a small opening of three to five millimeters through which the air can be pumped out. Thereafter, the opening should be welded.

During preservation of dosimetric devices, a granulated silica gel can be used as a moisture absorbent. It should be dried first to a constant weight. Then packaged in cotton bags with 200-400 grams per bag. The exact weight should be indicated on each bag so that the moisture content can be determined at a later date.

The color of the indicator paper inside the covering will disclose the relative humidity of the air. It will be dark green in color if the relative humidity of the air is less than 50-55%, and rose-colored if the humidity is higher.

CORROSION OF METALS

This year, "Science" publishing house plans to issue several works on protecting metals from corrosion.

The book, Radiatsionnaya Korroziya (Radiation Corrosion) by A. Byalobzheskiy, will be the first monograph in world literature to describe the influence of radioactive emissions in corrosion and electrochemical processes. Its author will examine such questions as the influence of radiation on the kinetics of corrosion and electrochemical processes, the influence of radiation in the corrosion of various metals in electrolytes, in the atmosphere, in halcid-organic systems, and the corrosion durability of metals which have been subjected to exposure under various conditions.

Having read the collection Ingibitory Korroziyi Metallov v Tekhnologicheskikh Sredakh (Metal Corrosion Inhibitors in the Technological Environment), the reader will have acquainted himself with the results of experimental and theoretical studies on the question of using inhibitors to protect metals against corrosion. He further knows how the tests were conducted with inhibitors and also how new alloys are assisting in the struggle against corrosion.

Korroziya i Zashchita Konstruktsionnykh Splavov (Corrosion and the Protection of Structural Alloys) is still anothe collection. This collection provides information on the theory of corrosive and electrochemical behavior of a number of metals and alloys under various conditions, the materials for studying the hydrogenation of titanium, the structural corrosion of alloys, the study of the corrosive and electrochemical behavior of vanadium and rhenium and the oxidizing of aluminum alloys.

In the book, Nauchnyye Osnovy Protivokorrozionnoy Zashchity (Scientific Principles of Anti-Corrosion Protection) by I. Rozenfel'd, questions on the theory of contact, slit and pitting corrosion of alloys and also rational methods for constructing chemical apparatuses, devices and metalic constructions which provide high corrosion resistance will be examined.

IN A COLUMN BY DAY AND BY NIGHT

Guards General-Lieutenant of Tank Forces B. Likhachev

Guards Lieutenant-Colonel M. Yelesin

A prolonged march conducted under given technical conditions allows young drivers to acquire firm experience in driving vehicles in column formation on roads or in areas devoid of roads at increased speeds and under difficult weather conditions. In the course of the march, the drivers will pass through sectors contaminated by radioactive and toxic substances; they will carry out partial decontamination of equipment and sanitary treatment of the personnel. In the field, soldiers will acquire experience by inspecting, servicing and carrying out simple repairs to the vehicles. As we will see, the problems resolved during the march are not simple ones, and they require serious preliminary work on the part of all personnel. Therefore, we are conducting daily work-study groups: officers supervise the study of young drivers for two days and sergeants for five days. We are systematically conducting exercises with young drivers where great emphasis is being given to studying traffic rules. We are conducting special exercises, for example, in maintaining distance between vehicles and are using the "pedestrian as an automobile" method, on a stage marked by flags. Later we will practice on terrain, both during the day and at night.

Experience confirms that, following these exercises, drivers confidently drive their vehicles in a column, maintaining the prescribed distance. We attach great importance to this facet of driving vehicles, since accidents are often caused by violations in distance keeping.

We began the tradition of conducting technical conferences for young drivers prior to their going out on field exercises. Veteran soldiers participate in these conferences. The conferences are developed along instructive as well as interesting lines, as, for example, the sub-unit in which officer Burlaka is the chief of the motor maintenance service. The senior commander will give an introductory speech on the problems and peculiarities of the march. Thereafter, experienced soldier-drivers and automobile inspection workers will discuss how to prevent automobile accidents. The young drivers will ask questions, and the details of the forthcoming march will be explained to them. They will have a socialist responsibility to execute the march in an organized manner without accidents. The conference usually ends with the showing of a film from our amateur film studio on the carrying out of a long march.

Immediately before the march, a board of experts will conduct examinations on traffic rules and practical driving. Only those drivers who have successfully passed these examinations and have completed all the driving exercises will be permitted to undertake the march.

The route is selected in such a manner so that one half will traverse field roads and areas in which there are no roads, and the other half will be on hard surface roads through cities and populated areas. The speed of movement along various sections of the route will be given and measures to insure safety of movement will be outlined. Sectors of the route containing railroad crossings, downward slopes, hills and main highway intersections, will be carefully studied.

In addition to the commander and his deputies, all the chiefs of the services will participate in planning and preparing for the march. In this manner, the soldiers and equipment will be thoroughly prepared, and all that is required will be made ready for the march. Special attention will be given to controlling the columns. For example, owing to good communications, a Chief of Staff will always know where a subunit is located along the march and thus will be able to issue instructions to it at any time.

For best orientation when moving in a column, each vehicle should be given a serial number, in chalk, on the doors and on the rear panel. Unfortunately, this is not done in all cases, although its need is beyond question. When changing to various modes of blackout, we have commands (signals), which, in a word, should be carried out in a unified manner and should be included in the table of light signals used for controlling a column.

The drivers will acquire practical experience in servicing their vehicles during control inspections which occur during minor stops and during daily servicing which takes place at times of major halts. Inspections and servicings are conducted as prescribed and in the sequence of work to be completed as provided by special charts. All drivers, without exception, are obliged to follow these charts.

Sectors contaminated by radioactive or toxic substances should be negotiated using individual equipment for chemical protection. Drivers should put these items on upon signal from their commanders at a distance of 300-200 meters from the contaminated area. At the same time, all cabin glass, louvres and ventilating hatches should be closed. The vehicles should be driven at increased speeds and at a greater distance apart than usual. The drivers should remove their chemical protection equipment after partial decontamination has been completed. This is done with the aid of individual treatment kits, ADK kits and emergency facilities. If there are insufficient individual kits, canisters with water and rags can be used.

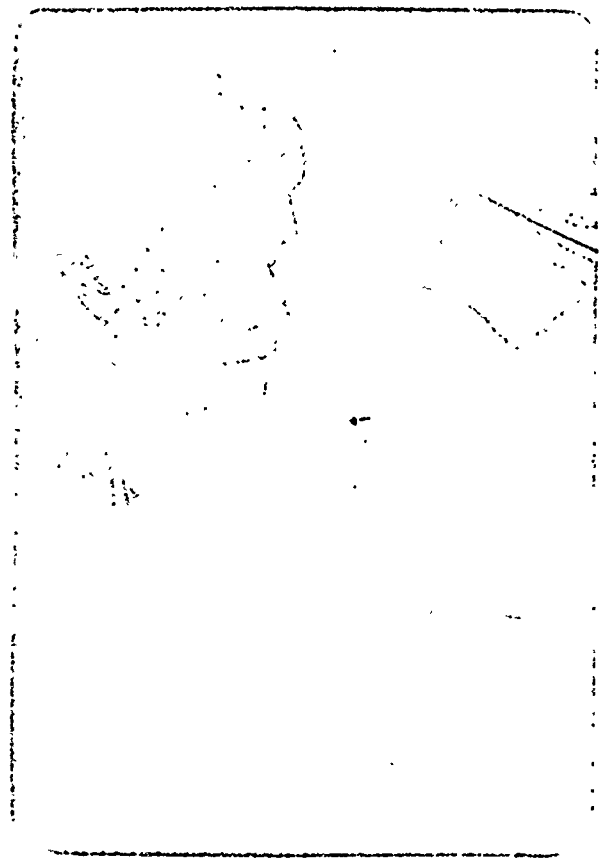
Driving the vehicles at night is a difficult job. Therefore it is necessary to ensure that drivers acquire experience in driving vehicles under conditions of poor visibility and to do everything possible to prevent automobile accidents. It is not necessary for young drivers to resort to partial or full darkening of headlights on roads where there is intensive movement. The same is true as concerns country roads where opposite traffic may be light but where the road is more intricate than highway. One should not forget that a single automobile, lacking proper light-concealing equipment, can cause an entire column to be revealed. Thus it follows that during the course of the march special attention must be given to discipline of lighting. It is not always easy to do this.

It is necessary also to remember that at dawn the drivers are more tired than at night. To combat fatigue, the drivers should lower the glass in the cabins. The commander of the column should make frequent stops to allow the drivers to exercise.

At times on the march, the need for instructing drivers and repairmen to determine and remove damages to the vehicles is forgotten. Under the conditions of modern combat, when time is limited, it is especially important to be able to do this. The technical closing-up of the column is organized in each sub-unit. To preclude a damaged vehicle from lagging behind the column, all damages must be removed within 15 minutes. During this time it is possible only to determine the cause of the defect and to issue the necessary parts. If it is necessary to leave a repairman to carry out the repairs, then he should be told where and when to rejoin the column. Sometimes, the volume of work is so great that it becomes advisable to repair the vehicle using the facilities of the unit or even the command unit. In this case, there are two possibilities; either the vehicle can be evacuated into the region of the major halt (two days) where repairs can be effected, or to abandon it along the way. In the latter case, the place where the vehicle is to be abandoned will be located on a map for further reporting to the senior commander and appropriate instructions are given to the driver (what to do, whom to wait for, etc.)

A prolonged march is a very responsible stage in the development of young military drivers. For this reason, it is important to improve its organization, to strive for good march training and to strictly observe march discipline and traffic safety rules so as to avoid automobile accidents.

In view of the fact that this is not the first time that an article has appeared in the press concerning the experience gained from a long distance march, we propose that the time has come to generalize this experience and to publish a special textbook.



During combat firing of anti-aircraft missles, the apparatus prepared by Senior Lieutenant N. Pyatishin, functioned excellently, and a successful firing under difficult conditions was ensured.

Photograph by V. Kunyayev

DO YOU KNOW WHAT AN ARMORED CARRIER IS?

1. At the turn, the driver of a multi-axle armored carrier, having disengaged the clutch, wished to engage the transmission and simultaneously turn the steering lever to the left. The vehicle, however, did not obey the driver. Why?

2. Why is it that brake liquids BSK and ESK can be used only in regions with moderate climates?

3. The armored carrier is floating. There are no cracks or leaks in the hull. The Kingston (drain valve) is closed; the reverse valve for water exhaust is working. Why then is water still entering the machine?

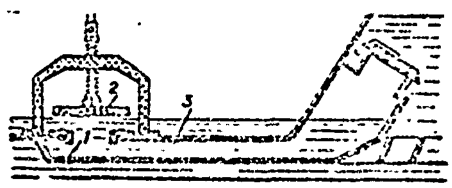
Answers

1. Upon disengaging the clutch, the hydraulic pump of the steering control booster closes, since it leads from the gear block of the intermediate transmission shaft. As is known, with a decrease in revolutions of the pump shaft, the force generated by the power cylinder decreases, and when there are fewer revolutions, the wheels of the vehicle turn generally only because of the strength of the driver's hands. If the pump is shut off completely, the driver in many instances is not able to turn the steering wheel. If the driver is inexperienced, quite often the thought arises that this condition is caused by a defect or breakdown of the steering control. Such a grave road situation can have serious results. During normal shifting of the transmission, the booster is almost never disengaged. This is explained by the inertia of the revolving mass, and the driver does not experience any difficulty in steering the vehicle. This case nevertheless confirms the need for careful and detailed study of the vehicles.

2. If BSK and ESK brake fluids are used in regions of high temperatures, vapor locks (boiling temperature of BSK fluid 75-78° Centigrade and of ESK 105-108° Centigrade) may form in the brake system. Because of this, a failure could occur in brake operation, especially if the brakes are used frequently. In regions where the temperature may drop lower than -20° Centigrade, the oil in these fluids gradually freezes, causing them to thicken. This can also have unpleasant results.

3. The driver forgot to close the valve "2" in the basic water-exhaust mechanism, the handle of which is located in the power

plant section between the motors. Water entered the hull through the opening "1" in the channel "3" (see drawing).



INNOVATORS FOR REPAIRMEN

The basis of modern communications equipment is the very complex nature of radio-electronic apparatus, instruments and equipment. It is possible to put it quickly back in order only if there is a high degree of technical art among repairmen and first-class equipment in repair shops.

Communication repairmen, for whom there are excellent repair shops, are restless individuals. They tirelessly work toward improving the repair equipment of the workshops and individual working areas.

Fixed Workshop

Captain N Maksimenkov

The testing of the basic parameters of radio and of radio-relay equipment is conducted in a radio workshop created by our innovators. It consists of two rooms (Figure 1). In one of them, all mechanical work is conducted. In this room, one may find a lathe, electric drill press, electric sharpener, bench vises, hand electric drill, electric shears and a remote switch for a compressor, the compressed air of which is fed to areas where equipment is being painted. Near each working area (there are three), there are sockets, bench console lamps and instruments and hardware in the bench drawers. In the other room -- the control room -- there are four working areas. In the first area, mobile radio sets and light radio-relay sets are repaired; in the second and third areas, radio-relay units; and in the fourth area, relays, telephone apparatus and commutators are repaired. Here the cables are tested and the graduation of the radio set and the frequency of the quartz crystals are checked.

The first three working areas are test stands set up on bi-pedestal tables having front and side panels. Inside the stands there are installations which feed the test units; on the leading panel there are measuring instruments, disconnecting switches, connecting blocks and safety devices. On the stands there are portable measuring devices and hoses. A skilled radioman, using this equipment, can quickly test and repair station units, although he may not be able to repair the set itself.

Various instruments can be set up on the stands, depending upon the type of apparatus to be used for measuring or repair. Among these are included: GSS-17 generators, heterodyne frequency meter VG-528, and individual units of the IK-1 assembly. To start the equipment working, one has only to connect up the power supply. The units undergoing test are connected up to one another and to the test stand by means of hoses.

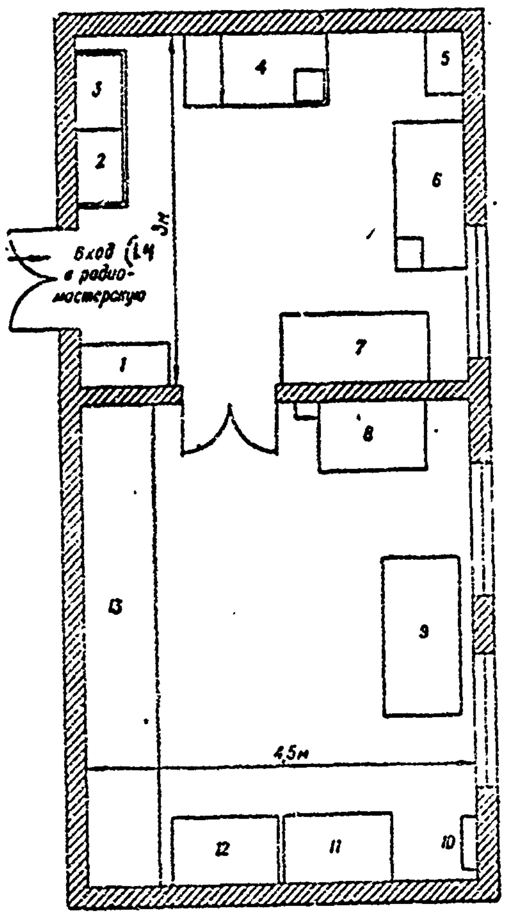


Figure 1

Radio Workshop Plan

1, 2, 3 - cabinets for books, clothing and instruments;
4, 6, 7 - working areas for drilling, machine and lathe work;
5 - wash stand and working areas;
8 - for the repair of ultra shortwave radio sets R-105, R-108, R-109 and radio-relay sets R-401 and R-405;
9 - for regulating relays, testing of telegraphic channel distortion and frequency of quartz crystals and repair of telegraphic and telephone apparatus;
11 - for the repair of R-400M units;
12 - for the repair of R-402 units;
10 - electric power panel board;
13 - four-tiered shelving;
14 - entrance into the radio workshop.

It is easy to use the stand. For example, to check the sensitivity of a military radio receiver, it is connected up to the rectifier in a circuit with an ammeter and a voltmeter. This permits one to determine the amount of current used by the receiver. The receiver sensitivity is determined by first furnishing a signal from the G4-6 unit as input to the receiver and subsequently measuring the output of this signal using a lamp voltmeter.

The power of an R-401M or R-405 transmitter is determined by using a lamp voltmeter built into the stand. To do this, the transmitter is connected directly to the housing of the leading panel of the stand. In a similar manner, other radio and radio-relay sets are tested and regulated.

Measuring instruments required for the repair and testing of equipment of a particular type have been mounted on the stands, enabling a skilled radioman to very quickly acquire professional experience.

For the testing of radio-relay set units, the stand has a combined power supply unit. Using hoses (or directly to the housing), the modulator, demodulator and telegraph channels are connected up to this power supply. The units are tested using an impulse generator and the transmitters and receivers are calibrated by a wave resonator having an indicator. Receiver and transmitter units are repaired using IMS-5 and GShSD instruments and also a lamp voltmeter. On this same stand, antenna reductors, high frequency feeders and three-phase DT-75 electric motors are tested and repaired.

The work tables are framed with angle iron and grounded. Instruments and spare parts are stored in them. The repaired and tested radio components or units are placed in compartments on the four-tiered shelves.

Working Area For a Skilled Radioman

Major L. Budylev

The quality of a skilled radioman's work in a military workshop depends to a large degree upon how well-equipped is his working area. For testing an ultra short-wave radio set, we have a panel which enables us to measure the parameters of the radio set several times faster than the usual method. The eyes are not so easily tired during repeated setting up of the radio set frequencies.

The radio measuring instruments, the antenna, the discriminator output and the micro-telephone fittings are connected directly to the panel situated on the stand, and the required measurement projects are carried out by switching to any one of five positions (Figure 2). Thus, when connecting the instruments and the radio set to the panel, time will not be lost in assembling and dismantling the measuring systems, and we will also prevent the possibility of crude errors when measuring the parameters. Damage to the instruments through incorrect switching will also be avoided. Moreover, the working area will not be cluttered with an excessive amount of connecting wires and what wires there are will be protected from rapid deterioration.

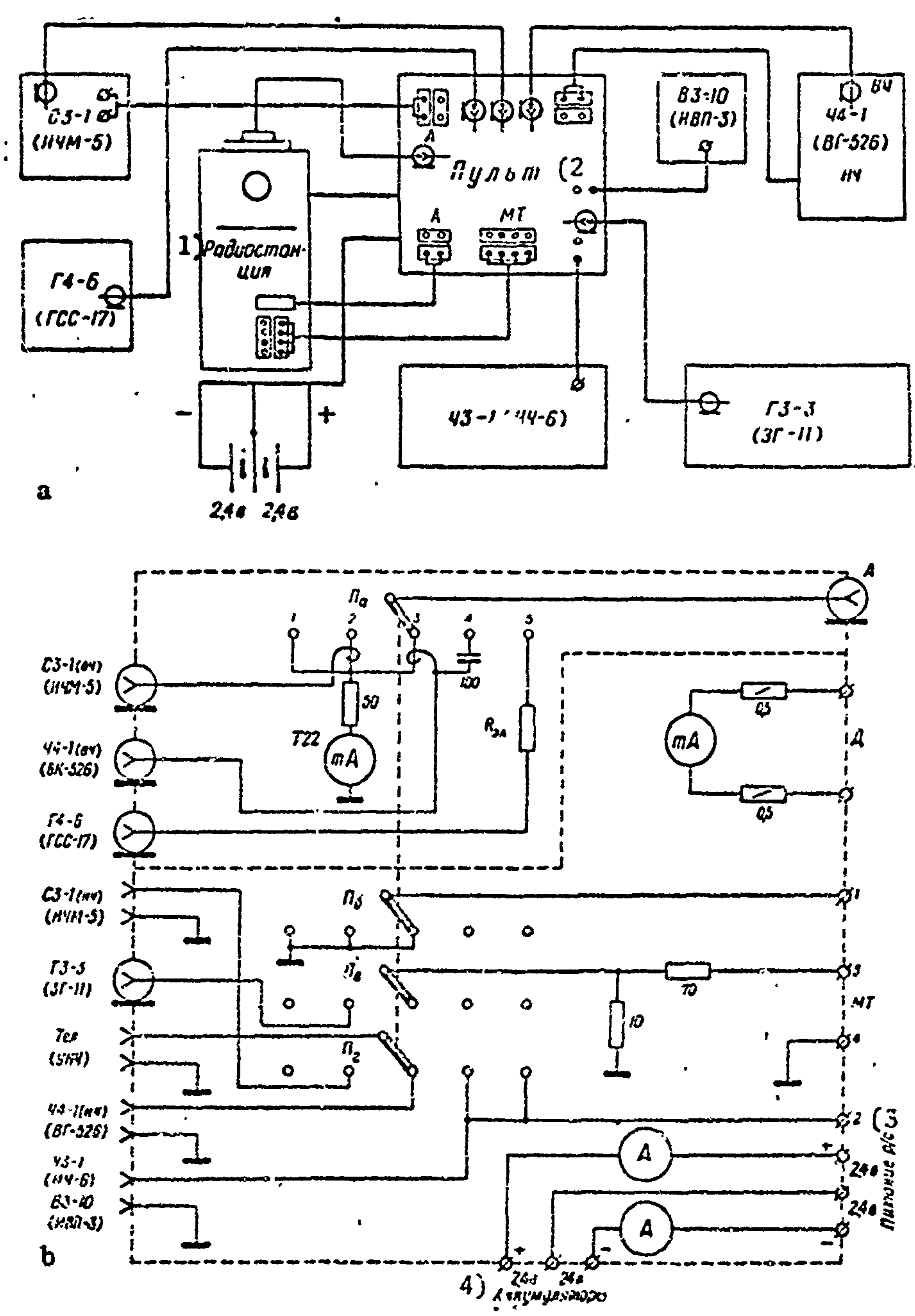


Figure 2

A Stand For Testing An Ultra Short-Wave Radio Set

a - block diagram for connecting instruments and the radio set to the panel.
b - panel diagram.

Wording used in Figure 2. 1 - radio set; 2 - panel; 3 - power supply; 4 - storage batteries.

The simplicity of the system permits one to measure all the parameters of the radio set first on one frequency and then on the others. Therefore it is not necessary to regulate the frequency of the radio set so often as was the case earlier. The panel does not introduce errors into the results of the measurements. It is situated in a metal housing, the dimensions of which are 130 x 350 x 200 millimeters. The cable connections with the measuring instruments and the storage batteries are situated on the rear side of the housing and the connections for switching on the radio set are on the front side of the panel. The antenna circuit of the radio set is shielded.

After the initial preparation, the panel can be adjusted easily -- a contact should be set up between the antenna circuit and the frequency meter input (calibrator), and between the antenna circuit and the frequency modulation meter. The linkage of the antenna with the modulation meter input is considered normal if the pointer of the instrument is in the middle of the zones of limitation and the transmitter is tuned to a definite frequency with the same frequency set up on the modulation meter.

To measure the current and power of the transmitting antenna, the assigned frequency should be set up on the dial of the radio set, the panel should be switched to the first position and the antenna contour should be tuned in accordance with the maximum reading of the milliammeter, which is on the panel. The reading of the instrument should correspond to the norms established by the technical conditions for each type of radio set.

The power of a transmitter can be determined either by the graph (Figure 3) or according to the formula: $P = I^2R$, where P is power (watts); I is current (amperes); and R is resistance of the equivalent antenna (ohms).

To determine the frequency deviation and the sensitivity of the microphone input, the panel switch is set to the second position, the S3-1 frequency modulation meter is tuned to the radio set frequency, a frequency of 1,000 cycles is set up on the G3-3 sound generator and, corresponding to the technical conditions, the level of the output signal. The frequency deviation can be read off on the S3-1 instrument. Thereafter, the output signal level of the G3-3 sound generator will be decreased until the S3-1 no longer shows the rated frequency deviation of the radio set. The measure of this level is expressed in volts and it is the sensitivity of the microphone output. Later the level of the generator output signal of the sound frequency is increased to the value established by the technical conditions for this event. At this time, the deviation of the transmitting frequency, as revealed by the S3-1 instrument, must not exceed that which is permitted by the technical specifications. In order to check on any error in graduation or in adjustment of the transmitting frequency, the panel switch is moved to the third position. The amount of error in kilocycles will be shown on the

Ch3-1 instrument. In order to determine its degree, the frequency of the radio set should be increased slightly. If at this time the frequency meter readings are increasing, then the degree of error will be positive -- if they are decreasing, then it will be negative. When measuring this parameter in the receiver, the panel switch should be moved to the fourth position. After having switched off the APCh, the readings of the voltmeter for the discriminator output should be noted. The amount of graduation and adjustment error in the receiving frequency can be calculated if we know the transconductance of the generator's transformation; that is, to how many volts of discriminator output does one kilocycle of graduation error correspond.

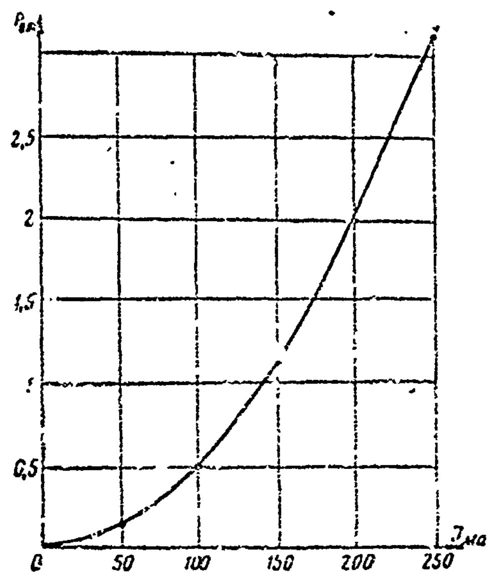


Figure 3

The Relation of Power to Antenna Equivalence (R electron amperes = 50 ohms)

When measuring the sensitivity of the receiver, the panel switch should be moved to the fifth position, a signal of 20-50 microvolts should be set up on the G4-6 standard signal generator and the deviation with modulating signal action should be 1,000 cycles, equal to 7 kilocycles (or as indicated in the technical specifications). The G4-6 generator should be tuned to the receiver's frequency of the radio set for hearing, and in accordance with the maximum reading of the V3-10. The amount of signal level is decreased to that value which corresponds to the nominal sensitivity of the receiver. The V3-10 instrument must show a voltage of not less than one volt, or such as is indicated in the technical specifications. The signal modulation is stopped. At the same time the voltage, as measured on the V3-10 instrument, is decreased (the instrument shows the voltage of residual noises). The amount of voltage should be varied and the frequency should be adjusted so that the V3-10 instrument readings during engaged modulation of the signal exceed by 10 times the readings when the signal modulation is disengaged (when the signal modulation is engaged, these readings should be no less than one volt). This is the minimum voltage of the signal which is created by the G4-6 and it represents the sensitivity of the receiver.

Having measured the sensitivity of the receiver, the G4-6 generator is de-tuned (there is no antenna signal output) and the amount of noise voltage, not to exceed that indicated in the technical specifications, is obtained from a reading of the V3-10 instrument.

The current used by the storage system of the radio set is obtained by reading the ammeter mounted on the panel. In the first, second and third positions of the switch, the ammeter will show the current expended during transmission, and in the fourth and fifth positions, when receiving.

Having completed a cycle of measurements on one frequency, the radio set can be changed over to another frequency and the operation repeated.

When making measurements, the following is recommended. The antenna contour of the radio set should be tuned on one frequency only one time (during the measurement of current in the antenna equivalence). When testing the parameters of the transmitter, there is no need to press on the tangent of the microtelephone set, since the switching of the radio set to transmission is provided for in the panel. The switch "Limit Control-Measurement" of the C3-1, must at all times be in the "Measurement" position. It is not necessary to put it in the "Limit Control" position to test the signal level since the required connection has already been selected in the panel.

Usually, the frequency deviation of the transmitter is measured at two points in the range, and the remaining parameters at three points. Practice indicates that the frequency deviation of the transmitter does not depend upon the operating frequency. Therefore, it is entirely satisfactory to measure it at one point in the range. Moreover, this speeds up the work significantly since it is then not necessary to set the frequency up on the C3-1 instrument.

When testing the radio set following repair, it is necessary to check the graduation error of the transmitter and receiver along the entire range by 100 kilocycles or 1 megacycle or by intervals as shown in the technical specifications for radio sets being repaired.

REMOVAL OF GREASE

The editorial office has received a number of letters from soldiers, asking to be informed as to the quickest and best method for removing protective grease when preserving infantry arms, using inhibiting paper. Engineer-Lieutenant Colonel N. Kudryavtsev provid the following answer to this question.

The removal of protective grease and the cleaning of arms is a very responsible operation. To remove the grease, the metal components of the weapons should be immersed in a spindle oil bath heated to 105-115° Centigrade, and allowed to stand 10-15 minutes. The wooden parts must necessarily be separated. This is required since the lacquer with which they are covered will, at a temperature of 60-70° Centigrade, begin to soften and come off.

The use of gun grease or diesel fuel in place of spindle oil is unthinkable, since they have a greater viscosity and do not easily penetrate crevices and inaccessible places. Furthermore, they are not capable of washing away the protective grease which, if it is left in mechanical joints, may cause failures when firing, particularly during periods of low temperature. Spindle oil does not interfere with the mechanical operation of weapons (up to a temperature of 35° Centigrade). The application of liquid gun grease for protective purposes is also not advisable. It is considerably more expensive than spindle oil and has a low temperature of combustion. After the protective grease has been removed, the weapon should be completely dismantled and all components should be dried thoroughly with a rag.

All protective grease should be removed completely, so that the inhibitor can react with the metal; any grease layer that remains will hinder this reaction. Moreover, any moisture accumulating under the layer of grease could result in corrosion of the metal. Before assembling and while using inhibiting paper to protect the weapon, all components should be lubricated with a liquid gun grease.

Before assembling the weapon, persons engaged in this operation must be sure to rub their hands in white spirits and liquid gun grease, and to wear special gloves.

SERVICING A BRIDGE LAYER

Major N. Lyubenko

Engineer-Major G. Repkin

In our work with TMM and KMM bridge laying tanks, it has been proven that the instruments and assemblies of a hydraulic system work reliably and for an extended period only if they are supplied with a completely pure and well-filtered AMG-10 oil. This is why an oil used in a hydro-system must be stored in hermetically sealed cans and tanks. Oil poured out of the system (for example, when replacing gaskets in the actuating cylinders), can be poured back into it only after it has been filtered twice through two to three layers of dense, coarse fabric and on condition that it was not exposed in open containers for more than 10 hours. The mixing of various hydraulic fluids when filling the system, is not to be tolerated.

The purity of the fluid in large measure depends upon the condition of the filters for the hydro-system. The following method is recommended for testing their condition. Turn the handle of the filter four to five times and pour the sediment through a batiste or other dense white fabric. If particles of dirt or metal remain on the material, take the filter elements and wash them in pure hydro-fluid. Simultaneously, the filter at the top of the tank should be washed.

Sometimes air enters the system, causing erratic or slow movement of the hydro-cylinder rods. To remove the air, pour fluid into the tank up to the upper mark on the gauge, and then shift the pistons of the hydro-cylinder three to four times from one extreme position to the other (at idling speed without load). After the air is removed, the tank can be refilled.

Sometimes oil leaks develop in the hydro-system units of a bridge laying tank. This results in unnecessary expense, and sometimes leads to contamination of the system. For example, during the return stroke of the rod in the cylinder chamber, dirt is allowed to enter through the gasket. To achieve a more reliable hermetic sealing of the joints of the manifold, the thread connections should be scoured with benzine and then covered with a special compound (eight parts by weight of white lead and one part of graphite lubricant).

Deterioration of the rubber sealing gaskets may cause oil to leak from one cylinder chamber into another. As a result, the rods will become overloaded. To correct the trouble the cylinder must be disassembled. Quite often when doing this, the workers through carelessness may damage the surface of the cylinder or the gasket. We recommend that the operation be conducted in the following manner. Having cleaned the dirt from the outer surface of the cylinder, disconnect the pipe-lines and pour the oil out of them. Wrap the ends of the pipe-lines in oily paper. Take the cylinder and pour the oil out of the chamber. Then unscrew the nut and remove the rod and piston. Indentations and scratches in the grooves under the sealing washers and on the surfaces of connected parts, should be removed by trimming or scraping. Before assembling, all the cylinder parts should be washed in diesel fuel or kerosene and the friction surfaces of the cylinder, pistons and rubber sealing gaskets should be covered with a thin coating of oil.

After assembling, the piston should be put back into the cylinder at a force of 1.5-2 kilograms per square centimeter. To check on the tightness of the gasket, the cylinder should be left under stress for 30-40 minutes. If the rod drops down no more than 20 millimeters, then the tightness is considered normal. To expose any external oil leaks, the cylinder should be wiped dry and then switched on two to three times during maximum turns of the pump. If oil filters through the gasket, the worn-out parts should be replaced by new ones from the ZIP [zapasnyye chasti, instrument, prinadlezhnost'; spare parts, tools, accessories].

Sometimes it becomes necessary to replace not only the worn-out gaskets, but also the steel pipe-lines. Having loosened the unit, the pipe-line is set in place and the covers are tightened, followed by the remaining nuts. If this sequence is not followed, so-called assembly tensions may appear in the pipe-line, which often cause a breakdown in the pipe-line during operation. The correctly adjusted pipe-line, after the nuts and clamps have been unscrewed, must not move more than 5-10 millimeters from the correct position. Cracks in the pipe should be sealed with copper. Cracks can be removed after driving a broach or sphere, corresponding to the diameter, through the pipe.

Pumps, three-positional valves, safety, reverse and electro-magnetic valves and hydro-locks are neither adjusted nor repaired. Under normal conditions, they continue working until it is time to overhaul the bridge laying tank. It happens however, that individual assemblies break down earlier than anticipated. At such times they should be changed, rather than waiting until the machine is repaired. If the factory service guaruntee for the bridge laying tank has not yet expired, it is not permissible to dismantle the assembly and remove the seals for adjustment. The serviceability check, adjustment and repair can be conducted only in workshops which has the proper equipment. One should be aware that manometers, set up in the cabins of bridge laying tanks, are tasked only with the control of pressure in the hydro-system. The adjustment of safety valves using these instruments is forbidden. One of the reasons for the rapid deterioration of a flexible hose is its incorrect installation. Before installation, we recommend drawing a straight longitudinal line on the hose, using chalk or paint. This will assist in insuring against twisting the hose.

It is necessary to constantly look after the condition of the winches, blocks and cables of the bridge laying tank. The winch brakes should be checked especially carefully. To do this, the bridge block should be lowered two to three times while sharply turning off the winch. If the bridge block does not lower simultaneously, the adjustment of the brake is normal. While servicing the blocks, the strength should be checked, clearances adjusted and the axles greased. The cables are not protected from rain, dust and dirt. A multiple bend of the cables on the blocks and rollers and excessive dynamic loads when starting and stopping the winch decrease their service life. A cable break can delay the work considerably and can even result in a breakdown of the machine. Therefore, during technical inspections and when servicing the machines, the condition of the cables must be checked. They should be examined carefully, giving special attention to the reliability of the strength of the ends on the winch drum and the points. If a strand or more than 10 percent of the wire is torn (for one meter in length), the cable should be replaced by a new one from the bridge laying tank ZIP. In no case should a cable having a different label be used, not even if it has the same diameter.

Usually, during a routine technical servicing, the cables are greased with a technical vaseline or graphite lubricant. This, as experience indicates, is clearly inadequate. The fact of the matter is that the lubricant fails to penetrate the cable, the unlubricated strands quickly rust and the entire cable breaks down prematurely. Before lubricating, the cable should be cleaned of dirt using steel brushes and then immersed for 1-1.5 hours in a mixture consisting of 60-70% benzine and 30-40% oil (for example, MT-16P). In this manner, all the strands of the cable will be well saturated with oil. Benzine evaporates easily, but oil will remain between the strands, protecting them from corrosion. After drying the cable on the outside, it should be covered with a thin layer of commercial vaseline. This layer should be replenished during routine technical servicing.

RESTORATION OF PARTS

Karel Augusta

People's Army of Czechoslovakia

When repairing armored equipment, the experience of Soviet Army specialists is widely employed. Thus, balancers, gears and brake drums of the T-54 are restored using electro-contact welded seams. T-34 drums are fused under a layer of flux. We weld carbon steel in a carbon-dioxide atmosphere, and light alloys (motor linings, bearing surfaces and crankcase transmission box) in an argon atmosphere. Worn-out bearing torsion surfaces are fused by hand with VN450 (13% Cr, o.2% C). This is the best method, since hardening is not required after welding. In this connection, when we attempted to employ an electro-contact weld, the hardness of the welded layer did not exceed 34 Hrc, that is, almost 20 units less than by hand. As concerns the T-54 tank, 70% of all repaired parts are restored through various welding methods and 6-8% by employing chrome plating.

We are beginning to employ steel-plating. By this means, we are restoring torsion sleeves. The sleeves are scoured in an alkali solution at a temperature of 90-100° Centigrade, after which the worn out surfaces should be grinded down to a diameter of 63.7 millimeters. Following this, the two sleeves are placed on a special device (Figure 1). Those areas which are not to be steel-plated, should be covered with tape. Thereafter, the sleeves should be scoured in a Viennese liquid, after which they are placed in a bath consisting of a special solution (30% H_2SO_4 and 10 gallons per liter $FeSO_4 \cdot 7H_2O$). The process lasts for one minute with a current density of 20 a/dM^2.

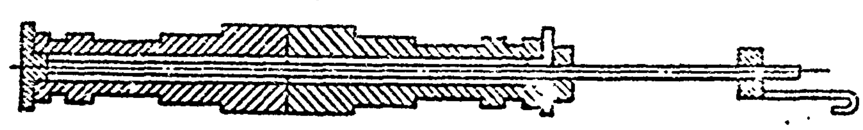


Figure 1

A Device For Electro-Plating Sleeves With Steel

Before lowering the sleeves into the bath for steel-plating, they are first washed in hot water (70-90° Centigrade), and subsequently in a special formula ($FeCl_2 \cdot 4H_2O$ - 500 gallons per liter, NaCl - 100 gallons per liter, $MnCl_2$ - 20 gallons per liter), for 1-1.5 minutes at a temperature of 85° Centigrade. After doing this, the current is turned on. Initially, the current density is set at 6 a/dM^2, and after 15 minutes it is raised to 15 a/dM^2. The time for applying the coating is generally 3.5 hours (0.15 millimeters per hour). The sleeve is washed in hot water for three minutes and then is neutralized in a 10% solution of caustic soda at a temperature of 70-90° Centigrade. Finally, it is again washed in warm water. The dried part is processed and its hardness, which must be in the neighborhood of 27-30 Hrc, is measured. When repairing bronze and brass sleeves, a coating is applied. In order to prevent cracking in brass sleeves containing more than 3% zinc, they are expanded at a temperature of 280-350° Centigrade for two to three hours, followed by air cooling. The plating process is shown in Figure 2. Initially, we compress the sleeve on a hydraulic press to obtain

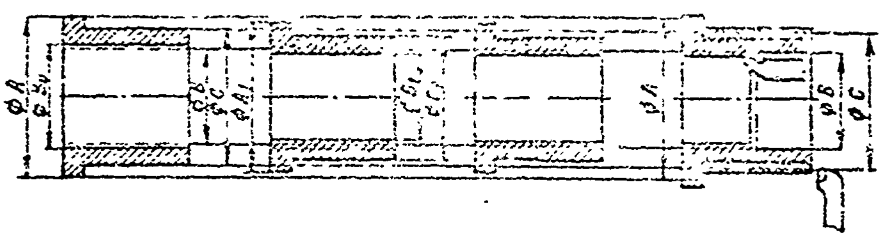


Figure 2

Technology of Repairing a Sleeve

diameter B. Thereafter, it is scoured and processed either with a tool or with sand. The surface C is plated with wire containing .1% carbon (see Table). The plated surface must not be heated more than 80-90° Centigrade, otherwise cracks may form or the applied layer may detach itself. In order to avoid high temperatures, a boride-chrome powdered wire is applied.

Parameters	Coating Material	
	Steel	Bronze and Brass
Air pressure, kilograms per square centimeter	$\geqslant 5$	3.5-4.5
Distance of the spray gun from the surface, millimeters	75-100	70-80
Voltage, volts	30-35	20-25
Current, amperes	100-150	50-100
Peripheral speed of the sleeve, m/min.	4-6	4-6
Longitudinal support, mm/ov	1.5-3	1.5-3

We have only recently begun using polymeric materials for repairing parts, but they are already available in the inventories of repairmen. For example, rosins are being widely disseminated.

We are exposing metal cracks using colored defectoscopy. A layer of red aniline paint, which freely enters the pores, cracks and corrosion points, is applied to the cleaned surface. Thereafter, it is rubbed with a rag moistened in a mixture of oil and kerosene. After this, the surface of the part is wiped with a dry rag and a thin layer of whiting applied. After some time, a red strip, outlining the contour of the existing crack, will appear in the white background. This crack will appear even if its depth is .01 millimeter and its width .0005 millimeters.

INTO YOUR NOTEBOOK

Engineer-Captain L. Teremkov

Usually, the strength of cable strands can be measured in the following manner. Short-circuit the strands on one of the ends and connect an ohmmeter to each pair on the other end. The instrument reading, divided by two, will give the strength of each strand.

Such a method is not accurate, since the strength of one strand can differ from that of another.

We propose a method which permits an exact measurement of the strength of each strand.

In order to do this, first short-circuit the strands on one end of the cable. Thereafter, measure the strength of pairs of strands on the other end, using the following combinations.

$R_1 + R_2 = a \quad R_2 + R_3 = b \quad R_1 + R_3 = c$

In the above, R_1, R_2 and R_3 represent the strengths, respectively, of the first, second and third strands; and a, b and c are the values of the measured strengths.

Next, solve the equations obtained. An expression giving the strength of the first strand of the cable will be provided.

$$R_1 = \frac{a - b + c}{2}$$

According to this same formula, the strength values of the other strands may then be obtained.

Let us assume that it is necessary to determine the strength of four strands of cable. Using the proposed method, we will obtain for example, the following results: $R_1 + R_2 = 12$ ohms, $R_2 + R_3 = 10$ ohms, $R_1 + R_3 = 8$ ohms, $R_1 + R_4 = 9$ ohms.

$$R_1 = \frac{12 - 10 + 8}{2} = 5 \text{ ohms} \quad \text{Thus, } R_2 = 12 - 5 = 7 \text{ ohms,}$$

$R_3 = 8 - 5 = 3$ ohms and $R_4 = 9 - 5 = 4$ ohms.

The accuracy of measurement by this proposed method is related to the accuracy of the instrument used.

THE BEST IN THE DISTRICT

Colonel N. Zav'yalov

The soldiers, commanded by Officer B. Presman, actively participate in efficiency work. It suffices to say that in 1965, 101 efficiency suggestions were made here. All of these were aimed at improving personnel combat training and raising labor productivity in the servicing and repair of combat materiel and arms.

Innovators contributed much labor in equipping the range, tank park, target range, firing camp and the classrooms. Training apparatuses for gunners, a screen for controlling the activity of a gunner during tank firing exercises and other equipment were produced. As a result, exercises were conducted involving the study of the materiel section of arms, the rules of firing as well as training exercises on firing from tanks. One can boldly say that if excellent results were achieved during the past year in firing preparations, then considerable service was rendered by such innovators as Major K. Aleksandrov, Captains K. Materiyi and V. Rogachev, Senior Lieutenant M. Azevichus, Sergeant K. Kuodzis, Master Sergeant on extended service P. Gnezdilov, Private V. Shadzhyus and other comrades.

Much attention is being given to efficiency work in a small unit commanded by Officer P. Lane. For example, Captain A. Limbaytis, an honored innovator of the Latvian SSR, only last year developed 17 valuable proposals. He prepared a panel control having a stop watch, an instrument for counting target hits, sound and light simulators and a number of other devices which were all used successfully during personnel firing training exercises.

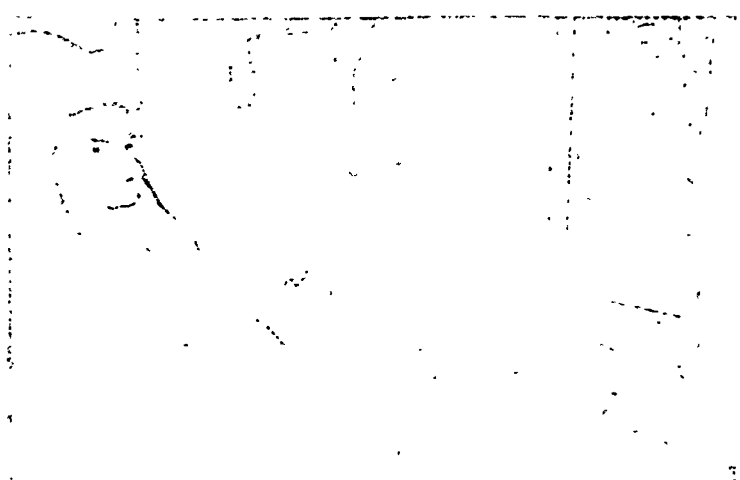
Command, Party and Komsomol organizations devote much attention to efficiency work. On many occasions, these and similar questions are discussed at Party and Komsomol meetings. Discussions, lectures on technical themes, consultations, and meetings with some of the best soldier-innovators are regularly conducted. Stands and stained glass windows telling of the experiments of some of the best innovators and of the novelties created by them have been designed. Authors of some of the most valuable suggestions and also members of a Commission on Inventions, headed by Officer P. Kur'yanovich, often address the personnel. Recognition for efficiency suggestions and monetary awards are rendered at a solemn ceremony before all of the personnel of a unit.

Creative brigades of innovators, with representatives from various specialities, work especially well. As experience has shown, complicated problems can be resolved by virtue of such an organization. For example, Captain B. Grachev and Private L. Remess developed and prepared a set of devices which permit a determination as to the number and duration of stops made by tanks during firing. Simultaneously, it is possible to control the work of three machines. Transmitting devices set up on the tanks, pass information along on the movement or halts made by them. An apparatus on the tower of the tank directrix receives signals, separates them (each tank will send a signal on a specific frequency), and displays information concerning the duration and number of stops on a screen.

The work completed by Engineer-Major N. Kachalkin and Private 1st Class V. Pukki in developing a trainer with an electro-mechanical drive was equally interesting. It permits training the turret on a horizontal plane at a speed of 2-6° per second, and the cannons on a vertical plane at a speed of 1-2° per second. The trainer is simple in structure -- the designers avoided the use of a hydrodrive and expensive pulleys and joints.

Officers M. Shul'gin, G. Patt and Sergeant I. Makhonin developed equipment for a training class, with a minimum of reliance on automated devices. This equipment assists greatly in training chemical specialists. It is being widely used, even beyond our district. Thanks to this equipment, the expenditure for automated devices used in preparing one trainee is now five times less than formerly.

Thanks to the activity of our personnel, to the joint efforts of our Command and to Party and Komsomol Organizations, our unit, commanded by Officer B. Presman, has for several years in succession occupied first place in this district for innovation and inventive work. Inspired by the decisions of the XXIII Congress of the CPSU, our soldier-innovators are firmly resolved to attain new creative successes in solving the problems now facing them.



The exercise leader, Captain V. Ignat'ev, need not be located along the route. The stand, developed by skilled tank crew-members, permits him from a command point to control not only the movement of vehicles, but also to observe errors of the mechanics and the drivers.

Photograph by F. Levshin

THE THEME OF THESE BOOKS -- ASTRONAUTICS

The great discoveries of K. E. Tsiolkovskiy showed the way to his followers who, more than forty years ago, organized the Society for the Study of Jet Propulsion (GSJP), which launched the first rocket using liquid fuel. Who were these followers of Tsiolkovskiy? What was the Society for? What did it actually deal with? These questions are discussed in a book by G. Kramarov entitled, "At the Dawn of Astronautics" (Moscow, "Znaniye" Publishing House, 1965).

The pamphlet by V. I. Igunov, "To the Distant Worlds" (Moscow, Military Publishing House, 1965) has another aim. In it, the author helps the reader to better visualize the cosmos, its structure and size, and to gain an understanding of the communications and methods by means of which man can unveil the secrets of distant worlds and obtain knowledge on the depths of the universe.

One can read about the basic mechanics of space flight in the book by E. A. Grebennikov and V. G. Demin, "Interplanetary Flights" (Moscow, "Nauka" Publishing House, 1965). The first two chapters of the book contain astronomical information required for solving astronautical problems. The remaining chapters are devoted to a description of the different interplanetary routes, from the point of view of the mechanics of flight.

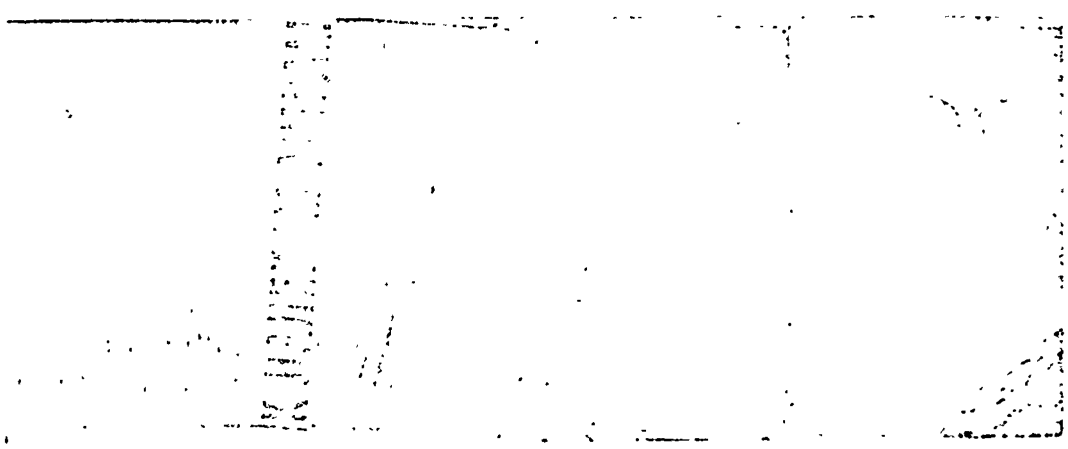
For those who are interested in questions concerning the motion of earth satellites and space rockets, we recommend the book by V. I. Levantovskij, "The Path to the Moon and Planets of the Solar System" (Moscow, Military Publishing House, 1965). This pamphlet discusses the theoretical basis for the flight of automatic stations and manned spacecraft to the moon and planets of the solar system. Special attention is given to the characteristics of space trajectories, fuel consumption for space maneuvers, and also to the weight characteristics of rockets and space apparatuses.

There is no doubt that the moon will be the first planet on which man will set foot. The pages of the book by K. A. Kulikov, "The First Astronaut to the Moon" (Moscow, "Nauka" Publishing House, 1965), carries the reader to the mysterious surface of a natural satellite of our planet and acquaints him with the many curious things which the astronauts will encounter there.

"Systems of Navigation for Spacecraft" (Moscow, Military Publishing House, 1965) by V. P. Selezhnev and M. A. Kirst, is a book devoted to the problems of controlling the flight of spacecraft. The characteristics and principles of constructing navigational systems are discussed and the principles of action and the structure of primary navigational information transmitters are examined. Special attention is given to astronomical, inertial, and composite navigational systems. The use of navigational systems during various phases of space flight is also discussed.

In the planning of a spacecraft, many problems arose which if done by hand, would have required tens or even hundreds of years of persistent work by a whole army of engineers and calculators. While high speed electronic computers execute these calculations in the shortest time, the chief task of such machines is to service the lift-off and entry of the spacecraft into orbit. Here it is impossible to stretch out the calculations for years or even decades since the situation changes within a fraction of a second. Cyberntics permit rapid solving of problems connected with calculating the most desirable trajectories, in terms of time and fuel consumption. The high accuracy of the calculations has been confirmed by the results of the launches of more than one hundred Soviet artificial satellites, interplanetary stations and spacecraft.

The techniques which have permitted man to take the first steps into space are discussed in a pamphlet by Candidate of Technical Sciences I. B. Gutchin entitled, "Cybernetics and Spacecraft" (Moscow, Znanie" Publishing House, 1965).



GRAPHIC NOT REPRODUCIBLE

EXPERIENCE INITIATIVE

A NEW BRACING PERMITS the conversion of an escape tube mounted on a tractor from a horizontal to a vertical position twelve times faster than before. Engineer-Captain Yu. Burdeynyy writes that it was necessary earlier to have a special machine to transport the tube, and hoisting equipment to install it. But, now the escape tube is conveyed on the tractor itself.

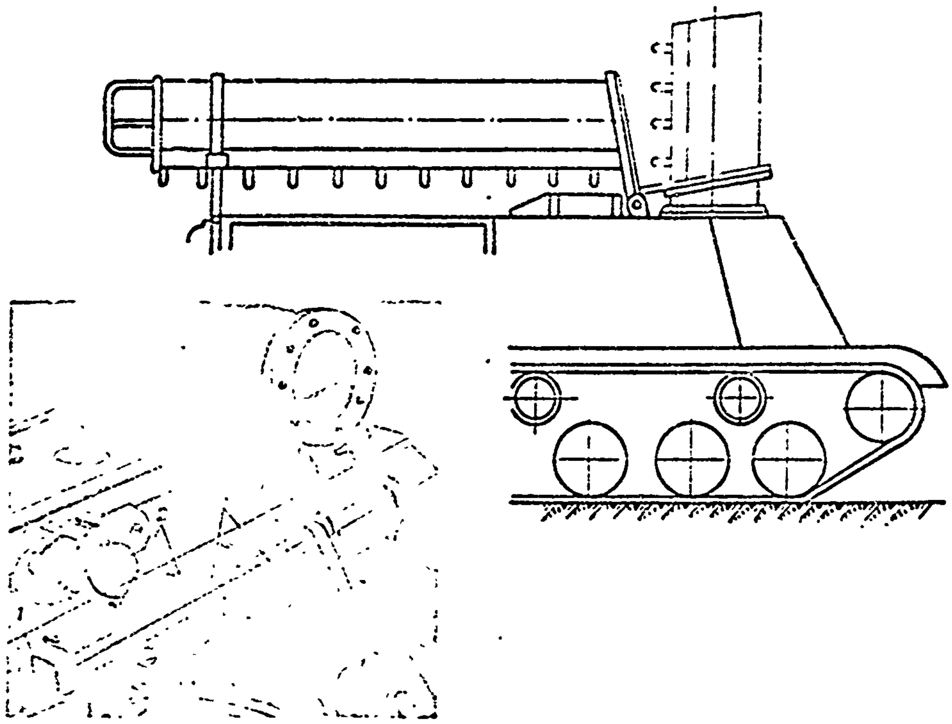


Figure 1

The escape tube (Figure 1), with the help of axles "5" and "7," is connected to brackets "4" which are welded to the body of the tractor. The lug "6" is rigidly connected to the torsions "3." Their other ends are secured to bracket "1." The tortions are closed by housings (not shown in figure) which are bolted to the small rods "2." When the escape tube is in a horizontal position, the tortions are unwound and only one man is required to put it in a vertical position.

A BEAM on which VV blasting charges are placed to blow up the span of a reinforced concrete bridge was made on the suggestion of Guards Sergeant N. Berdnikov. It's length is equal to the width of the bridge's span and its weight, together with the charge, is 250-300 kilograms. On the ends of the beam are adaptors for securing cables. The explosive charges are fastened at distances determined by an engineering survey. The prepared beam is carried under the bridge in a DL-10 boat -- in winter it is carried on the ice -- and the beam is raised with the aid of two small winches. For this the cables pass through an opening in the trestles of the bridge and the assembly is mounted to the railings. This device, reports Guards Colonel A. Cusarov, reduces by two to three times, the time needed to prepare to blow up a bridge.

A DRIVE MECHANISM (Figure 2) for simulating the vibration of a tank's chassis in gunnery training establishments, reports Engineer-Colonel A. Tokarev, is assembled from discarded units: a gear box "2," a PMP "3" and gears ("4," "5," "6"). The power of the electric motor "1" is 3.5-4 kilowatts delivering 960 rpm. The gear ratio for the belt gear is 2.8, for the gear box 4.95 and for the PMP 3.86 A gear "6" having 16 teeth is welded to the shaft and with it mesh two gears having 36 and 42 teeth. Gears "4" and "5" are fitted on the shafts connected to the frame.

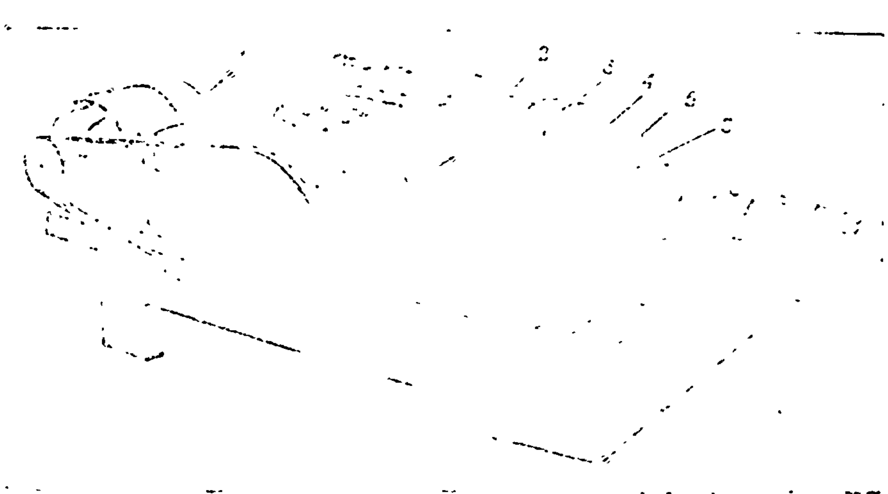


Figure 2

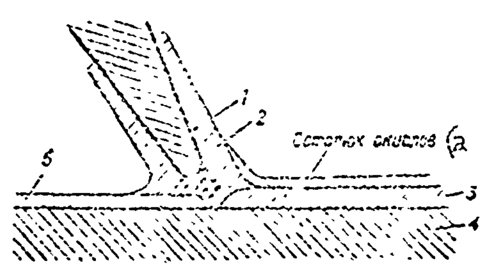


Figure 3

Wording used in Figure 3: a - oxide residue.

ALLOY SOS 6-6 (5.5-6.5% Sb, 5.5-6.5% Sn, 89-87% Pb) can be used in repair of bimetallic ferroaluminum bearings. First, tin-zinc alloy (80% Sn 20% Zn) is applied with an ultrasonic soldering iron UZUP-2. The core "1" of the soldering iron (Figure 3) vibrates with the ultrasonic frequency. As a result, a cavity emerges under the action of which the oxide layer "5" disintergrates and at the same time a moistening by the alloy "2" of the purified aluminum surface "4" occurs. In this way the application of a layer "3" does not require flux. The firmness of the cohesion is 336 kilograms per square centimeter. Alloy SOS 6-6 is applied by means of pouring and the ultrafrequency bath UP-31 can be used.

Engineer O. Tsapskaya writes that the bench tests of the bearings, which were conducted in the Leningrad Repair-Mechanical Plant "Selkhoztekhnika," yielded positive results as a good working-in was secured from the applied coating. The surfaces of the crankpin showed no wear. Expenditures for reconditioning bearings for the D-54 engine in small-series production is 4 rubles 42 kopecks. Earlier, bearings with only slight wear were not reconditioned since it was considered economically unjustified. The portable ultrafrequency apparatus can be used in field conditions.

TRAINING CLASSES for the study of BRDM and BTR-60p machines were established in units where Engineer-Captain I. Barlov and engineer G. Sytnik serve. For convenience, the school equipment is separated into units, assemblies, working stands and mock-ups which are placed on three-tier racks and in revolving stands. Small parts are kept in cans. Such classes can be set up in repair sub-units.

DRAWBAR EXTENSION ARM has been suggested by Officer Yu. Turanskiy for the transport of an M-30 and D-1 Howitzer behind an ATL truck-tractor (Figure 4). On short turns, the extension arm will protect the howitzer framework from being damaged. Experience indicates that it is very dependable in operation.

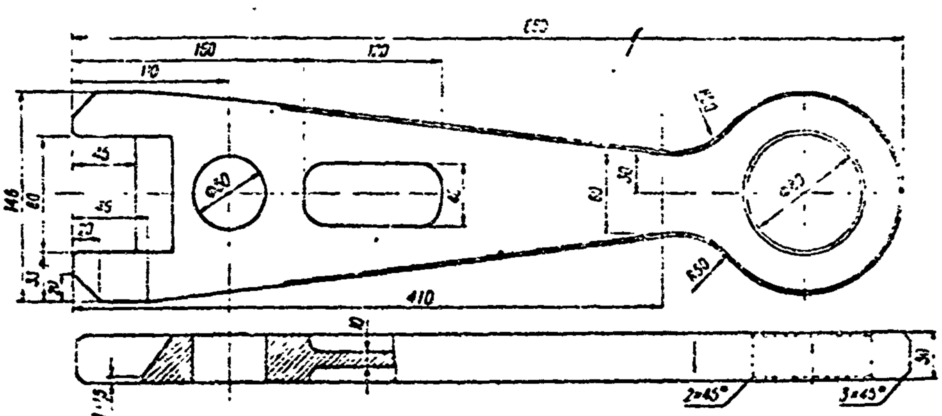


Figure 4

EQUIPMENT AT AN OPTICIAN'S OPERATING POSITION has been developed by B. Ol'nev, a Soviet Army employee (Figure 5). The shelves and drawers of the workbench, the upper part of which is made of blue plastic, are used for storing parts, instruments and materials. To the right of the workbench, there is a rack for the storage of large parts of optical instruments and supports. It is very easy to work at such a position; everything that is required for the repair of instruments is conveniently at hand.

GRAPHIC NOT REPRODUCIBLE

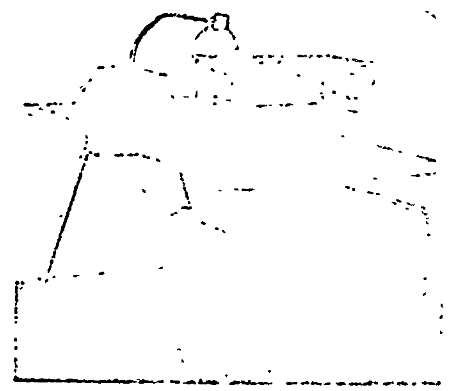


Figure 5

REMOTE CONTROL with a new method has been proposed by Captain of Technical Service M. Petrov for radio-sets R-105D, R-108D and R-109D, which have UM-1 power boosters. Three components should be installed on the rear section of the UM-1 kit and then connected up to the circuit. These components are: RP-5 relay (RS4522016, single coil, 9500 turns, current action - 1 milliampere), MBGP-2 condenser for 200 volts voltage and L clamps (Figure 6). In the drawing, the connection of the additional components is shown by the dotted line. A double-wire connecting line for remote control, up to 300 meters in length, is connected up to the clamps. During operation of the radio set, a TAI-43r telephone apparatus, with a remote control attachment, is used.

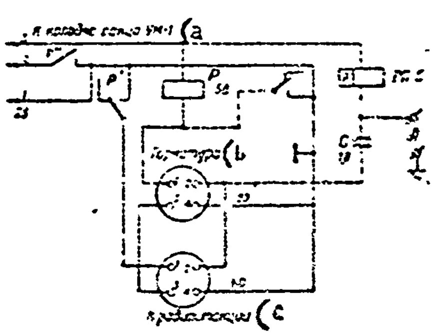


Figure 6

Wording used in Figure 6: a - to the block of the UM-1 kit; b - mountings; c - to the radio-set.

CONTROL BLINKER, PUSH-BUTTON, diode and resistor significantly improve the operational characteristics of a P-193M switchboard by their inclusion in the system (Figure 7). The switchboard, as Engineer-Lieutenant Colonel I. Portnoy reports, responds to a subscriber call even when the appropriate exchange call button is depressed. A ringing signal is also noted if the exchange call button of the system connecting the two subscribers, is depressed. Using the Kn push-button, it is possible to test the subscriber's line. When depressing the push-button, a control blinker and resistor R are connected up to the circuit; the disconnecting of the diode does not interfere with the call current. We mounted the control blinker and the push-button in a metal box attached to the upper hood of the switchboard.

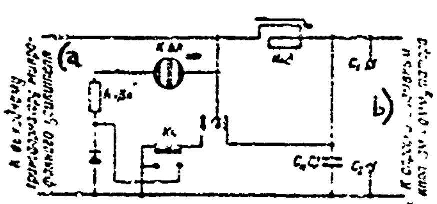


Figure 7

Wording used in Figure 7: a - to the discharge transformer of the microphone booster; b - to the exchange call of the switchboard.

There are 6100 coils of copper wire, 0.1 millimeters in diameter, in the winding of the blinker. Its resistance is 300 ohms. The D7Zh diode, during remote control of radio sets connected up to the switchboard, acts as an air valve. The resistor R increases the speed of current build-up in the control blinker circuit.

Unit signalmen, familiar with the deficiencies of the P-193M switchboard system, must not leave the exchange call push-button depressed unless for an emergency. Changes can be introduced into the system only with the approval of the Command.

AN UNLOADING DEVICE has increased labor productivity 15 times for unloading free-flowing materials. It was designed by innovators, Captain N. Pokrovskiy, and Master Sergeant I. Kashin. It was installed on the S-80 tractor (Figure 8). It can be used in the building of roads and in other engineering endeavors.

Figure 8

KEYS for regulating the valves of tank engines and sleeves (Figure 9), as reported by their inventor, Senior Sergeant on extended service V. Klishin, have advantages over standard means. A wrench for regulating valves (Figure 9, a) never slips off the disks. It can be made out of steel plate, and the detachable stem "1" -- also out of steel (e.g., out of a sheet of discard resources). The teeth of the key only set the predetermined position, and thus for all practical purposes, do not wear out.

The head of the screw of the regulating sleeve should be unscrewed by another wrench (Figure 9, b) which also seldom wears out.

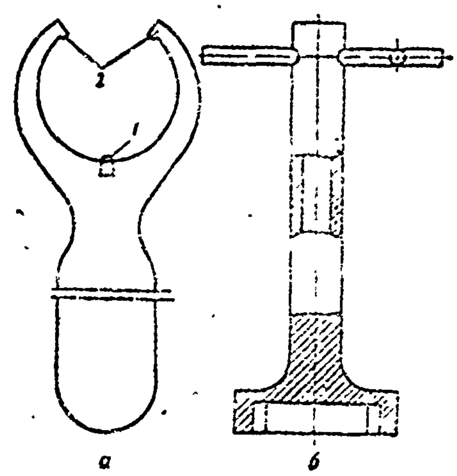


Figure 9

EXTRACTORS, according to Engineer-Lieutenant Colonel P. Alpatov, can be made in any workshop and significantly facilitate the dismantling of ZIL-130 automobile transmissions. In order to depress the main shaft unit, an extractor, made from the cover "1" (Figure 10) of the main bearing shaft, (part 120-1701040), is used. Holes are drilled in it, into which are screwed two bolts "2" with prongs. The extractor is strengthened on the main shaft through the use of two half sleeves "3." The sleeves are set in the flanges of the shaft grooves and the extractor in the collar. If the bolts are uniformly screwed in the cover, the extractors, while pushing against the transmission, will easily remove the main shaft together with the bushing, through the opening in the crankcase.

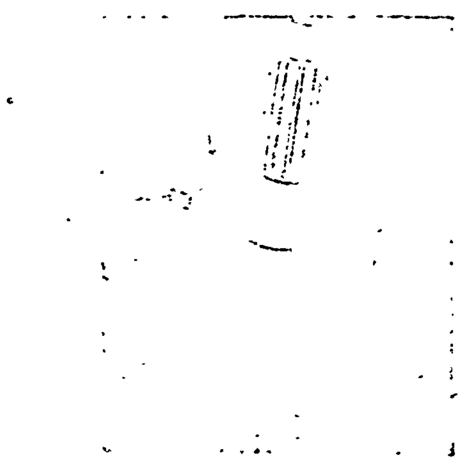


Figure 10

The secondary shaft and the ball-bearing can be removed from the crankcase using a similar type of extractor but made out of the flange of the secondary shaft (part 120-1701148). It is strengthened on the shaft by the usual nut. In order to remove the ball-bearing from the secondary shaft, a somewhat shorter type 295 extractor is used.

INSTRUMENT FOR DETECTING FLAWS IN SPRINGS has been proposed by innovators, Major of Technical Service Yu. Mikhaylov and student A. Shabalin. The moveable baffle "2" (Figure 11), coupled with the screw "3," slides along the guide pedestals "1." Using a tap wrench "4," the screw is rotated in the nut welded to the flange "5." The second baffle is connected to the rod of the dynamometer "7," to which is fastened a needle-indicator "8." The spring of the dynamometer is set in the frame "10," which sets on the base "11" of the instrument. A gage "6" with a scale in millimeters is set up on this baffle.

The spring to be tested is set up between the moveable baffles and its height is read on the scale. The screw is then turned, compressing the spring to the extent called for in the technical specifications for noting defects. The amount of stress generated by the spring is then determined by a reading of the dynamometer scale.

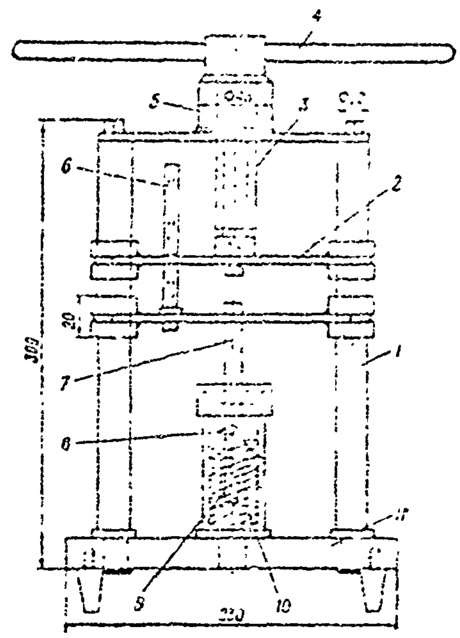


Figure 11

AN INDICATOR SIGNAL, according to Engineer-Lieutenant Colonel I. Portnoy, instead of the polarized call in the BIP unit of the telegraph cross and telegraph switchboard permits one to accurately determine the working order of ringing circuits in the P-133M and P-194M switchboards (Figure 12).

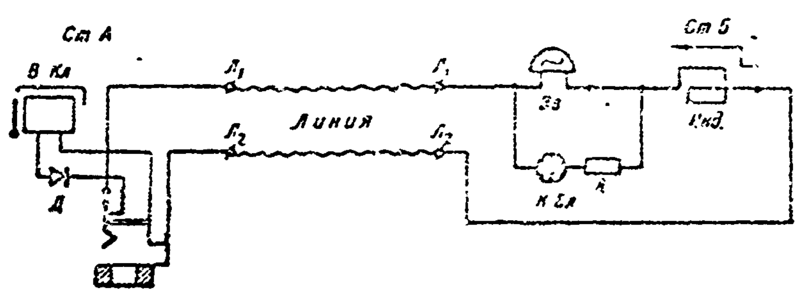


Figure 12

The diodes in the call and ringoff indicator circuit of the P-193M switchboard and in subscriber units No. 11-20 of the P-194M switchboard, can cause errors when testing the lines connected to these units. The generally accepted method for testing the working order of a line is to send a call signal from the TAI-43 apparatus, while depressing the shunting button. This is unsuitable, since the call in the apparatus will not ring, although the line and the circuit for receiving a call at another station switchboard, may be operable. The knob of the inductor is turned significantly more freely. Therefore, to make a judgement on the working order of the circuit, based on the difficulty in turning the inductor knob, is impossible.

The indicator, attached in parallel to the call of the alternating current in the BIP unit, operates independent of the receiver system for a call signal at another station.

MOBILE COMPRESSOR LASHING on the E-305 dredger makes possible the use of 1380-1600 millimeter drive belts. The pull of these belts, writes Guards Lieutenant Colonel A. Gusarov, occurs as a result of the movement of the compressor, which is mounted on two runners. Four grooves are cut in them, through which four foundation bolts pass.

AN ALL-PURPOSE INSTRUMENT has been developed by Captain N. Tkachenko to regulate the level of an electrolyte in tank and automobile storage batteries. It consists (Figure 13) of a rubber pear "1" and an ebonite pipe "2" with an iron band "3." In the lower part, the pipe has a slot "a." In order to attain the required level of electrolyte in the storage battery, the height of the slot is regulated (for tank batteries 8-10, for automobile batteries 10-15 millimeters), by turning the iron band. The pipe is lowered into the storage battery and the electrolyte is drawn off. As soon as its level is lower than the iron band, the drawing off of the electrolyte should be discontinued. In order to draw off all the electrolyte, the slot should be shut off completely.

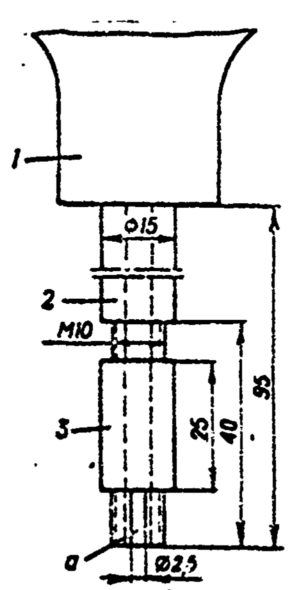


Figure 13

T AND [illegible]

In the first issue of our journal for this year, a competition for the introduction of inventions, a description of which was furnished in patent literature, was announced. A competition for the introduction of achievements, demonstrated at the Exhibit on Achievements of the National Economy of the USSR, was also declared. In this issue we are publishing a description of the exhibits of innovators, inventors and efficiency experts from enterprises of the electrical engineering industry. The inspection of these exhibits was conducted in March of this year at the Exhibit on Achievements of the National Economy of the USSR.

No. 604 -- A Burner For Welding Metals Using Natural Gas: Acetylene and propane-butane fuel gases are used basically for welding metals. However, burners of known construction can not be used for the welding of steel, using natural gas.

In the laboratory for gas-flame processing of metals of the Novocherkassk electric locomotive plant, where the "Moskva" burner has been serially produced, a new burner has been developed. This burner welds steel, the thickness of which is .5-6 mm, using natural gas, KV-.8, NS, SV-.8 G2s and SV-12Gs welding wires and also cast iron and non-ferrous metals. The nozzle of the "Moskva" burner is replaced by a nozzle having a coil and drain tube. Natural gas enters the burner. That part of the gas which passes through the drain tube heats the coil up to 600°. This raises the calorific capacity of the natural gas.

The quality of the weld and the output is the same as that when welding with acetylene. The substitution of natural gas for one t of calcium carbide results in an economy of 70 rubles. The quality of production is raised and equipment at the point of production is simplified. A minimum amount of time is required to prepare this point for production.

This burner can be made in any workshop.

No. 679 -- A Pneumatic Screwdriver with Counter-clockwise Rotation: At the "Elektroapparat" Plant, F. S. Opshanskiy developed a pneumatic screwdriver with counter-clockwise rotation which operates on the principle of a rotary motor. In the frame of the screwdriver, there is a stator made out of 45 steel and hardened to HRC-4[illegible]-50 Off-center in the stator, there is a rotor made out of 58A steel and hardened to HRC-46-50. In grooves of the rotor, blades are radially located in the form of textolite blades. The rotor turns on its bearings.

No. 748 -- A Universal Device For Removing Insulation From Wire: At the Sverdlovsk Electromechanical Plant, according to a suggestion by F. S. Lazutin and S. L. Maslov, a universal machine for removing insulation from PR-500 and PRG-500 wire, having a gage of 1.5-4 mm^2, has been developed and introduced.

The wire is inserted into an opening in the mechanism for removing insulation, up to a stop; the insulation is cut, removed and discarded into a tray by a mechanical catch.

The bending mechanism appears as a miniature punch suitable for a bend in a coil up to a diameter of 4.5-6 mm.

No 780 -- Instrument For Machining Internal Cubic Openings: At the Tallin Mercury Arc Rectifier Plant imeni M. I. Kalinin, an instrument was proposed by lathe hand E. A. Trel' for machining cubes up to a diameter of 6-22 mm on a lathe, or in the chuck of the drilling machine. It consists of a frame, to which a shaft having a Morze jaw is attached. Inside the frame, there are two bearings on which a die stock with changeable dies rotates. Using trihedral or tetrahedral dies, it is possible to machine internal trihedrons and tetrahedrons.

The use of this instrument for machining internal hexadrons, tetrahedrons and trihedrons, increases the operational possibilities of the lathe and drilling machines and raises output through the machining of polyhedrons.

No. 837 -- Carrier Center For a Lathe Machine: At the "Dynamo" Plant imeni S. M. Kirov, A. D. Poryadin and P. N. Andreev designed and made a floating center for turning parts having a diameter of 12-100 mm and any length on one mount (can not be turned around).

The center can be prepared by either of two operations: 1) if there is a protective bushing, teeth should be installed on the end of the bushing to restrain the part from pulling; 2) if there is no protective bushing, the teeth should be on the end of the center.

The parts are set up and removed without stopping the machine.

The use of a floating center has significantly lowered labor costs in processing metals and has increased the productivity of labor.

No. 878 -- A Pneumatic Polishing Machine: At the "Electric Power" Plant, N. D. Dvorov has developed and introduced a pneumatic machine for polishing and finishing stamps, press-forms, etc. The overall diameter of the polishing attachment is 20 mm; the motor is pneumatic; it is turbine driven; the circuit air pressure is 6 atm; the revolving speed of the shaft is 50,000-60,000 turns/min; the clearances are 60 x 230 mm;

the weight is .7 kg. The polishing machine insures a high degree of purity in the processing of metals.

No. 895 -- Quick-Removable Chuck For a Milling Machine: At the "Electric-Rectifier" Plant, V. M. Zarenkov developed and introduced a quick-removable chuck for a milling machine.

The chuck is used for strengthening the milling cutter, and is installed in the spindle of the machine. The chuck is provided with a set of intermediate bushings, the outer diameter of which corresponds with the jaw of the chuck. The internal jaw corresponds with the jaw of the installed milling cutter. The intermediate bushings are fastened with a special nut.

The introduction of the chuck saves time when replacing the instrument during operation.

Technical documentation for any of the above exhibit descriptions can be obtained by addressing an order to: Moscow, E-37, P/B 3016, Special Division of VNTTEhM. The text of the order should read as follows: "Please send C.O.D. a set of diagrams for _______________, which was introduced during the exhibit by innovators, inventors and efficiency experts. We guarantee payment for the cost of the diagrams. Our address is ________________________. Manager of the Organization Chief Bookkeeper"

The number of the exhibit should be included in the order.

EXHIBITS ON ACHIEVEMENTS OF THE NATIONAL ECONOMY OF THE USSR - FOR 1966

Traveling Exhibits

Experiment in the use of plastic materials in machine building (April - Kharkov. May - Cheboksary, June - Perm', November - Voronezh).

Economizing with non-ferrous metals in the national economy (April- Alma Ata, June - Ukhta, August - Gor'kiy, September - Perm', October - Tbilisi, November - Riga).

The modern manufacturing technique for a stamp instrument of a cold press (April - Volgograd, May - Khar'kov, June - N. Kramotorsk, July - Dzhambul, August - Kentay, September - Sverdlovsk, October - Gor'kiy, November - Riga).

Optical instruments for controlling rectilinearity, roughness and waviness of surfaces (May - L'vov, June - Odessa, July - Nikolaev, August - Khar'kov, September - Vitebsk, October - Gomel', November - Minsk, December - Vil'nyus).

Organization of patent funds and their use (April - Minsk, May - Arkhangel'sk, June - Yaroslavl', July - Kuybyshev, August - Rostov on Don, September - Odessa, October - Kiev, November - Novosibirsk, December - Vladivostok).

Instruments and methods for measuring temperature (May - Alma Ata, June - Dzhambul, July - Perm', September - Riga, October - Sumgant, November - Yerevan).

Standardization of manufactured equipment and the organization of its specialized production. (May - Kiev, July - Khar'kov, September - Minsk, November - Leningrad, December - Gor'kiy).

Technical means and training documents for programming instruction in higher and secondary educational institutions (May - Tbilisi, June - Riga).

TO THE MOON, MARS AND VENUS

Engineer-Colonel M. Novikov

What the cosmos represents and why man stubbornly and persistently invades its space is interestingly discussed in a book by Candidate of Physical-Mathematical Sciences M. G. Kroshkin*. The book speaks of the need for conducting space research not solely for studying space itself, but artificial earth satellites in meterorology, navigation, geodesy and geology. The history of a still-young space age is recounted along with the accomplishments of N. I. Kibal'chich, K. E. Tsiolkovskiy, F. A. Tsander and other Russian scholars who did much for the development of Soviet rocket construction.

The author dwells in detail on space research conducted in the Soviet Union, beginning with the first launch of a meteorological rocket in 1949, and ending with the flight of automatic space stations to the Moon, Mars and Venus. Interesting facts have been brought to light. The reader discovers, for example, that during the International Geophysical Year (1957/58) alone, 125 different scientific rockets were launched in the Soviet Union. A special chapter, devoted to manned space flights, examines the unforgettable exploits of Yuriy Gagarin and his comrades, the features of the flights of Soviet cosmonauts and the significance of these flights for science. The book also contains information on space research in the United States.

One reads with special interest the pages discussing the possibility of intelligent creatures on Mars, the "mysterious planet," Venus and on planets of other systems of our galaxy and universe. The author critically examines the hypthesis concerning a visit to the earth by strangers from other celestial systems.

The language of the book is lively and clear. There are graphic comparisons to assist the reader in easily mastering several complex concepts. The book contains much interesting and factual material; however, it does have distinct shortcomings. As an example, on page 54 it says, "Four to five years ago, during the period of preparation for the IGY . . . ." It was not four to five years ago, but more than eight years since the IGY occurred in 1957/58. There is also another inaccuracy; on page 203, we read, "strangers from other planets or from other stars . . . ." It is more correct to say, "from other celestial systems." Also, in our view, the book should have furnished a summary of the launches of all Soviet satellites, spacecraft and automatic stations.

The shortcomings which were noted in no way reduce the value of this needed and helpful book which succeeds in pointing out that our

* Kroshkin, M. G., Kosmos . . . Chto my znaem o nem [The Cosmos -- What We Know About It], Military Publishing House, Moscow, 1966, 206 pages, price 32 kopecks.

Motherland has not only achieved colossal successes in the mastery of space, but that the day is not far off, when the feet of a Soviet man will step onto the surface of the moon, followed by spacecraft bearing the red star and reaching out to Mars and Venus.

We should take this opportunity to note the effectiveness of the Military Publishing House. Despite the fact that the book went to print on January 4, 1966, it contained material about the successful soft landing on the moon on 3 February 1966, of the automatic station "Luna-9" and the subsequent transmissions of images of the moon's surface. On the eve of publication of this book, new reports were circulating about both the automatic station "Venus-3," which reached the planet Venus, and about the flight of satellite "Cosmos-10" with two dogs aboard. But this probably will be described in another book for which the readers doubtless wait with interest.

RELIABILITY IN AVIATION

Engineer-Lieutenant Colonel A. Gamulin

Candidate of Technical Sciences

A new book*, devoted to reliability questions, has just been published. It examines various factors which influence operational reliability and the means and methods for insuring operation. Additionally, it analyzes some characteristic faults found in aircraft units and systems.

In the preface, some reasons for the emergency of reliability problems are set forth. While revealing some of the most important of these reasons, the author provides an understanding of reliability and characterizes it as an inherent indicator of the quality of any machine and of any technical apparatus.

The first chapter begins with an analysis of the basic factors which influence the operational reliability of aviation equipment. The classification of these factors is sufficiently complete and clear. The physical nature of phenomena, arising as a result of the heating of aircraft construction elements at different times during the flight, are also revealed. Mechanical influences on aircraft components and units during flight are examined fully.

This material will be of interest to research workers who are concerned with providing technical resources for aircraft and aircraft systems. Thus, for example, a very definite and extremely convincing explanation is given for the pulsating acoustic pressure, caused by the jet stream of turbo-jet engines. A typical oscillogram, with a recording of pressure pulsations occurring in one of the aircraft systems, located near the source of noise, is obtained.

In this same chapter, the nature of changes in the parameters of technical mechanisms, influenced by factors which affect the reliability of aviation engineering, are revealed. Basic concepts and criteria for estimating reliability are also set forth.

Basic concepts in the theory of probability, which has great application in the theory of reliability, are very briefly reviewed. Somewhat greater space is allotted in the book to a simplified account of the basic characteristics of reliability. The classical curve which characterizes a change in the intensity of failures is examined in detail, and actual curves on the changes in intensity of equipment

* "Questions Concerning Reliability in Aviation Engineering" by P. A. Solomonov, Military Publishing House, 1965, 144 pages, cost 24 kopecks.

lures in aviation engineering are obtained. This material can be recommended to a reader only for the purpose of acquainting him with the elements of reliability theory.

At the present time, there is an acute need for a quantitative estimate of the operational properties of various equipments in aviation engineering. However, there are still no accepted opinions on the advisability of widely using this or that coefficient for the operational characteristics of units, systems or aircraft. Thus, the coefficients, their definitions and mathematical expressions, as provided by the author, will no doubt be of considerable interest to specialists engaged in this field.

In the second chapter, the author discusses how reliability can be insure during experimental development and also series production. At the same time, he furnishes a classification of methods and measures which can insure the required degree of reliability. Taking as an example the main diagram of an aircraft fuel system, the procedure for calculating reliability is provided. The information furnished in this book will be of use when arranging programs and during the analysis of test results of the design elements of an aircraft. The material will also be of use to teachers in educational institutions.

Toward the end of this chapter, the author relates in general terms, how reliability in aviation has been improved.

In the third chapter, the complex of work conducted to insure the required degree of equipment reliability is reviewed in detail. A table showing the classification and results of the work, as well as listing the equipments used, is provided.

The information provided in this chapter concerning the methods used in studying the state of aviation engineering following special operational tests, has great practical meaning. For the first time, this material is now available. Without a doubt, operational specialists will read it with great interest.

The section in which the author discusses the methods for revealing the causes of failures in aviation engineering and analyzing defects is also of great interest. This will be of interest to specialists who will make recommendations on the use of this statistical information on failures to insure the proper use of technical resources and accurate accounting of spare parts.

Several characteristic faults in aviation engineering are examined in the fourth chapter. The material is richly illustrated. There are actual photographs of examples of defective parts and construction elements of aircraft. The nature of the most typical incidents are described. Among these are included: destruction of the wing, plating, fuselage, individual supports, suspension axles, landing gear and other parts.

The chapter has special value in that it furnishes methods and indicators which aid in disclosing defects during an inspection of an aircraft.

This book by Engineer-Lieutenant Colonel P. Solomonov, is dedicated to an important and actual problem -- the problem of insuring reliability in aviation engineering. It can be recommended not only to a wide circle of specialists in aviation engineering, but also to pilots. Teachers in aviation schools will find much that is interesting in it.

There are some deficiencies in the book, such as inaccuracies and over-simplifications in certain problems reviewed. These do not however reduce the overall value of the book.

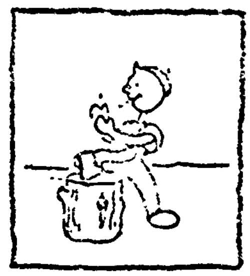
THEY ANSWER US

Articles concerning reliability of machines and the forecasting of break-downs, published in several issues of this journal, have interested many of our readers. In their letters, we find much advice and many requests. Almost all of them are interested in detailed descriptions of automatic tests of assembly elements and other instruments and mechanisms which can be made easily in troop units. Engineer-Captain V. Peretyanin, in particular, has asked if a brochure will be issued concerning the automatic testing of elements.

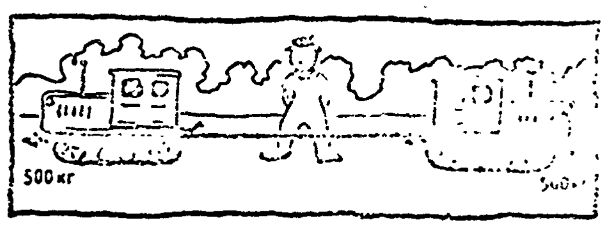
The Military Publishing House Directorate of the Ministry of Defense of the USSR, has informed us that such a brochure is not planned for 1966. However, the issue of a collection of articles on reliability and the forecasting of break-downs, is planned.

THINK A LITTLE AT YOUR LEISURE

1. It is known that the lubrication of rubbing surfaces decreases friction. Why is it more difficult to hold the handle of an ax with a dry hand, but not with a moist hand?



2. Two tractors stretch a cable in opposite directions with a pull of 500 kg each. Will a cable which withstands a tension of 800 kg break?



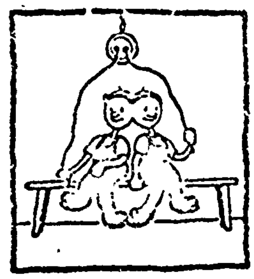
3. How can one determine the voltage of a high voltage line according to the number of insulators in the chains?

4. How can the condition of a six-volt lamp be checked with the help of a 220-volt electric hot plate (the voltage of a city network is 220-volts)?

Answers to questions published in issue No. 3

1. On the surface of an incandescent wire, a layer of cinder is formed, which does not conduct electric current. As a result of this, the active diameter of the wire decreases and its resistence increases. If the amount of current in the wire, the diameter of which continuously decreases, remains constant, the temperature will increase. As a result, the wire will burn out.

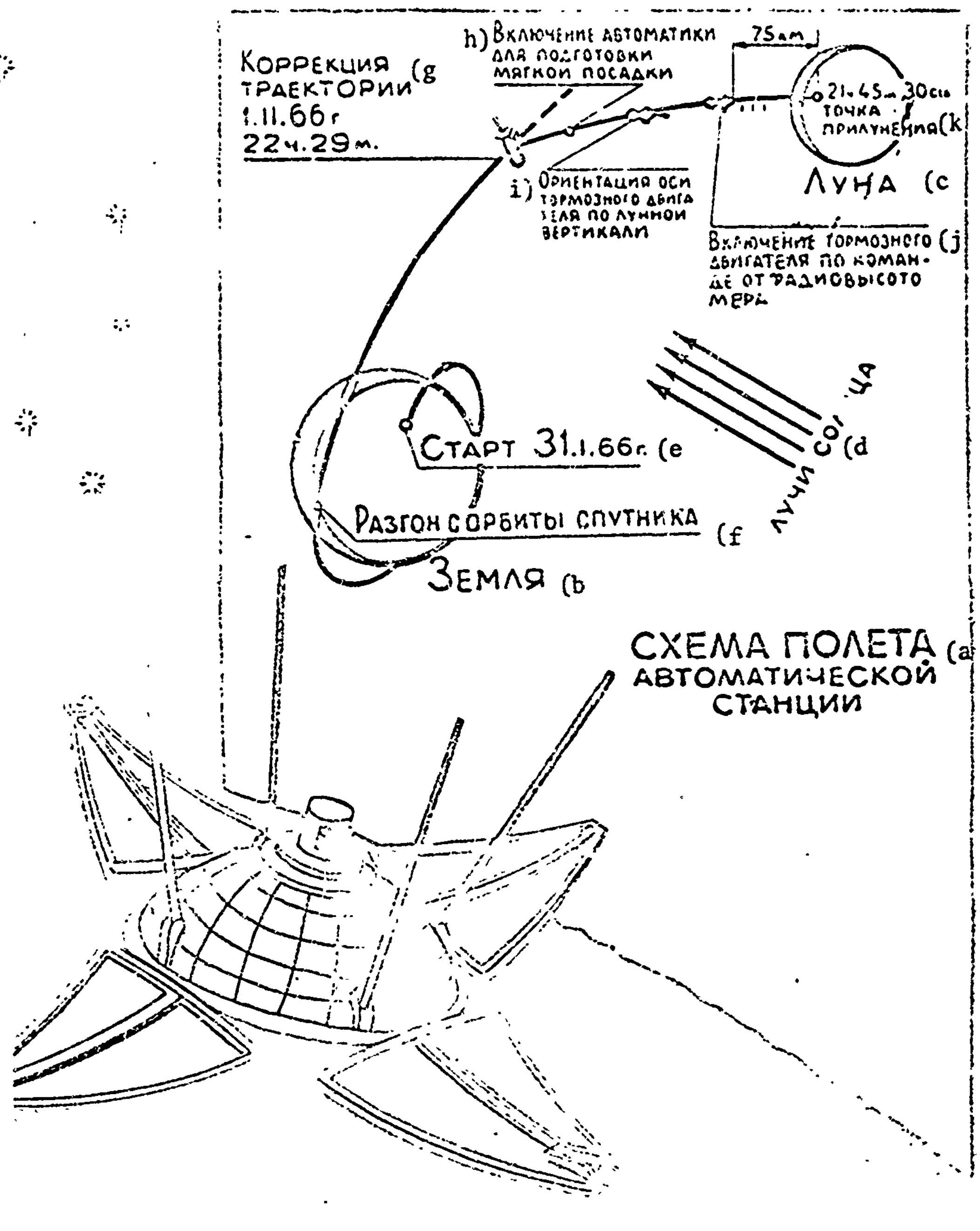
2. Surprisingly enough, a radio transmission traveling through a relay circuit may be received directly by ear. For this, two people must press together, ear to ear, and touch their hands to the receptacles of the socket of the relay circuit. Each of them will hear the radio transmission absolutely clearly.



3. When the neutral wire is connected to the spiral thread and the phase wire to the central contact of the base of the bulb, then during screwing in and unscrewing the bulb, the possibility of the fingers contacting the phase wire is almost excluded.

4. The upper particles in a rising branch of spray have less speed than the lower particles. This compresses the spray. In a descending branch of spray the different speeds of the particles means that the distance between them is not maintained with the passing of time and the spray breaks up into separate drops.

LUNA-9 -- ON THE MOON!



Wording used in drawing: a - flight chart of the automatic station; b - earth; c - moon; d - sun's rays; e - liftoff; f - boost from the orbit of the satellite; g - correction of trajectory; h - switch-on of automatic equipment in preparation for a soft landing; i - orientation of the axis of the braking engine to be perpendicular to the moon; j - switch-on of braking engine by command from radio-altimeter; k - lunar landing point.