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See Table of Contents

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14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT

The following definitions apply for the transliterated organizational entities included in the text:

chast'	[voinskaya chast'] - Administrative, line, and supply unit (yedinitsa) of the [branches] of troops, which has a number and banner, e.g., a regiment, separate battalion (batal'on, division) and troop organizations equal to them.
ob"yedineniye	[operativnoye ob"yedineniye] - Large-scale unification of various soyedineniye of the branches of troops, which is nonpermanent in composition and is intended to conduct operations in a war.
podrazdeleniye	Troop unit of permanent organization and homogeneous composition in each branch of troops, which unit forms a larger podrazdeleniye or a chast'.
soyedineniye	[soyedineniye voyskovoye] -- Combination (soyedineniye) of several chast' of one or various branches of troops into a permanent organization (division, brigade, or corps), headed by a command and a staff and including chast' and podrazdeleniye of auxiliary troops and services necessary for combat operations.
Source:	Russian-English Dictionary of Operational, Tactical and General Military Terms, 1958

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

I. THE MILITARY DISTRICTS, GROUPS OF FORCES, AND FLEETS

(Unattributed Article)

Order of Lenin Leningrad Military District: Young efficiency experts, Komsomol members Engineer-Lieutenant V. Sobakin and Sergeant D. Kapelyush work in close creative cooperation. They have developed a number of proposals for improving equipment.

Order of Lenin Moscow Military District: Senior Lieutenant V. Khromov is a good organizer and a skillful indoctrinator. More than half of the personnel in the platoon commanded by him are superiors of combat and political training. The most important component in the successes of the <u>podrazdeleniye</u> is superior engineering equipment servicing, a subject of constant concern of this exceptional officer.

Red Banner Odessa Military District: From the first days of service Technical Lieutenant A. Mit'kin proved himself to be a trustworthy, highly qualified specialist with great initiative in the aviation chast'. The aircraft maintained by him are always prepared superiorly for flight.

[Photo caption obliterated]

THE TRIUMPH OF THE CONCEPTS OF OCTOBER

(Unattributed Article)

The laboring people of all continents on our planet are triumphantly marking the 54th anniversary of the Great October Socialist Revolution. In its significance, this revolution cannot be compared with any of the major events that have occurred in the history of civilization. It shook the edifice of capitalism to the foundation and raised the international liberation movement to a new, higher level. "It indicated to the whole world," said V.I. Lenin, "the paths toward socialism, and it showed the bourgeoisie that the end of its triumph was approaching." A number of countries are already moving with sure footing along the road laid by Great October. Firmly entrenched in the states that presently form the world system of socialism, the socialist social structure has proven its great vitality in its history-making struggle against capitalism.

"We can state with full confidence," emphasized L.I. Brezhnev in the Central Committee's Final Report to the 24th CPSU Congress, "that many plans of the imperialist agressors were foiled because a world socialist system exists and functions actively." Collectively defining the thrust of foreign affairs, the countries of the socialist fraternity are having positive effects on the development of the international situation, on the course of the common battle of revolutionary forces of today against imperialism, for peace, democracy, and socialism. As a result of collective measures the military organization of the Warsaw Pact countries has been fortified.

The CPSU sees it as its international duty to promote the might of the world socialist system in every way possible. It is doing everything so that the fraternal countries could expand cooperation and create a friendly family which the people of the world could view as a model of a future world society of free peoples. The friendly visits of CPSU Central Committee General Secretary L.I. Brezhnev to Yugoslavia, Hungary, and Bulgaria have been a weighty contribution to the work of solidifying the unity of socialist countries.

For the Soviet people the present October holiday is noteworthy because it is being celebrated in the year of the 24th CPSU Congress, which has earmarked a grandiose program of social and political measures for the new five-year plan. This program encompasses all spheres of our society. It foresees a growth in the material welfare and culture of the population, The CPSU Central Committee's decree "On the Further Improvement of the Organization of the Socialist Competition" ushered in a new tide of activity among Soviet soldiers. They are directing their bubbling energy toward reducing the time necessary for attaining combat readiness, employing each minute of training time in achieving the desired ends, thoroughly learning about and skillfully employing and servicing combat equipment, obtaining classed qualifications, and developing invention and efficiency work. The problems of observing the moral and ethical standards of behavior, performing in-house details and guard duty, improving military bearing and personal appearance, and others have been reflected in the socialist responsibilities accepted.

The socialist competition is a living, creative business. Its forms and methods must be improved constantly. They must be updated with respect to new demands and tasks. It is very important that the Leninist principles of its organization -- visibility, comparability of results, and the possibilities for capitalizing on experience -- are injected without deviations. It is just as important to make proper use of incentive measures and to increase the attention given to moral incentives, which are becoming the main rousing forces for our movement forward under the conditions of communist construction. One-man commanders, political organizers, and party organizations are obligated to consider all of this in their work.

The country of the Soviets, in which a developed socialist society was started and is functioning successfully for the first time in history, is entering the 55th year of its existence. Its economic might is greater than ever before. The unity of the Soviet people, which they demonstrate through heroic labor, unanimous approval of the wise policies of the Communist Party reflected in the decisions and documents of the 24th Congress, is monolithic as never before. Our people see a pledge for complete fulfillment of the tasks posed for the next five-year plan in the policies of the party and in its scientific management, which embodies clarity and firmness, Leninist purposefulness, and logical order.

Laboring selflessly in various sectors of communist construction, the Soviet people are applying their efforts to see that the defense of the country would be strong and reliable at all levels and in all occupations. And this is understandable. Although the forces of imperialism and reaction are losing their positions they do not shy away from attempts to place obstacles in the path of the all-people's revolutionary restoration of the world begun by the Great October Revolution. They continue to fabricate acute, critical situations that are laden with serious consequences for the safety of peoples. Especially typical is the agressive political course of the

USA, which has generated a barbarian war against the people of Indochina, and which stimulates Israeli extremists.

High alertness and constant readiness to protect the historical achievements of Great October are the most important tasks of the party and the people and will continue to be so in the future. We have no territorial claims against anyone. We threaten no one, and we are not planning to attack anyone. We stand for the free and independent development of all peoples. But let no one try to speak to us in the language of ultimatums and force. But if ignoramuses do arise and embolden toward disrupting the enspirited labor of people in countries of the socialist fraternity, they will be met with inescapable destruction. Together with their brothers-in-arms in the armies of the Warsaw Pact member countries, Soviet soldiers are always prepared to fulfill this noble mission.

AGRICULTURAL EQUIPMENT

A. Melyubov, Deputy Director of the All-Union Scientific Research Institute of Agricultural Machinery, Candidate of Technical Sciences V. Fedorov, Chief of the Institute Department

"Consider a significant increase in agricultural production and more complete satisfaction of the population's growing demand for food products, and of industry for raw materials, as one of the most important tasks of the new five-year plan."

From the Resolution of the 24th CPSU Congress on the Financial Report of the CPSU Central Committee.

In the Financial Report of the CPSU Central Committee to the 24th Congress Comrade L.I. Brezhnev emphasized that the pace of uplift of the whole economy of the country and of improvi[illegible] the welfare of the Soviet people depends in many ways on the s[illegible]cessful development of agriculture. During the five-year plan the average annual agricultural production volume will increase by 20-22 percent. This means that agriculture must produce an annual average of 16-18 billion rubles' worth of goods more than in the last five-year plan using the same production space. Fortification of its material-technical base and all-possible intensification of agricultural production are the deciding conditions for the further uplift of agriculture. The list of agricultural machines already exceeds 700 brands today. We will treat only some of the models that are in use already or which will be delivered to rural laborers in the next few years.

The most labor-consumptive operation in the industrial cycle of agricultural work is plowing. The most important condition for obtaining high yields is conducting the plowing in the optimum agrotechnically-prescribed periods. The appearance of [illegible] tractors made possible the employment of machin[illegible] an enlarged operating width and, simultaneously, [illegible] increase of working speed. For example, the K-700 [illegible] mounted eight-body plow provides for high-quality plowin[illegible] up to 10 kilometers per hour. The use of hydr[illegible] steering in modern plows led to the freeing of a significant number of agricultural workers who had previously served as plow operators.

The Exhibition of the Achievements of the USSR National Economy: New machines being supplied by industry to rural laborers are a permanent exhibit on an open-air platform at the "Mechanization and Electrification of Agriculture" pavillion.

The new unified multipurpose plows, which contain from three to eight bodies, differ favorably from the previous ones in a number of design features. Their frames are welded out of thin-walled, curved structural sections of low-alloy steel. The body standards are drop-forged. The machine units are furnished with wear-resistant, self-sharpening shares. Plows with revolving working parts, which are presently in the development stage, will ensure high quality plowing.

The next operation after plowing is soil loosening and weed disposal. Industry is supplying various machine units for this purpose, including cultivators predominantly of the mounted type with interchangeable working parts. Their working width is 2.8 to 5.6 meters. Furrow cultivators with fertilizer-distributing units make it possible to combine furrow treatment and application of mineral fertilizer to the soil. Production of scarifying cultivators with revolving working parts, which make it possible to work the soil even better, is beginning. Special flat-cutting cultivators that leave a stubble on the field surface have been planned for regions in which the soil is subjected to wind erosion.

The fleet of modern machines ensures full mechanization of the sowing of all crops cultivated in the Soviet Union. The sowing machines employed for these purposes can work at heightened speeds and perform drill and narrow-rowed sowing for grain crops, square-nest sowing for corn and cotton, single grain sowing for beets, and wide-row sowing for vegetable crops.

Improvements in machines of this type are following the course of making them multipurpose and increasing their working speeds. For example, the new SZ-3.6 sowing machine seeds grain, flax seeds, grasses, and soy by the normal and the narrow-row methods at speeds of up to 15 kilometers per hour. Beet seeders can be used to sow millet, buckwheat, beans, and vegetable seeds. Removable attachments created for corn seeders make it possible to sow soy, melon crops, beans, sunflower, and peanuts. The machine units are furnished with automatic control devices.

Combined seeders have been developed which will be able to fulfill several operations in one run (seeding, fertilizer application, soil packing), while precise seeding machine units will make it possible to reduce the norms for seed expenditure by two times. The SKM-6 six-row potato seeder, which has a productivity of 8 hectares per worker day, will be used in place of the SN-4 mounted four-row seeder.

The need for further chemicalization of agriculture was especially emphasized both at the July (1970) CPSU Central Committee Plenum and at the 24th CPSU Congress. Industry is steadfastly increasing the supply of chemical, mineral, and organic fertilizers, liming materials, as well as various toxic chemicals for protecting plants from diseases, pests, and weeds.

Mineral fertilizers are applied to the soil with basket-like spinner broadcasters mounted on the chassis of trucks or on suspended machine units. RTT-4.2 fertilizer distributers joined together into a machine unit are also employed for this purpose. The total working width attains 16.8 meters. Spinning devices spread fertilizer evenly enough in a strip up to 12 meters wide at speeds of 8-10 and even 15 kilometers per hour. The loading capacity of the new 1-RMG machine is 4 tons. A model with a 6-ton loading capacity is also being developed.

Organic fertilizers are applied to fields with trailer-type machine units, while liquid manure is introduced with the AMZh-2 power-driven spreader and the EZhV-1.8 trailer type. Soon they will be replaced by a machine with greater capacity (3.6 cubic meters). The self-loading, high output ARUP-8 machines which have an 8-ton loading capacity, have been designed for introducing reducing agents into soil -- dolomitic and phosphorite meal, cement powder, and shale ash. A machine of similar type that unites with the T-150K tractor has been prepared for production. The application of liquid nitrogenous fertilizers and herbicides has also been mechanized. In addition to the SAM-8 herbicide-ammonia machine, the improved multipurpose POU machine is being supplied. An outfit of machines is being developed for introducing anhydrous ammonia into soil.

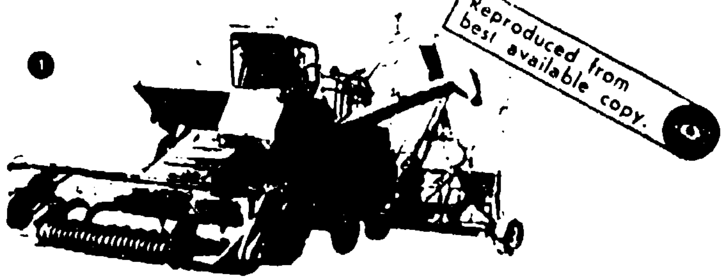


Figure 1. The new Niva SK-5 combine is furnished with a 100 horsepower engine and has a throughput capability of 5 kilograms of grain per second.

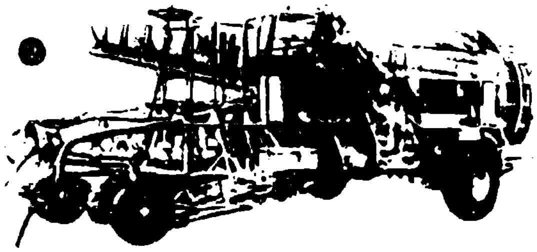


Figure 2. The Druzhba KKU-2 potato harvesting combine digs out the potatoes and cleans them of tops and soil.

Plants are treated with protective chemical compounds by sprayers, dusters, seed dressers, aerosol generators, and fumigators. Especially great use is made of high-productivity spraying fans -- the tractor-mounted OVT-1A for treating field crops, the OVS-A for orchards, and the special OV-4 machine unit that simultaneously treats three rows in a vineyard, and other machines. When combined with the APR and SZS-10 machine units, which mechanize solution preparation, these machines make it possible to raise labor productivity significantly in protection operations and to improve the quality of field treatment. Moreover, the possibility has appeared for conversion to so-called low-volume spraying, which provides a greater savings of the treatment liquids. For example, the standard for liquid expenditure in treating field crops with the OP-450 sprayer is only 5-50, as opposed to 100-600 liters per hectare for hose-type sprayers. With the use of the new machines in orchards the expenditure of treatment liquid decreased from 1,000-2,000 to 250-500 liters per hectare.

Figure 3. The ARUP-8 machine enriches soil with powdered liming materials.

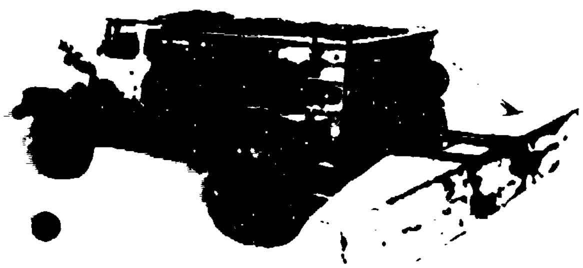


Figure 4. Mounted on a motor vehicle, the KSA-3 broadcaster applies mineral fertilizers to fields.

Artificial (sprinkler) irrigation is becoming more and more significant because it ensures high, stable yields. For irrigating small fields sprinkling equipment is used that contains detachable pipelines on which revolving sprinklers are situated at certain intervals. Large fields are irrigated with self-powered DDA-100M double-cantilever sprinkling units mounted on a caterpillar tractor. Such a machine unit has a working width of 120 meters, and it expends up to 130 liters of water per second. It takes the water from an irrigation canal, into which it is pumped, as in the case of diversion pipelines, by self-powered tractor-mounted or floating pumping stations.

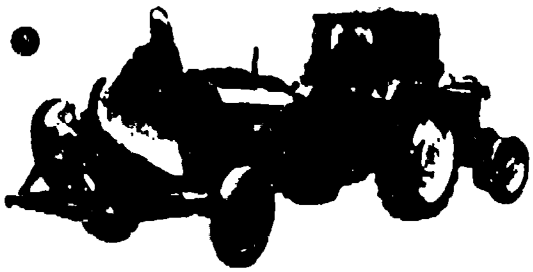


Figure 5. The CVT-1A, a powerful spraying fan, reliably treats plants and provides a significant savings of treatment fluid.

The DDN-70 suspended long-range sprinkling machine units are the most maneuverable. They include a centrifugal pump with a reducer, an intake hose, and a turning discharge nozzle with long-distance spraying equipment. Water from this equipment is forced under great pressure into two jets at a 30-35° angle with respect to the horizontal and breaks up into drops at a radius of up to 70 meters. The facility is furnished with a tank for soluble fertilizers, making it possible to combine irrigation and plant fertilization. In the next few years long-range sprinkling machines with higher productivity will appear on the fields.

The harvest is the finale of a hard-paced agricultural year. In our country grain crops are harvested by combines exclusively. Their presence in agricultural production increases constantly. As foreseen by the Directives of the 24th CPSU Congress, by 1975 rural laborers will receive 541,000 of these machines.

Since 1958 our industry has been converted to the production of self-powered combines only (SK-3, and later SK-4), which became the principal grain harvesting machines. The SK-4 combine has a through-put of 3.7 kilograms of grain per second. It has a number of modifications. In regions of heightened soil moisture, for example, the SKP-4 machines on half-tracks are used. Rice harvesting is done by the SKPR-4 combine with an additional pin-type thrashing drum. The crawler-mounted SKG-4 combine has found employment on irrigated land and in a number of regions. A number of special attachments make it possible to use a combine such as the SK-4 to harvest sunflower, seed plants of grasses, beans, pulse crops, groats, and some other crops.

A continual growth of yield forced a need for raising the through-put of combines. This problem has been solved. The modernized SK-4A combine and the double-drum Sibiryak SKD-5 have a through-put of 5 kilograms per second. New models of the combine will soon appear on the fields -- the Niva SK-5, as well as the Kolos SK-6, which has no equals in the world with respect to the through-put of the thrasher -- over 6 kilograms per second. There are two modifications of the SK-5 and SK-6 manufactured -- single- and double-drum. A number of technical improvements that reflect the achievements of modern combine building has been introduced into their design.

In place of the ZhVN-6 and ZhVN-10 reapers for swath harvesting of grain crops with preliminary mowing and placement of the grain into wind-rows, agriculturalists will receive the multipurpose ZhVN-6-12, which forms one wind-row from a 12-meter strip or two wind-rows from two strips each 6 meters wide. Normally the straw that remains is collected into shocks with a mounted mechanized piler. Then they are transported by a haysweep or shock hauler to a stacking point generated by a hay stacker. Another method is used. Straw pulverized in the combine is collected into a replaceable trailer cart with a capacity of 40-45 cubic meters. Presently more highly improved methods are being developed for removing straw that employ special machines -- stack formers and stack transporters.

The collected grain is treated by grain cleaning machines. If need be the grain is also dried artificially in drum- and compartment grain driers. Fully mechanized grain cleaning machine units and grain cleaning-drying combinations, which have already been introduced at many farms, will see wide employment during the present five-year period. The productivity is 5-40 tons per hour, and the grain is treated on automated flow lines. The new Khersonets-7 corn-harvesting combine is designed for harvesting grain corn and simultaneously removing the outer coverings from the ears and pulverizing the leaf-and-stubble mass.

Mechanization of such a laborious process as potato harvesting is one of the important problems. Until recently it was solved by the employment of various types of potato diggers which did not eliminate manual labor -- the removal of the tubers from the field. A mechanized production method has been created and is being introduced. The Druzhba KKU-2 potato-harvesting combine, the KSP-15 potato sorting facility with a productivity of up to 15 tons per hour, and the TEK-30 loader-transporter are included in the outfit of machines designed for this purpose. The combine digs up the furrows, removes the tops and soil from the potatoes, and hauls them to the transporting vehicle. At the sorting station the tubers are cleaned for the last time of soil residue and sorted into three groups. Then the potatoes are dumped into a storehouse by the loading vehicle. When equipped with the TPK-30 attachment it also can unload the potatoes if the need arises.

The KKU-2 combine is being used as a basis for developing a multirow potato-harvesting combine as well as a family of unified machines for harvesting carrots, table beets, onion, and other roots.

Sugar beets are harvested by the KST-3 and KST-2A plucking combines. They dig out the beets, grasp them by the tops, remove them from the soil, and pass them into a special device. Here the tops are trimmed off and dirt is removed from the beets. The roots pass into a motor vehicle moving along with the combine, and the tops are dumped into a trailer hitched to the combine. With another type of combine the tops are cut while the beet is still rooted and passed to a hitched trailer. Then the beet roots are removed from the soil by a disc plow, cleaned, and unloaded into a transporting vehicle. The machines have hydraulic steering and guiding devices that automatically align the working parts with the rows. Improved machines are being developed that make swath harvesting of beets possible. One machine removes the tops, while another digs out the roots, cleans the dirt and top remains from them, and loads them into the transporting vehicle.

Cotton harvesting was mechanized relatively recently. The first single-row SKhM-48 vertical spindle cotton picking machine was designed in 1948. Later machine units appeared that harvested unopened bolls (kurak [transliteration]) and stems (guza-pay [transliteration]), and production of two-row cotton picking machines began. The first high-productivity four-row cotton picking machines in the world, the 14KhV-2.4, began operating on the fields in 1968.

Full mechanization of feed procurement and preparation has great significance for the creation of a sound stock-breeding feed base, for the solution of one of the more important tasks outlined by the Directives of the 24th CPSU Congress. The achievements in this field were not few in the last five-year plan. The harvesting of crops for silage, corn primarily, has been mechanized. The KS-2.6 and KS-1.8 forage harvesters mow and process the plants and load them into transporting vehicles as a pulverized mass ready for storage. The KS-1.8 has a modification that can be mounted on an SSh-75 self-powered chassis. A machine has been developed on the basis of this combine that can harvest corn not only for silage but for grain as well.

Various types of mounted and hitched mowers, rakes, windrow pick-up-pilers, and hay stacker-loaders are included in the outfit of hay-harvesting machines for preparing pulverized hay. Another outfit is designed for harvesting baled hay. A new outfit has also been created for harvesting senazh [transliteration], a feed that is distinguished by a much higher content of nutritive substances. The preparation of grass meal, used as a highly vitaminized supplement, has also been mechanized fully. Soon there will be a sharp increase in the supply of machines that wash and pulverize roots and tubers and steam and mix succulent feeds.

The modern procedures for stock- and poultry raising for meat are based on an extensive employment of concentrated combined feeds. They are prepared by outfits of equipment in feed shops present in kolkhozes, sovkhozes, and interkolkhoz plants. The equipment is combined into an industrial production line with automated control of the whole process -- from receipt of the initial components to the output of the finished product. Mechanization of all the basic jobs significantly reduces the production costs.

Farms are being furnished with stationary and movable feed distributors, various type of self-waterers, and improved milking machines. For example the Daugava milking facility with a milk line includes equipment for cleaning, cooling, collecting, and storing milk. The collection and transport of manure is also being mechanized. The buildings are being equipped with thermal generators for heating and ventilation.

Large specialized stock-breeding farms require a higher level of mechanization. They are furnished with multipurpose sections with flow-line production procedures and with all processes mechanized. In this regard the most typical are the outfits of machines and equipment that fully automate the production of poultry meat (broilers) and eggs. Today over 300 poultry factories furnished with such equipment are already operating in our country. Automated outfits are also being introduced into other sectors of stock-breeding.

Industry is also supplying agriculture with increasing numbers of special machines and attachments that mechanize the operations in vegetable growing, horticulture, viticulture, and those for cultivating tea, hops, tobacco, and other crops.

Successful fulfillment of the measures for raising the mechanization level, outlined by the 24th CPSU Congress, will ensure the further development of agricultural production, a rise in labor productivity, and a reduction of production costs.

TIRES WILL BE LONG-LIVED

Special Correspondent Engineer-Lieutenant Colonel I. Belen'kiy

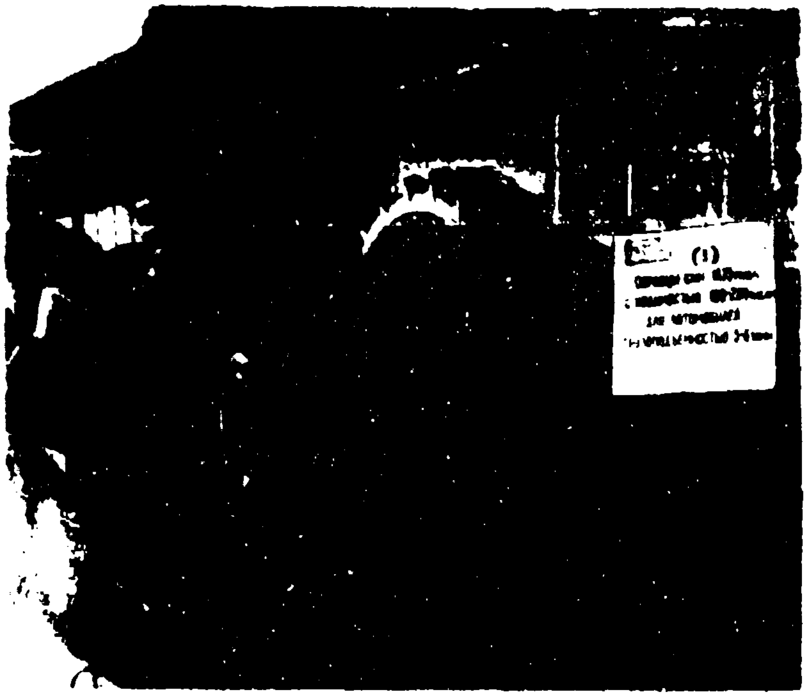
> The Directives of the 24th CPSU Congress have ordered that motor vehicle production must be increased to 2-2.1 million units in 1975, and that truck production must be increased by approximately 1.5 times, and passenger cars by 3.5-3.8 times. Completion of this tremendous task will require the joint efforts of workers in many industrial sectors and the solution of a number of difficult technical problems. One of them is improving tire quality.
>
> Deputy Director of the Order of Lenin Scientific Research Institute for the Tire Industry, USSR Academy of Sciences Corresponding Member Professor V.F. Yevstratov described tire production for the Ninth-Five-Year Plan in a discussion with our non-staff correspondent Engineer-Lieutenant Colonel I. Belen'kiy.

In the Eight Five-Year Plan the average life of truck tires increased by 25-30 percent, as a result of which the national economy obtained a savings of 1.1 million rubles. This was possible to attain owing to an increase in tire life, primarily through changes in tire design, introduction of radial tires (type R), as well as through the employment of new production procedures and higher quality initial materials -- synthetic rubber, cord, carbon black, and various chemicals.

As foreseen by the Directives of the 24th CPSU Congress, the average truck tire life must be increased by 20-25 percent. What would be the return? It would be very great: Such an increase in tire life is equivalent to the production of 20 million new tires, for the production of which 50,000 tons of synthetic rubber, 120,000 tons of cord, and 250,000 tons of carbon black would be required. If we also consider the capital investments that would be necessary for expanding the production capacities of both the tire plants and the enterprises cooperating with them, the savings would be many hundreds of millions of rubles.

The experience accumulated during the development and organization of type R tire production gives all the justification for considering the task of creating truck tires that are capable of running for 180,000-200,000 kilometers on improved roads fully realistic. Thus in the near future the life of tires will be comparable to the service time of the motor vehicle between repairs.

Projects are also being conducted intensively to improve other operating indices of the tires. Their weight, in particular, will decrease by about 10 percent as compared to the weight of tires produced in 1970. Imbalance will be reduced, and there will be a 10-15 percent reduction of losses due to rolling. The warranty period for storing and using adjustable-pressure tires, type R tires, and some others has been raised from three to five years, and in the next few years it will reach 8-10 years owing to the use of high-quality preservatives and antifatigue agents.



Key: 1. 1975 tire models with a 180,000-200,000 kilometer running life for 5-6 ton motor vehicles

In addition to the improvements being made in tire operating characteristics, a problem is being solved for which the importance is obvious without special explanations: The employment of domestically produced synthetic materials in materials is a significant achievement of domestic science and technology. Understanding well the significance the incorporation of series output of such products has for fulfillment of the national economic plans, workers of the tire industry are fighting with enthusiasm to solve this highly important task in the shortest time possible.

ACTIVE PARTICIPANTS OF THE COMPETITION

Lieutenant General V. Dyatlenko, First Deputy Commander of the Forces of the Moscow Order of Lenin Military District

As noted in the Directives of the 24th CPSU Congress, one of the paths for embodying the main tasks of the Ninth Five-Year Plan is complete introduction of scientific organization of labor. It also plays an important role in the organization of combat equipment maintenance and repair. Taking this into consideration, steps were taken in the forces of the Moscow Order Of Lenin Military District to ensure the active participation of repairmen in the competition publicized in Tekhnika i Vooruzheniye. Generals and officers of the district's administrations, departments, and services, and the commanders, political workers, and party and Komsomol organizations of the repair enterprises, chast', and podrazdeleniye were included into the work.

Party meetings were dedicated to this problem, publicity work was conducted on the purposes and tasks of the competition, measures were formulated to attract personnel to participate in it, and visual aids were set up to arouse the personnel.

The question of the competition's progress was examined and reports were heard from officers of the Guards Tamanskaya [transliteration] Division imeni M. I. Kalinin and of a number of the district's administrations at an expanded assembly of the district committee on inventions. Many representatives from commissions on inventions participated.

The results of participation of the capital's district repairmen in the competition were summarized. It was already reported in one of the issues of Tekhnika i Vooruzheniye how the personnel of the repair and restoration battalion in which Technical-Senior Lieutenant A. Tsivinskiy is the chairman of the commission on inventions actively joined the competition. As of the present the outfitting of all five working places recommended for introduction has been completed in the battalion.

The report of the competition reached the repair and restoration battalion in which Major V. Klyukvin heads the commission on inventions at a time when replanning and re-equipping of the production sections was beginning there. In particular, at that time they were introducing mechanized resources for moving heavy parts and machine units from the warehouse to the working places. All buildings were carefully renovated, and the walls and equipment were painted with colors that satisfied the demands of scientific organization of labor. Daylight lamps were installed. In the more critical sections the working places of the turner, the electrician, fitter, and electric welder were re-equipped. The published conditions of the competition, which provided descriptions of the working places, were of great assistance.

Repairmen of the regimental team participated actively in the competition. For example, specialized working places were furnished that ensured high quality of and faster completion of repairs and preventative maintenance in one of the equipment-using chast', in which Major Technical Service G. Stupin is the chief. One such working place is that of the radio instrument mechanic created by efficiency experts captains technical service V. Makarov and P. Khotyakov, and extended service Sergeant I. Belous. It is standardized and can be adapted for work in any repair podrazdeleniye where work must be done with instruments and radio equipment. This working place consists of an all-purpose table finished in light plastic with drawers for storing monitoring and measuring instruments and expendible materials, a working surface for the articles being tested, a unified device that provides 28, 36, 115, and 220 volts working power to the instruments both in stationary and in field situations, and a revolving stool. The working place is outfitted in such a way that the radio mechanic could test, repair, assemble, and disassemble equipment without leaving his stool, as a result of which labor productivity increased by 20 percent, and the quality of the work fulfilled was improved.

We note incidentally that experience has indicated that the best results were attained wherever the work of the competition was headed by commanders and supervisors, and where inventors were encouraged to participate in it. And this is as it should be. The specific nature of military repair required that essential design changes be introduced in certain cases into the working places recommended on the pages of Tekhnika i Vooruzheniye. Moreover, such procedures had to be developed which would result in minimum expenditures of resources, labor, and time for manufacturing the equipment. The perception of efficiency experts helped here.

As is known, military repair units must posses light, portable equipment. It is namely with a consideration for this requirement that Major V. Barabash, in one of the technical maintenance units, developed a multipurpose working place for an aviation specialist to repair and test aircraft equipment. It is a table with a height that is adjustable within 50 millimeters, with overall dimensions 1,600x750x800 millimeters. The table has three drawers within a container 620 millimeters wide and 600 millimeters high for the necessary **materials**, technical documents, and instruments. The container separates easily from the table and is moved independently (Figure 1). Set-up and dismantling are completed in 10 minutes. Power is supplied through a special panel that is mounted with a consideration for operating convenience, as is also true for the lamps.

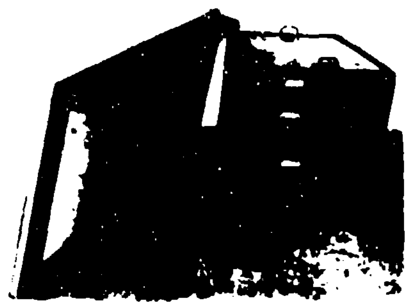


Figure 1

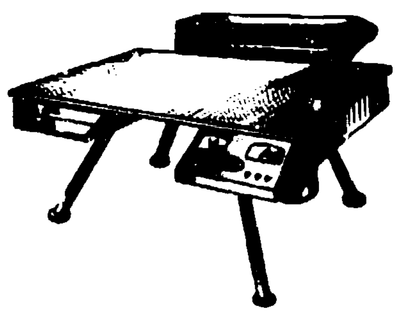


Figure 2

A great amount of work on the competition was also carried out in a number of the district's repair enterprises. At one of them, Soviet Army employee B. Dvoretskiy and Soviet Army worker I. Mogil'nyy developed and actively helped to introduce a welder's working place designed for electric welding in an argon medium (Figure 2). It includes a table, its overall dimensions are 1,200x700x300 millimeters, and a swivel chair with adjustable height (not shown in the figure). The table top is made of sheet steel mounted corners. For greater stability the table legs are fastened at an angle. It can be set at a precisely horizontal position by adjustable screw supports on which the two rear legs are mounted. A suspended pedestal made of sheet steel is situated in the table to the left of the welder. Roller-mounted drawers in which instruments and technical documentation are stored are installed in it. To the right of the table a panel is mounted on which measuring instruments and controlling elements for argon supply and current parameter adjustments are positioned.

A powerful fan is used in the extract system, owing to which the gases produced during welding are almost entirely removed from the working zone.

The dimensions of the table and the positions of the pedestal and welding mode control panel were selected in such a way that the working zone of the table, drawers, and control knobs would be within the reach of the operator while sitting. With the introduction of such a working place, the welder's labor productivity increased by 20 percent.

At this same enterprise Soviet Army employee A. Belyakov and Soviet Army worker P. Mikhutov designed an all-purpose mechanic's working place. Besides fitting operations, it can be used for part monitoring and defectoscopy. Below the table of the working place there is a lower shelf on which blanks are stored during fitting jobs and on which parts and units are placed during fault detection. Dozens of working places are furnished with such equipment at the enterprise.

In the repair enterprise in which Engineer-Major B. Korchagin is the chairman of the commission on inventions, Soviet Army employee M. Serzhantova developed a comfortable two-place fitter-tool maker's working place (Figure 3). With its introduction the expenditures on nonproductive losses in working time decreased by 20 percent.

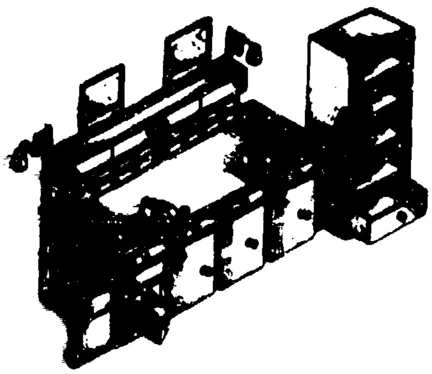


Figure 3

The frame of the work bench is manufactured from corner steel and is faced with sheet steel. The table top is made of wood, covered with sheet steel, and framed with corner pieces. Mounted on it are four compartments with sliding doors for storing diamond jewels and lubricating materials, and eight drawers for small, standard specialized parts. Local lighting is provided by two lamps. Two brackets are mounted on a transverse bar and have clamps for holding drawings, which can be positioned at any angle and moved along the bench.

In the lower portion of the bench there are four drawers for fitting instruments, and under them there are four partitions with revolving shelves (two for each worker) for small instruments and ancillary materials. The internal faces of the doors for the outside partitions contain pockets in which technical documentation is stored.

A set of shelves with four open shelves for storing semifinished products and a drawer for wastes is positioned next to the work bench.

The enterprise in which Engineer-Major B. Rybalo heads the commission on inventions attained good indices in the competition. Here all working places at which radio equipment is repaired satisfy the requirements of scientific organization of labor. As a result the labor expenditures for repairs decreased by 1,300 standard hours. And this was done with the active participation of efficiency experts. For example, Engineer-Captain A. Karpun proposed a comfortable working place for the radio engineering equipment assembler, and Engineer-Senior Lieutenant A. Tutarinov developed as working place for the winding of coils for electric motors, generators, selsyn motors, and other electrical instruments. It is a table, the frame of which is made of steel tubing and corners. A pedestal with drawers is mounted on the left side. The table top, pedestal, and front of the drawers are finished with plastic. On the table top there are three stands for spare spools of winding wire, a shelf for lacing boards, two supports with a crosspiece for the horizontal working spool, supports for the vertical working spool, a lamp, a soldering iron stand, and a power pack. There is a turntable on the table's working area on which the articles under repair are mounted.

All working places in the production training workshops of the district's military academies have been remodeled in correspondence with the requirements of scientific organization of labor. After all it is very important that junior officers who enter the forces after completing the academy be bearers of all that is advanced and foremost. For example, at the Ryazan Higher Command Communications Academy Honored RSFSR Efficiency Expert Colonel U. Spivak and Engineer-Senior

Lieutenant A. Safronov developed a multipurpose radio mechanic's working place designed for fulfilling circuit assembly and adjusting operations during practical lessons in the communications equipment repair course. Instruments can be mounted on it in any combination, depending on the type of equipment being repaired. The training class is equipped with such simply manufactured and inexpensive working areas.

A special working place has been manufactured at the Ryazan' Higher Command Motor Vehicle Academy for fulfilling practical and experimental operations involving gas flame treatment of metals. It is illuminated by a safety lamp. The ventilation is balanced. Local gas removal is accomplished by a fan. In addition to a table and a chair with adjustable height, there is a water bath at each working place.

Owing to efficient organization of the working places for welding operations, it became possible not only to improve the quality of the operations completed by the cadets, but also to ensure the satisfaction of safety and industrial sanitation requirements.

The participation of many repair enterprises, chast', podrazdeleniye, and training institutions in the competition provided an economic effect that was not small. It facilitated further introduction of the principles of scientific organization of labor, successful completion of the planned quotas for combat equipment, armament, and military resources repair, and the improvement of their maintenance.

A SIGNIFICANT EFFECT HAS BEEN OBTAINED

Engineer-Captain 1st Rank (Reserve) I. Khain

The competition announced in the journal Tekhnika i Vooruzheniye by the USSR Ministry of Defense Department of Inventions, the Central Council of the All-Union Society of Inventors and Efficiency Experts, and the board of the Exhibition of the Achievements of the USSR National Economy helped us in starting to design and manufacture various types of equipment adapted to local needs, and to select it from among enterprises involved in the same sort of production, as well as from the Exhibition of the Achievements of the USSR National Economy.

Workers in navy repair enterprises as well as production innovators displayed great activity in this work. They have proposed many new types of equipment. For example, semi-enclosed racks are employed for storing various units and parts at the enterprise in which Soviet Army employee V. Dolgov is the efficiency engineer. On two sides they have enclosed sections in which bins that can rotate 360° are mounted, used for storing fasteners and other small parts. Such a rack of larger size makes it possible to have a great quantity of spare parts right at the working place, as a result of which the losses of working time in trips to the storeroom decrease.

Work benches for electric motor assembly and disassembly, based on the standard plans for a ship electrician's working place, were manufactured at that same enterprise. They are furnished with special drawers for instruments, fasteners, and technical documentation, and with racks that have circular shelves which can turn 360°. Electric machines are placed on these turntables in positions convenient for assembly and disassembly. The shelves are fixed in the needed position by a spring catch.

The working places of the pipe mounting repair fitter and the refrigeration unit repair fitter, which were introduced at the enterprise where Soviet Army employee M. Limmo is the efficiency engineer, are also furnished with facilities that ensure efficient storage of instruments and technical documentation.

Experience confirms that the best results are obtained if the standard plans foresee not only the most efficient equipment for the working places but also the most convenient layout and advanced servicing procedures. We have developed such plans for machine tool operators, ship electricians, ship hull repairmen (for repair of deck fittings), piping repairmen (for repair of ship fittings), and diesel engine fitters. We have also made up integrated scientific organization of labor plans to improve labor organization during dock work.

The effect of introducing such standard plans is significant. For example, one of the enterprises that used our plans to equip the working places of an engine repair fitters' team and of a ship hull repairmen's team for deck fitting repair saves several thousands of rubles per year.

THE PROBLEM OF AUTOMATION OF CONTROL

Engineer-Colonel L. Karnozov

The demands for forces control grow. Automatic machines collect information. The battlefield is on a screen. A machine prepares recommendations.

Continuity, firmness, flexibility, swiftness in reacting to changes in a situation. These are the universal demands made on forces control. It stands to reason that the level of these demands increases with a rise in the amount of equipment the troops have, equipment that brings with it profound changes in the nature of combat operations. It is felt that operations will distinguish themselves as never before by even greater decisiveness of the outcome, affected range, by high dynamism, and by rapid, sharp changes in the situation. Under these conditions the quantity and rate of receipt of information involved in forces control will increase immeasurably. But the time allowed for processing it and making a sound decision will decrease significantly. All of this has served as a motivation for extensive introduction of technical resources into the control process.

We can raise control efficiency significantly by automating information collection, employing electronic digital computers to process it, and using the latest communications and display systems to transmit control signals and orders. In this case it is considered possible to delegate only the functions of information collection, storage, and processing to automatic machines. After all, undoubtedly the potentials of a digital computer are limited. Machines can make mathematical computations, select and classify information, and compare different stages of a situation as it changes. But only a human being can evaluate the information, penetrate into the thoughts of the enemy, and correspondingly select the proper decisions. This is precisely why the basic purpose of automation of control hinges not upon the exclusion of human beings but on raising the productivity of their actions.

It has been noted that an automated control system could be viewed as effective only when it does the jobs of information collection, transmission, processing, and output completely. The search for technical facilities that are able to fulfill the enumerated functions in the best way, and their testing began abroad more than two decades ago. But to this day, judging from the foreign literature, the automation problem has not been solved completely. The well-known American systems SAGE (air defense control), MASS (army and navy supply system control), FIELDATE (ground forces control), and others are recognized to be far from perfected. Therefore the development of such systems continues.

Presently serious attention is being devoted to developing and introducing technical resources for collecting information about the enemy. The construction of infrared, laser, and television equipment designed for night work is felt to be especially important. As is noted, definite successes have been attained in the creation of infrared (IR) instruments. Instruments with high sensitivity and resolution aready exist. Instruments are being developed in which lasers of the arsenide-gallium group are used to illuminate facilities under observation and to increase operating range.

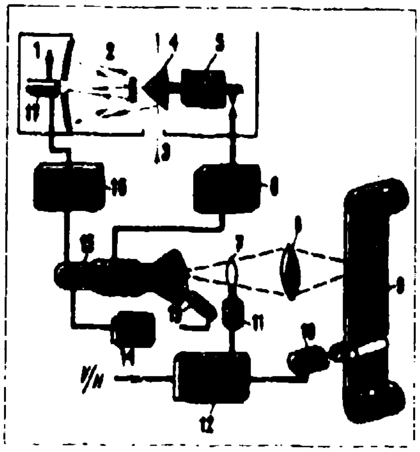
Television reconnaissance systems that work at low light levels are being introduced. The television tubes of such systems contain photoconductors combined with image amplifiers for work with illumination by starlight.

The modern methods of aerial reconnaissance employing various instruments make it possible to collect a significant amount of information. However, for it to be used as a rule the aircraft must return to the base where this information is subjected to initial processing. A lot of time is spent on this. Reports can be transmitted much faster if the data is communicated from on board the aircraft.

For example a device that makes it possible to develop the film immediately after exposure has been used in aerial photographic systems. The development, fixing, and drying cycle takes only 20 seconds. Then each image is scanned by a linear scanning device. The total cycle of image transmission by radar takes one minute.

Work is being done to design devices that make it possible to transmit graphic information along telegraph communication channels. For example equipment is being tested that reads typewritten texts and transfers them to teletype ribbon for subsequent transmission along communication channels.

An optical pickup reads the text, using the reflection or absorption of light by specific points on the text. After this the symbols are compared with an alphabet stored in the memory. The equipment can read 370 symbols per second and record 1,200 words on tape per minute. A page of text is processed in 5 seconds, which means 17,280 pages per day.



In one of the on-sight IR aircraft reconnaissance systems radiation 3 coming from the ground surface strikes mirror 4, which scans through the action of motor 5. The scanning axis coincides with the aircraft's longitudinal axis. A system of parabolic mirrors 2 directs IR radiation corresponding to a point on the ground below the aircraft at each moment onto a sensitive element. Under the effect of IR rays the resistance of the sensitive element, located in a cooling liquid 1, changes. Voltage passes from its output to video-amplifier 16, and then to the modulator of cathode-ray tube 15. The tube's horizontal scanning is synchronized with rotation of the mirror, since a signal from motor 5 passes to the tube through amplifier 6.

The intensity of the image on the tube's screen is sufficient to expose film 9 passing across objective 8. The speed of the advancing mechanism 10 is proportional to the angular velocity of the aircraft -- that is, it depends on the horizontal flying speed and altitude, data on which are transmitted from servo-amplifier 12. The exposure is varied by diaphragm 7 moved by device 11. Signals from photocell 13 on the light intensity of the cathode-ray tube and from servo-amplifier 12 on the aircraft's flying speed are transmitted to this device. Amplifier 14 controls the cathode-ray tube.

The tape is introduced into an electronic switching system, a high-speed computer controlled by a program stored in the memory. One hundred sixty communication lines, along which information is exchanged with telegraph devices great distances away, can be hooked up to it.

At first the system checks the address code and the message format. Then it analyzes its priority code, after which if there are no errors it immediately transmits it to the proper addressee. If errors are detected the tape is rejected for subsequent manual correction. When errors are detected on urgent messages the latter are presented on a screen of a display device, and corrections are made with a teletype keyboard.

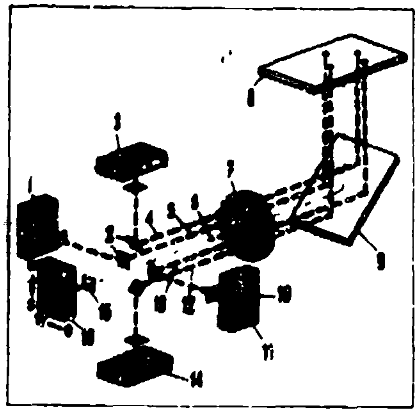
There are dozens of various types of display devices based on the most diverse principles. In one of them in the ARTOC system digital information from a computer is produced with a drawing device for visual display. The machine can produce two types of slides -- graphic and tabular. The transparencies are corrected by operators and then automatically issued to executives at a prescribed time.

Seventy millimeter transparencies of a combat situation are projected onto a topographic map. Up to four transparencies can be superimposed over one map. Data on the combat situation can be presented on each of them in the form of symbols of different colors.

Equipment in which information is projected off of a cathode-ray tube onto a large screen is also used widely. The principle of operation of such equipment consists of the following. An input objective projects an image off of the screen of a high resolution cathode-ray tube such as a kharaktron [transliteration] onto negative film. During exposure the shutters of the input objective open and close automatically in accordance with a given program. The exposed film is advanced at a constant rate through a processing chamber, in which black-and-white negatives are obtained in 10 seconds.

Then the film is fed into a contact printer. It presses against positive film sensitive to ultraviolet light. At this moment an ultraviolet lamp flashes, after which the exposed film is fed into a special device in which the film is subjected to heat treatment for 3 seconds, as a result of which a positive image appears. Later the film passes through the framing window of a projector. Multicolored images are produced on the screen by means of superimposition of three primary color light beams projected onto the proper frames of the film.

of movement. Then this voltage is divided in a synchronous resolving instrument into the voltages of component speeds along north-south and east-west axes. The resolving instrument is fixed in the necessary position by the two-speed servomotor in accordance with information produced by the gyrocompass.



The plotting table of the navigation-tactical situation display system converts information on the target and the movement components of the ship, passing from pickup units, into control signals that are fed into five optical projectors in which lamps 11 are installed. Four of them project yellow 1, red 3, orange 10, and green 14 target symbols, while the fifth 16 projects a compass card with circular range marks. Light rays from projectors 4, 5, 6, 12, and 13 pass through an optical graticule and light filters 15 and, being reflected from mirror 2, fall on objective 7. The main mirror 9 deflects the rays onto a horizontal plotting screen 8, where the positions of the ship and four targets are displayed as symbols of different colors.

Display devices that include various types of cathode-ray tubes have received wide application. For example, data are fed into the input of one display device from an electric typewriter, as well as in the form of digital or continuous signals from magnetic tapes, discs, drums, perforated tapes, and radar and television equipment.

All coded data are converted into analog signals and recorded on the screen of a cathode-ray tube of high resolution.

Statistical information is projected in the form of charts or tables onto the same screen from a magazine separately installed into the tube's rear opening. Urgent information that is not handled by the program is automatically fed to the display device. Some messages are fed to recording equipment. Printing is done by machines at speeds of 1,000 lines per minute.

Specialists note that such a system allows a commander to receive data on the true situation of subordinated forces and equipment in the course of several minutes.

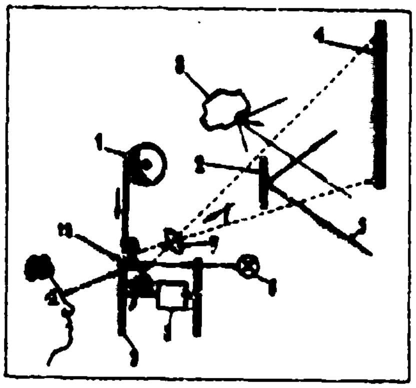
Inasmuch as the production of display equipment involves great expense, it is not always considered justified to improve existing systems. Frequently the improvements affect only an increase in speed. It is felt to be more expedient to seek new approaches to the problem. They can be summarized as the creation of display equipment that works at slower speed, perhaps, but which display data in a form more convenient for individuals. This would allow them to react to changes in a situation more efficiently.

Together with recording tools the electronic digital computer is the nucleus of any automated control system. It should be noted that computers designed for operation in headquarters' and command posts must satisfy special demands in regard to their mobility, overall dimensions, weight, reliability, productivity, servicing convenience, and stability against the affects of high and low temperatures and vibration.

The basic directions in the development of military computers are felt to be the use of solid state components and printed circuits, as well as the employment of the most diverse memory components (semiconductors for example). Reports have it that we can expect a significant reduction of the volume of computers in the near future. Machines that presently occupy a volume of 20 liters can be installed in a space of 3-5 liters.

Let us examine as an example the high-speed multipurpose VIC computer, which is a component of an automated system designed for a flying command post. It has two memory units on magnetic drums and two on magnetic tapes, five cathode-ray tube displays, and two printing devices -- one employed when the equipment is being serviced and another used to obtain copies of the display screens.

This computer is compatible with other machines because its control memory can store specific microprograms.



A radio frequency holographic camera can take photographs in the dark. The camera employs a plate 4 sensitive to radio waves, on which a holographic image is formed as a result of interference of radio waves reflected by an object 3 and a reference wave 5 from reflector 2 striking the plate.

The hologram image is reduced approximately 500 times by an optical system 7. Then it is projected onto aperture 10 through which a color photographic film 1 is advanced. Striking the aperture, a laser beam 6 rectifies the image of the object.

The keyboard for data input and inquiry output is similar to that of a typewriter. There are an additional nine keys for erasing individual symbols, individual lines, or the whole image, obtaining copies of a screen, and for turning off the display when composing messages and during editing.

The printer employs heat-sensitive paper onto which symbols are applied by a special heat-emitting semiconductor matrix with a glass surface and having a low excitation voltage.

The electronic digital computer is also the basis for one of the automated ship systems. Information stored in the memory unit makes it possible for the senior supervisor and the staff to obtain a complete picture of the actions of their own forces and those of the enemy. The computer automatically fulfills the functions of recognition, classification and tracking of targets (aircraft, ships, guided missiles) on the basis of information fed from on-board and remote communications and observation equipment, as well as on the basis of data fed from a control board.

Making a quantitative analysis of data on the situation, the computer evaluates the effectiveness of the weapons and generates recommendations on the suitability of a particular action on the basis of criteria in its program. It feed information to plotting boards and screens in combat information posts and main command posts, as well as in fire control posts. After evaluating the recommendations of the machine and considering the factors not subjected to machine processing, the commander makes the final decision.

After the proper commands or signals are fed into the system it automatically issues orders and instructions involved in carrying out the decision made.

Soyedineniye and individual fighting ships that are operating at great distances from one another can employ this system to continuously exchange automatically coded information and to coordinate the use of forces and equipment in carrying out many types of combat missions.

Presently the work on automating the control of forces is progressing on a wide front. However, no technical improvements, even the latest ones, can replace the human being. They cannot reduce his decisive role in the control of forces.

WE ARE ANSWERED

(Unattributed Article)

Using the experience of one of the repair enterprises of the USSR Ministry of Defense, the article by Engineer-Lieutenant Colonel I. Makarenko "To Reduce Losses of Working Time" published in journal No 7, 1971 discussed the most efficient paths and directions of work on disclosing and eliminating the causes for nonproductive expenditures and losses of working time. In this regard, in particular, public inspections of the use of production reserves were also discussed.

We received a report from the USSR Ministry of Defense Administration for Labor and Wages of Laborers and Office Workers that such public inspections produce most significant results.

Inspections basically consist of a scientific and technical-economic analysis of the activity of collectives, sections, shops, and of the enterprise as a whole. Engineering and technical workers, the managerial staff, the best workers and production innovators, shop laborers, and representatives of public and people's control organizations are encouraged to participate in them.

During the course of inspections studies and analyses are made of the state of labor organization for a great quantity of people and, in particular, the degree to which they employ working time is established, as are the level of organization of working places and of their maintenance, the correspondence between established standards and the psycho-physiological, sanitation, and hygienic conditions of labor, and the state of labor discipline. A study of the degree to which working time is employed through spot observations makes it possible for one observer to efficiently determine the labor expenditures of large groups of workers. And their massive participation in time-and-motion studies provides a possibility for revealing more fully the deficiencies in the preparations for and organization of production, maintenance of working places, and in their supply of materials and equipment.

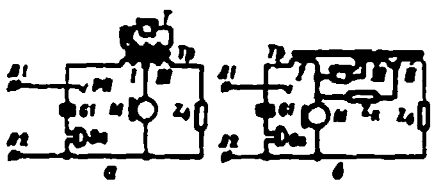
In light of the requirements of the USSR Ministry of Defense, fortification of labor discipline and an uplift of labor productivity are presently the most important tasks of the USSR Ministry of Defense's repair enterprises. And public inspections, which should be conducted everywhere, play a great role in fulfilling these tasks.

The decree of the Presidium of the All-Union Central Trade Union Council and the Bureau of the All-Union Lenin Communist Youth League Central Committee is a confirmation of the importance of such a measure. According to the decree an All-Union Public Inspection on employment of production reserves and on saving practices is being held from November 1970 to the end of 1971. The repair enterprises of the USSR Ministry of Defense are participating in it actively.

THE TELEPHONE

Extended Service Master Sergeant K. Aralov

The telephone is the most widely used communications resource. This is why a wide range of specialists must know its structure and principles of operation.



Anti-sidetone telephone circuit: a -- bridge type; b -- compensating type.

At this time telephones with anti-sidetone circuits of the bridge or compensating type, such as the TA-60 and TA-65 (see figure) are used extensively. With respect to structure, all of its electric components are located in a rigid housing. Electroacoustic converters are mounted in the microphone.

In telephone equipment we distinguish between calling components, which include condenser C1 and bell 3B, and the speaking components -- microphone M, telephone T, transformer Tp, and balancing $Z_б$ and compensating Z_K circuits. The speaking or calling components are switched into the line through output terminals Л1 and Л2 by lever-operated switch PП.

The telephone is rung by a 15-50 cps alternating current which passes through circuit Л1-PП-C1-3B-Л2. An alternating current bell, which converts a calling signal into an acoustic signal, serves as the call receiver. When the telephone unit is switched into the communication line circuit a constant voltage is fed to its input terminals. When the lever-operated switch PП is in its resting state the direct current does not flow through the unit's circuit, since condenser C1 is in the circuit. When the telephone receiver is raised the direct current flows through coil 1 of the transformer and the microphone. In this case the telephone station receives a calling signal.

Let us examine the circuit's operation when a call is received and transmitted. When speech is transmitted the microphone's electromotive force generates a direct current, part of which passes into the communication line. When speech is received the speaking current in a bridge-type circuit passes from the line through connected matched coils I and III of the transformer. An electromotive force which generates the current passing through the telephone is induced in coil II. When speech is received in a compensating circuit the principal component of the speaking current passes through coil I of the transformer and the microphone. The electromotive force induced in the connected matched coils III and II generates a current that passes through the telephone.

In a bridge circuit the microphone and telephone are connected through the transformer in the diagonal of the bridge, the arms of which are coils I and III of transformer Tp, balancing circuit resistor $Z_{\text{б}}$, and the communication line. In this case the condition $Z_{I} \cdot Z_{\text{б}} = Z_{\text{л}} \cdot Z_{III}$ for bridge equilibrium must be observed, where Z_{I} and Z_{III} are the resistances of coils I and III of transformer Tp, and $Z_{\text{л}}$ is the input resistance of the communication line into which the unit is connected. The equality is attained for a given value of $Z_{\text{л}}$ by selection of values for $Z_{\text{б}}$, Z_{I}, and Z_{III}.

In a compensating circuit all transformer coils are matched when they are switched on. When speech is transmitted a speaking current passes from the microphone through coils I and II in opposite directions. The difference in the magnetic currents created in the core induces an electromotive force in coil III which provides equal potentials to the connecting points of the telephone.

The requirements placed on telephone units are separated into telephonometric, electroacoustic, electric, mechanical, and climatic. Telephonometric requirements establish certain values for the equivalents of attenuation and intelligibility that a telephone unit must satisfy for a particular transmission channel. Electroacoustic requirements set standards for amplitude and frequency distortions introduced into the communication line by electroacoustic converters and the telephone unit circuit, as well as for the quality of the unit's bell. Mechanical requirements determine the life of individual parts of the unit, and the mechanical stability and vibration resistance. Climatic requirements set the range of temperatures, humidity, and pressure in which a given telephone unit can work reliably.

SCINTILLATION COUNTERS

Engineer-Senior Lieutenant G. Odzhagov

Scintillation (luminescence) counters are employed widely in dosimetric equipment. Having approximately the same features as gas-discharge counters, they are dependable in their operation and quite simple in construction. Their basic components are scintillators, photomultipliers, and electronic pulse amplifying and counting devices.

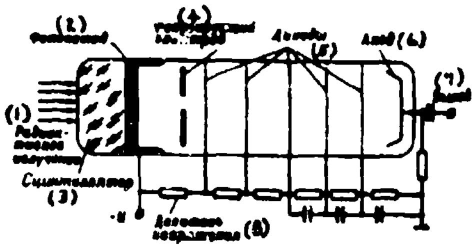
The word scintillation is of Latin origin. In translation it means sparkling, sparking. This is the origin for the name of the physical phenomenon of luminescence in the form of spark flashes, observed, for example, on a screen made of zinc sulfide bombarded by alpha-particles. Both crystalline and amorphose, and liquid and gaseous substances are used as scintillators in counters. Scintillators can be employed to record alpha- and beta-charged particles, gamma-quanta, x-rays, and neutron currents.

Scintillators are separated into two groups by nature of the substance: Organic and inorganic. All of them have high "transparency" for emitted light. This is one of the most important features of scintillators. The greater the amount of light coming from them, the more electrons are pulled from the counter's cathode, which at the same time is also the cathode of the most critical component of the instrument, the photomultiplier.

This component is an electronic tube in which electrons, one or several, which are hit out of the surface of the photocathode by a quantum of light, are multiplied by a number of serially positioned secondary electron emitters called dynodes. The voltage increases by approximately 100 volts at each subsequent dynode. The anode has the highest potential. The difference in potential between the anode and cathode attains 1,500-2,500 volts.

The quantity of multiplying cascades is determined by the needed magnitude of the electron current flowing through the load connected to the photomultiplier's anode. The secondary emitters can be either the reflecting type or those that operate "na prostrel" [translation unknown]. Very thin layers of materials that emit electrons are used in them.

The effectiveness of employment of a particular type of scintillation counter depends in many ways on the type of scintillator used in it. For example, a zinc sulfide scintillator is distinguished by high sensitivity to alpha-particles emitted by radioactive substances. Sodium iodide crystals are good scintillators for registering gamma-quanta. The presence of iodine in the crystal raises the effectiveness of gamma-quanta detection up to 60 percent (the Geiger counter's sensitivity to them is 1-2 percent). The discrimination time of scintillation counters used presently varies from 10^{-8} to 10^{-5} seconds. This significantly raises the rate of emission counting in comparison with that of gas-filled counters.



Connection Circuit of A Scintillation Counter

Key:

1. Radioactive radiation
2. Photocathode
3. Scintillator
4. Focusing electrode
5. Dynodes
6. Anode
7. Output
8. Voltage divider

ANTITANK GUNS

(Unattributed Article)

A tendency for noticeable increase in the proportion of armored and tank forces in the armed forces was seen in the beginning of the 1930's. At that same time the problem of creating antitank weapons for infantry podrazdeleniya arose.

In our country in 1932 the Kurchevskiy 37-mm dinamo-reaktivnoye [translation unknown] antitank gun was developed and accepted into the armory. Deficiencies -- low maneuverability and low armor penetrability -- were disclosed during its use. The Kurchevskiy PTR [antitank gun] had to be removed from the armory.

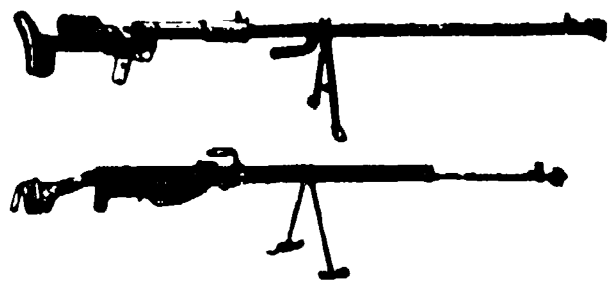
In March 1936 the Soviet Government adopted a decree on designing a more effective antitank gun. The well-known infantry weapon designers M.N. Blyum, S.V. Vladimirov, S.A. Korovin, and others were recruited to design PTR. In two years they manufactured 15 models. However, not one of them passed the tests. The weapons were found to be heavy, cumbersome, and had low armor penetrability.

The need arose for developing more rigid tactical and technical requirements with special emphasis on the following: The guns had to be light, convenient to handle, and penetrate 20 mm armor at a range of up to 500 meters and at an incidence angle of 30°. Design studies indicated that these requirements could be satisfied by a 14.5-mm caliber weapon under the condition that a 64 gram bullet would have an initial speed of 1,000 meters per second.

N.V. Rukavishnikov, S.V. Vladimirov, and B.G. Shpital'nyy developed such guns in 1939. The 14.5-mm semiautomatic Rukavishnikov gun gave the best results. Comfortable and reliable in operation, it had a sufficient firing rate (up to 15 rounds per minute). Two persons could easily carry it with shoulder belts. In October 1939 the gun was accepted into the armory under the title "1939 model 14.5-mm antitank gun."

However, production of Rukavishnikov antitank guns had not started by the beginning of the Great Fatherland War, and extensive use of tanks by the enemy demanded that the infantry be provided with mobile, substantial antitank weapons as quickly as possible.

The well-known weapons designers V.A. Degtyarev and S.G. Simonov joined the work of creating a simple and effective PTR. As early as the end of July V.A. Degtyarev submitted two models of 14.5-mm magazine PTR for testing that were simple in construction and easy to build. However, sometimes they jammed during firing. Thus it was proposed to the designer that he quickly improve one of the models and make it a single-action type.



Above: 14.5-mm Degtyarev single-action antitank gun; below: 14.5-mm Simonov magazine semiautomatic antitank gun.

S.G. Simonov employed the design features embodied in the 7.62-mm single-action rifle in creating a model of a PTR. Only the triggering mechanism and the ammunition feed were subjected to changes. After a number of tests on 29 August 1941 the State Committee for Defense adopted a decree on the acceptance of the 14.5-mm Simonov magazine semiautomatic antitank gun and the 14.5-mm Degtyarev single-action antitank gun into the armory and on commencing their production.

Simonov's antitank gun works on the principle of the removal of powder gas through a transverse opening in the barrel. The barrel tube is closed off by angular deflection of the breech mechanism. In this case when it lowers, the rear part of the breech mechanism's frame contacts its bearing surface against that of the breech bushing. A flag-type safety catch is situated on the right side of the breech. The trigger-type firing mechanism allows single-action firing only, and the quadrant sight allows firing at a range of up to 1,500 meters.

The Degtyarev gun worked on the barrel recoil principle. Locking was accomplished by arming projections on the breech which enter, when the breech turns, into the bearing shoulders of the breech. The breech mechanism is unlocked automatically. Breech ramming and barrel tube locking was done manually. The sight had a collapsible back-sight with two positions for firing at 400 and 1,000 meters.

The structural simplicity and ease of manufacture of these PTR, especially the Degtyarev single-action gun, made it possible for plants to start production quickly. The need for them was so great that sometimes they were shipped to the front straight from the shops.

The Soviet antitank guns were used successfully against the enemy's light and medium tanks. They were usually fired at a range of 250-300 meters. Individual deficiencies that were revealed during battles were quickly eliminated, and the PTR became fully reliable weapons.

The number of guns shipped to the troops grew continually. While on 1 January 1942 there were only 8,116 guns in the Red Army chast' participating directly in combat operations, by 1 July 1942 their number increased to 65,365, and to 145,861 by 1 January 1944.

During the course of the Great Fatherland War Soviet designers tirelessly improved the antitank guns, devoting their principal attention to increasing their armor penetrability. In 1942 a 20-mm antitank gun with a horizontally shifting breech block was being developed by F.I. Rashkov, S.I. Yermolayev, and V.Ye. Slukhotskiy. In the same year M.N. Blyum designed a PTR for a special 14.5-mm round that had a great initial bullet speed.

Beginning with the second half of 1943, with the appearance of heavy tanks and self-powered weapons with strong armor protection in the German fascist army the effectiveness of the PTR started to decrease, and the main role in the fight against tanks passed to artillery.

The blade is controlled (raised, lowered, tilted vertically) by double-action hydraulic cylinders. The bulldozer's good passability and maneuverability make it possible to use it effectively for a number of excavation operations. The machine has a diesel engine that generates 184 horsepower at 1,?00 rpm. It travels at up to 13 km per hour and weighs 1?,200 kg.

The DS-39A (D-640A) motor bitumen sprayer demonstrated at the exhibition spreads hot or cold bitumenous substances by means of impregnation, partial impregnation, or surface treatment of gravel and metalled surfaces. It will find application wherever the construction of expensive highways or asphalt roads is not always expedient, or where improved dirt roads must be built quickly. The motor bitumen sprayer is also used to oil and stabilize dirt during airfield construction.

Its design makes it possible to maintain the bitumen at the needed temperature while it is transported in the tank, and to heat it when necessary.

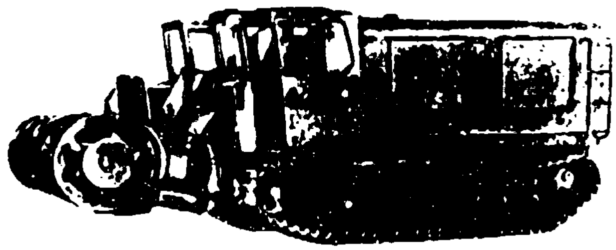
The All-Union Scientific Research Institute of Construction and Road Machinery is displaying the Avtoplan-1 and Avtoplan-II systems at the exhibition. They provide automatic control of a bulldozer and stabilization of the position of its working element.

The Avtoplan-II system is designed for a bulldozer weighing over 5 tons with hydraulic control of the working element. It provides stabilization of the position of the pushing frame of the blade relative to the horizontal within a range of ±30°, it allows the driver to change the blade angle within ±5° by remote control from his cab, it automatically pulls the blade out of the ground when the speed of engine shaft rotation drops and returns the frame to the prescribed position.

The employment of this system significantly increases the machine's productivity, makes a reduction of time spent on layout operations possible, and eases the work of the bulldozer operator.

A contactless electronic roll alarm for bulldozers, scrapers, and other construction machines is of interest. It automatically warns the driver when working on slopes and hillsides that its bank is approaching a critical point. The instrument consists of a pickup unit and a signal panel with two lamps: The green lamp lights when the bank is within allowable limits, and the red one lights when the machine tilts 27°.

The RS-66 snow blower is designed for maintaining roads. Mounted on a GAZ-66 motor vehicle chassis, it piles the snow, carries it to transport resources, and it can dump it to the side. Owing to sprinkling equipment mounted on it, during the warm period of the year the machine can be used to wash improved road surfaces. The tank capacity is 4,000 liters.



D-904S Scarifying Snow Blower

The more powerful D-904S snow blower is used for strip working of snow deposits at any height and density of snow. It is mounted on a TDT-55 tractor with a scarifying rotary working element that has an independent power supply. It is driven by a 170 horsepower YaMZ-238G diesel engine. The tracks are driven by an SMD-14B tractor engine. Both engines are equipped with heaters. All control instruments are centralized in the driver's cab. The snow blower's productivity is up to 700 tons per hour, and it moves at speeds of up to 11 km per hour.

Scrapers and excavators, all sorts of lifting cranes, and various rollers and machines for road surfacing are also widely represented at the exhibition. Their introduction into operation will ensure a faster development of the operating and repair base of construction and heighten its technical quality.

YEARS, EVENTS, PEOPLE: THE FIRST SCHOLAR

(Unattributed Article)

Mikhail Vasil'yevich Lomonosov, who was born on 19 November 260 years ago, is not only a true scholar and poet. He is, according to V.G. Belinskiy's definition, a great personality, a phenomenon that imparts honor to human nature and the Russian heritage.

The tremendous, truly encyclopedic activity of the great scholar was distinguished by diversity, and at the same time by a remarkable wholeness. Working in various fields of science he tried to comprehend the unity of the laws of nature, the universal connection and interrelationship of its phenomena. He outstripped his educated contemporaries by a whole century in solving many scientific problems. The most important problems of natural history, chiefly physics, chemistry, geology, and astronomy, were illuminated in his works. The contribution he provided to the development of mining and metallurgy, history, philosophy, and philology was not small.

One of the greatest scientific breakthroughs of Lomonosov is the discovery of a "general law of natural science," the conservation of matter and motion, of its theoretical and experimental foundation. The concept of the indivisibility of matter and motion is at the basis of this law.

Lomonosov was not only a theoretician but also a major practical scientist. For example during his research on the upper layers of the atmosphere he invented and manufactured a working model of a small "flying machine" for raising meteorological instruments to significant altitudes. He is also the first to be credited with sounding the upper layers of the atmosphere with automatic recording instruments launched into it.

The problems of optics, chiefly its practical aspect -- the design and manufacture of various optical instruments and devices -- occupied a large place in the scientist's work.

A "catoptric-dioptric igniting instrument," an ingenious combination of flat mirrors and double convex lenses, was designed by Lomonosov in 1741. Employing the rays of the sun to get high temperatures the scientist used this instrument to melt crystals. By its igniting power it surpassed similar instruments known to that time by many times. Later Lomonosov invented a "horizontoscope," a periscope with a mechanism for local panoramic observation. In 1762 he built a telescope consisting solely of one concave mirror and an ocular. In 1756 Lomonosov demonstrated at the Academy a "night scope" with which one could "distinguish rocks and ships in twilight and at night." Such scopes were used on the vessels of V.Ya. Chichagov's Russian polar expedition (1765), organized on Lomonosov's initiative. After the death of the scientist this invention was forgotten, and the concept of an instrument for night observation came to be considered erroneous. It was two centuries later that the concept was employed in the creation of night viewing instruments.

The depths of the content of most of Lomonosov's work came to be recognized only as a particular science developed. The more time passed, the more obvious his superiority in many fields of science and engineering became.

There was the development of the principles of physical chemistry and of the molecular-kinetic theory of heat and the kinetic gas theory, research on electric phenomena, the discovery of the atmosphere of Venus, and the invention and design of a recording compass, a mechanical log, and other instruments for sea navigation. This is far from all that the great Russian scientist -- the first Russian scholar, a member of the Swedish Academy of Sciences, and an honorary member of the Bologna Academy of Sciences -- did for the development of science.

No matter what Lomonosov studied, no matter which natural phenomona he investigated, no matter what discoveries he made, his foremost goal in all endeavors was to benefit the Motherland!

SHIP ELECTRICAL ENGINEERING

N. Korneyev, Master Engineer of the All-Union Scientific Research Institute of Electromechanics

The Soviet Maritime Fleet is developing vigorously on the powerful base provided by the socialist economy. As of the beginning of 1971 it already possessed an inventory of 6,612 cargo, passenger, commercial, auxiliary, and other types of vessels with a total capacity of close to 15.2 million registered tons. The high level of development in domestic science and engineering ensured not only quantitative but also qualitative growth for the fleet. In the last few years the cargo and passenger capacity of transport vessels increased significantly. The speed of all types of vessels and their range without refueling also increased, and the output of power facilities has been raised.

Technical progress in the maritime fleet, as is true for many other sectors of the national economy, found obvious expression in the high p e of electrification. The output of electric power facilities on ships increased, and new, improved electric equipment appeared. New generators, electric motors, converters, and other electric machines and instruments put into production by the domestic electrical industry are employed extensively on maritime vessels.

In particular, ship electric power sources experienced great changes. Naval synchronous generators equipped with excitors and built in the form of individual direct current commutating machines gave way to generators with self-excitation and automatic voltage regulating systems. The desire to increase the output of generators, improve their weight and size indices to the maximum, and to increase the reliability and life of the machines produced a need for employing new electrotechnical materials, such as silicone insulation. Water cooling and forced bearing lubrication found wide application, and a number of new design concepts were formulated that improved the operating qualities and economic indices of the machines.

The unit output of ship alternating current synchronous generators with air cooling now reaches 1,500 kw, and 3,000 kw with water cooling at 380 volts and 50 cps. Owing to the employment of heat-resistant insulation and the water cooling system it became possible to greatly reduce the weight and overall dimensions of synchronous generators. For example, an air-cooled 1,500 kw generator has overall dimensions of

2,415x1,408x1,805 mm and weighs 7,080 kg, while a water-cooled generator with almost the same dimensions and weight has an output of 2,000 kw. Direct current generators also experienced design changes. Presently their unit output attains 1,500 kw at 220 volts.

In the last few years complicated navigation systems, radio and hydroacoustic equipment, and automated and remote control systems have attained extensive employment on maritime vessels. Alternating current of the most diverse voltages (110, 115, 127, 133, 230, and 380 volts) and frequencies (50, 400, 470, 485, 500, 975, and 1,000 cps) are required to power such systems. The quantity of independent current converters has increased on modern vessels because of this by two to three times in comparison with vessels of prewar design. There has also been a significant rise in the demands on converters with respect to both the precision of output parameter maintenance and the length, reliability, and noiselessness of operation.

Presently the domestic industry has started production of large series of marine converters that are to be installed on domestic and foreign vessels. The output of such machine units attains 75 kw. They convert direct current of one voltage to direct current of another voltage (series APP), to nonophase (series APO), or triphase (series APT) alternating current. With other machine units triphase current is converted into direct current (series ATP), or into monophase alternating current of another voltage and frequency (series ATO). Finally, there are machine units that convert triphase alternating current of one voltage and frequency to an identical current of another voltage and frequency (series ATT).

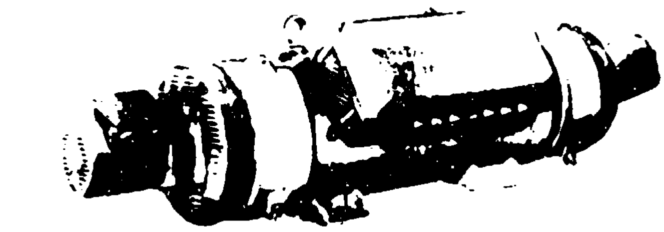


Figure 1. One of a multitude of dynamoelectric converters produced by the Soviet electrical industry, the series APO machine unit, which converts direct current to triphase alternating current.

In design, such a converter is a machine in a single housing (Figure 1) with two or three armatures, one of which is the driving electric motor armature, and the other or the other two are direct or alternating current generator armatures. Varous types of alternating current generators are used -- inductor, salient-pole and nonsynchronous, and claw-shaped and rostrate. As a rule all of them have a self-excitation system. Inductor, claw-shaped, and rostrate generators do not have windings about the armature. These are contactless machines; their excitation coils are located on the stator, imparting to them a great operating advantage over other designs.

Converter control equipment is outfitted as a rule in separate cases. It consists of an automatic circuit (or power) switch, a starter, control units (for speed, voltage, and frequency), and protection units.

An important feature of modern converters is that all problems involving design, the electric and mechanical indices of both the machine unit itself and the equipment for the start-up of the machine unit and for automatic output parameter control have been solved integrally. In this case the modern demands upon converters with respect to all electric and mechanical indices (this should be taken into account) have become significantly higher and more rigid than before.

The most complicated problems in developing dynamoelectric converters with high technical specifications are being solved successfully by Soviet scientists, engineers, and designers. For example, the power supply units for navigation systems -- series AMG machine units -- are now being operated on almost all vessels in the maritime fleet of both domestic and foreign construction, and they have acquired a reputation as being very reliable machines. The inventors were awarded the State Prize for the development of this series of machine units.

Semiconductor technology has taken a firm foothold in the composition of ship electric equipment. Using silicon control valves -- thyristors (Figure 2),-- as a basis, series production has been started for a number of machine units of different purposes -- static semiconductor frequency converters, inverters, and reversible converters. The creation of diffusion silicon valves was marked by a high honor: Their inventors were awarded the Lenin Prize.

Today our industry is producing a series of rectifying machine units (Figure 3) designed for different purposes -- power (VAKS), charging (VAKZ), starting (VAKST), electrolytic (VAKEL), welding (VAKSV), synchronous generator excitation coil power supplying machine units (VUKV), and electric drive powering machine units (VAKEP). This series is widely employed in transport, in the national economy, and on vessels both in our country and abroad.

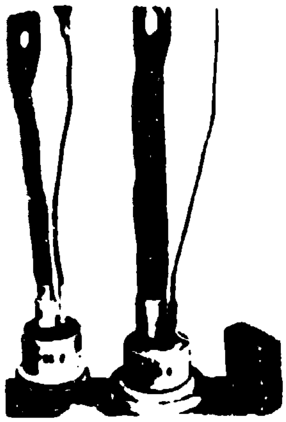


Figure 2. The creation of thyristor power control valves was an outstanding achievement of domestic electronics. They have found wide application on the maritime fleet's vessels.

The output capacity of the machine units attains 585 kw, and the voltage of the rectified current attained is 380. Their efficiency fluctuates between 0.77 and 0.89, and their unit weight varies from 1.59 to 37.0 kg/kw. For most machine units it is 8.5-12.5 kg/kw.

In comparison with dynamoelectric converters, the static semiconductor type have lower weight and smaller dimensions (see Table). They are noiseless, require less service, and are simpler to maintain. Having invaded the electronics of powerful currents so decisively, semiconductor instruments continue to occupy the foremost position in radio engineering, radio electronics, and automation.

It is impossible for us to imagine a modern vessel without electric drive for a multitude of mechanisms. From powerful electric propeller motors with an output of several thousand kilowatts to galley machines and personal instruments with an output of several watts: This is the range for the employment of electric driving motors. The modern series of Soviet electric direct current motors are most highly perfected in design. They are installed on various types of vessels and compose a share of our export volume that is not small. New series of starting devices are also being supplied in the outfits for direct current electric motors.

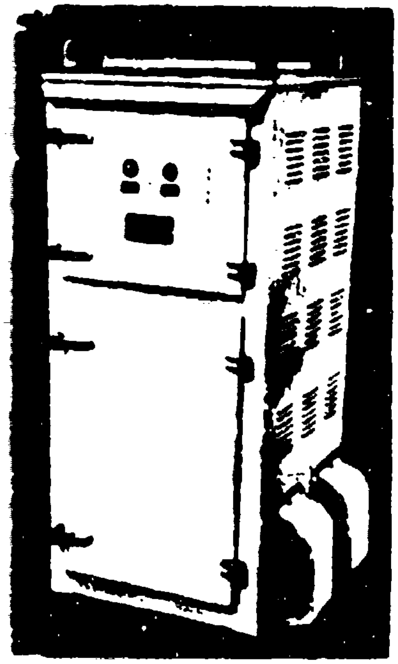


Figure 3. The powerful static semiconductor rectifier with automatic output parameter control works reliably and noiselessly.

(1) Тип и марка агрегата	(8) Питающая сеть		(11) Выходные данные		(13) Вес без аппаратуры, кг	(14) Габариты агрегата, мм
	(9) напряжение, в	(10) частота, гц	(12) мощность, квт	(9) напряжение, в		
(2) Электромашинный АТП-8 рн	380/220	50	8,0	230	[illegible]	1210×[illegible]×[illegible]
(3) Статический ВАКС-7-230	380/220	50	7,0	230	165	[illegible]×[illegible]×[illegible]
(4) Электромашинный АТП-20 рн	380/220	50	20,0	230	[illegible]	[illegible]×[illegible]×[illegible]
(5) Статический ВАКС-17, 35—230	380/220	50	17,35	230	[illegible]	[illegible]×[illegible]×550
(6) Электромашинный АПП-8В	220	—	8,0	110	[illegible]	1120×[illegible]×475
(7) Статический ВАКС-7, 0—115	220/380	50	7,0	115	165	[illegible]×[illegible]×[illegible]

Key:

1. Type and make of machine unit
2. Dynamoelectric ATP-8rn
3. Static VAKS-7-230
4. Dynamoelectric ATP-20rn
5. Static VAKS-17, 35-230
6. Dynamoelectric APP-8B
7. Static VAKS-7, 0-115
8. Power circuit
9. Voltage

[Key continued on following page]

10. Frequency, cps
11. Output data
12. Power, kw
13. Weight without instrumentation, kg
14. Machine unit's overall dimensions, mm

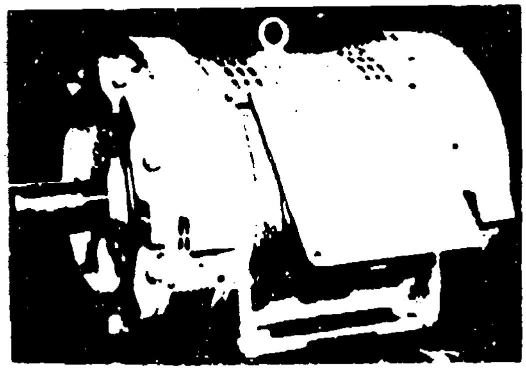


Figure 4. The vertically or horizontally built series AM asynchronous electric motor with short circuited rotor can be encountered on ships and boats of various displacement and purpose.

With the introduction of alternating current to vessels, the need arose for developing several series of asynchronous electric motors for maritime purposes employing a short circuited rotor in a comparatively short time interval. Such asynchronous maritime electric motors as the MAP, MAF, MRZ, AM, and AMSh, as well as the high-frequency AOM, DMVO, AOMSh, and DFV, which are employed on maritime vessels and in the national economy, are earning a high evaluation (Figure 4). A number of changes that significantly increase reliability, convenience and simplicity of operation, working life, and noiselessness of operation, and which improve the weight and size indices have been introduced into the design of modern asynchronous electric motors.

As an example, here is the system for starting and controlling a three-speed electric motor. In the course of projects on the unification of vessel deck mechanisms being conducted by CEMA member countries, a number of standard capstains as well as the electric driving motor for them and the control equipment have been developed. This new drive, created on the basis of a triphase current asynchronous electric motor with short circuited rotor, replaces the previously employed electric motor with a phase rotor (with rings). It is controlled by a controller and a contactor station. When the controller is set at position 1 the 16-pole coil is turned on (a triangular connection that ensures the smallest possible rpm. In position 2 the coils are switched from the triangular to a star connection, while in position 3 they are switched to a double star connection, and the electric motor operates at the standard rpm. This is the way the most difficult problem in controlling the rotation speed of asynchronous electric motors is being solved.

New cables with synthetic rubber sheaths, new lighting fixtures, and all possible types of deck and personal electric machines have found wide application on modern vessels of the maritime fleet. Special equipment has also been developed for the fishing fleet, ice breakers, refrigerator ships, and tankers. The comforts of passenger liners and the comfortableness of living quarters have increased significantly on all transport and commercial vessels.

The rapid growth of the Soviet maritime fleet is indebted in many ways to the high level of development of the domestic electrical industry. The Directives of the 24th CPSU Congress foresee a 1.4-time increase in the freight turnover of maritime transport. An essential role in completing this task will belong to our electrical industry, which is developing at a pace that has never been witnessed before.

THE HYDRAULIC TRANSMISSION

Engineer-Lieutenant Colonel Ye. Aleksandrov

One of the distinguishing features of the PKT track layer and the BKT bulldozer is that their design employs an hydraulic transmission, a machine unit that includes a stepless torque converter and a two-row planetary gear-box. It is designed for changing the traction force and moving speed of the machines, engagement of reverse, and disengagement of the engine from the power transmission. In order to get a clearer impression of the operation of this quite complicated machine unit, we will examine its structural and dynamic plans at the same time (see Figure).

Torque is varied without stages by means of a torque converter. Its driving component, pumping wheel 10, is connected right with the input (drive) shaft 1 of the transmission through casing 9 and housing 3 of the locking clutch. The wheel, casing, and housing of the locking clutch form a hermetic cavity into which the working fluid -- a mixture of spindle and motor oil with a special additive -- is introduced.

The driven component of the torque converter -- turbine wheel 6 -- is connected by hub 2 to the turbine shaft 11, which at the same time is the drive shaft for the planetary gear-box. The hub of the locking clutch, on the spline of which a driven powder metal disk is fastened, is rigidly connected with the hub of the turbine wheel. Piston 4 and a gasket are situated in the clutch housing.

Two reactors 5, which increase the torque transmitted to the turbine wheel, rotate between the pumping and turbine wheels on free-running couplings. The internal band of the coupling is connected to the reduction gear housing. The couplings allow the reactors to rotate only in one direction.

The gear-box contains two planetary rows with a common sun wheel 19 and four control clutches. Each planetary row consists of a sun and corona gear and three satellites. The sun gear 21 of the first row and the intermediate shaft are built as a unit. The hubs of the direct and intermediate drive clutches are mounted on the splines of this shaft. Coronal gear 15 simultaneously serves as a cover for the direct drive clutch 13, to the housing of which it is rigidly connected. Sun gear 20 of the second planetary row is mounted on the turbine shaft and is the drive gear for the gear-box. Coronal gear 18 of this row freely rotates on satellites 22.

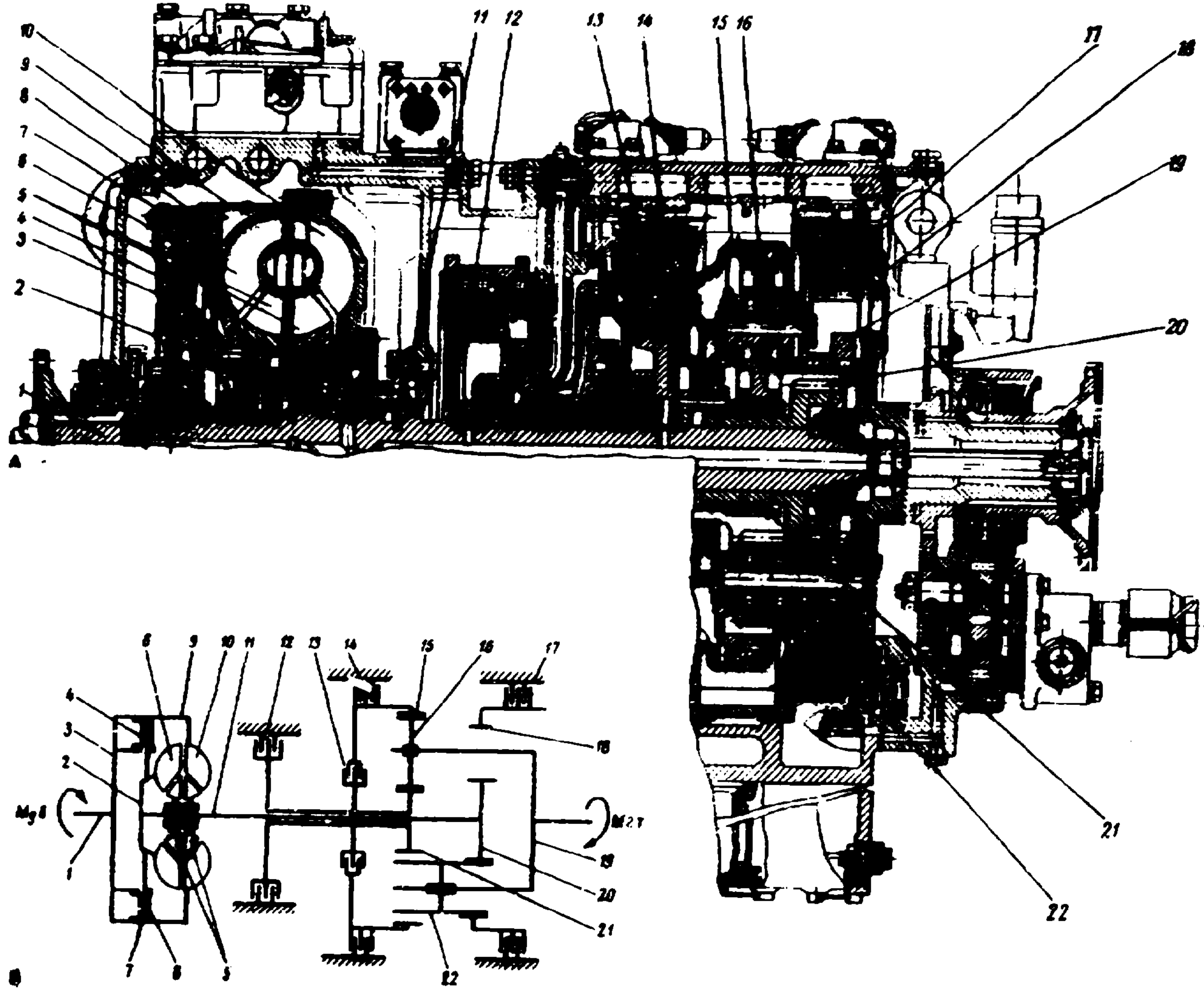


Figure. Hydraulic Transmission Diagrams: A -- Structural; B -- Dynamic engaged but t[illegible]ne is standing still), maximum transformation (conve[illegible]) of torque occurs. Entrapping oil, the vanes of the working wheel twirl it and forcefully dump it onto the turbine vanes. Emerging from the turbine, the streams of oil fall onto the reactors, trying to turn them in a direction reverse of that in which the working wheel is rotating. But the free-running clutches prevent this. The flow of oil accumulates in the direction of rotation of the pumping wheel. Because of the reaction forces arising the torque on the driven shaft increases to its maximum value.

The nature of interaction between the hydraulic flow and the converter's parts changes as the load on the driven shaft decreases (the machine has started moving, and the turbine has begun rotating). At a certain rpm the oil streams emerging from the turbine act on the vanes of a close reactor in such a way that it starts to turn in the same direction as the working wheel. The clutch unlocks, and the reactor begins to rotate freely. As the turbine rpm increases the second reactor also unlocks. The converter shifts to the hydraulic coupling mode. The speed of rotation of the turbine wheel starts to approximate that of the working wheel, but it does not equal it. The relative slippage of the wheels increases sharply when unexpected loads arise (for example when the vehicle's wheels hit rough spots).

Thus the torque converter also fulfills the function of a device that protects the engine from overloads. In order to eliminate slippage completely, if this is necessary and possible in regard to the road conditions, the locking clutch is engaged. To do this, oil is fed into the booster at a pressure 5-10 kg/cm^2 greater than that which arises in the converter's cavity. Piston 4 presses disk 7 against stop 8. Both wheels of the converter rotate as a single unit, and the engine is rigidly connected to the power transmissi[illegible].

An hydraulic transmission operates trouble-free if maintenance is conducted when required, and if the established operating conditions are observed. Detailed descriptions of adjustment operations, as well as of the possible malfunctions of the transmission and the means for eliminating them, are contained in manuals dealing with these subjects. We should note that the overwhelming majority of these malfunctions arises as a result of contamination of the working fluid or violation of the optimum working conditions for hydraulic systems. Therefore when a track layer is being used care must be taken to ensure that the temperature and pressure in t[illegible]nsmission hydraulic systems do not exceed values prescrib[illegible] by the instructions, and that working fluid be carefully cleaned before being poured in. Oil temperature in the reduction gear of the planetary transmissions is considered to be normal if it is within the range 60-95°C. In torque converters it should be maintained within 70-115°C (its reduction to 40° and short-term increase to 125°C is allowable, but not recommended).

Temperature increase is caused primarily by heightened slipping in the torque converter. It arises in cases when a higher gear is engaged before the proper time or, on the other hand, when shifting from a higher gear to a lower one is done at great speed without engagement of an intermediate gear. A still greater load and, consequently, a sharper rise in temperature of the oil is caused by engagement of reverse gear before the machine has had time to come to a complete stop. Another cause for overheating could be prolonged operation of the converter while the vehicle is standing still or is moving at speeds beyond those recommended by the instructions for a particular gear.

At the same time, locking of the converter before it begins to operate in the hydraulic coupling mode is totally prohibited. Otherwise the loads on the transmissions could exceed the rated ones, resulting in heightened wear or even breaking of transmission parts. Therefore the locking clutch can b engaged only after the vehicle attains the speed established by the instructions for a particular gear. An exception is the descent of the vehicle down a steep incline, when it is necessary to brake with the engine.

The standard pressure for the lubrication system is 1-1.5 kg/cm², 3-4 kg/cm² for the torque converter, and 9-13 kg/cm² for the clutch boosters. When the oil pumps are working properly, sharp jumps in pressure or a reduction of pressure are most frequently symptoms of the fact that air or water has gotten into the oil. An emulsion forms as a result of its vigorous mixing with the oil. The working fluid in the converter foams up, the conversion coefficient decreases, and the parts overheat. Therefore if water is detected in the system the oil must be changed completely.

We remind the reader that hydraulic transmission systems are filled with a mixture of AU spindle oil (GOST [All-Union State Standard] 1642-50) and MT-17p oil (GOST 6360-58), with obligatory addition of AKOR-1 anticorrosive dope (Soviet National Economic Technical Specification 36-13-15-64). Oil temperature must not be lower than 10°C (not lower than 20°C in the cold part of the year). After the oils are carefully mixed at a ratio of 7:3 (by volume), dope is added in a quantity 10 percent of the total weight of the mixture.

The oil filters must be cleaned and rinsed strictly by the schedules prescribed by instructions. Here the nature of the sediment in the hydraulic cyclone bunker should be observed. If there are many aluminum shavings and much powder metal dust in it, the transmission should be disassembled and repaired.

FRONT AVIATION REPAIR WORKSHOPS

S. Pilipovich

October 1941. The front approached all the way to Moscow. Our aircraft suffered great losses in constant battles. A decision was made to create front aviation repair workshops (FARM) in order that damaged aircraft could be returned to action as quickly as possible. We were posed the task of repairing the machines not just in stationary conditions alone, but right at the air bases. In addition the workshops were faced with ensuring combat readiness for a an air defense fighter regiment, and servicing squadrons of Po-2 night bombers.

The organization of repair had to be simplified to the limit because of a shortage of labor. When a damaged aircraft arrived a trouble statement was compiled with the assistance of the crew, and integrated brigades consisting of laborers, skilled workmen, technologists, and designers, guiding themselves by the statement, carried out the repairs, sometimes under the open sky. The massiveness of the work volume can be judged at least by the fact that one Pe-2 had 564 bullet holes when it returned from its combat mission. And the trouble statement was essentially the sole design and procedural document. It was what was used in case of serious damage to indicate what had to be done and how, and sketches were drawn in by hand.

Employing their knowledge and experience and caught up in a patriotic desire to preserve their own Moscow, the workshop laborers made irreproachable repairs. Skilled workmen V. V. Plenidin and L.P. Kozlovskaya, process engineer D.M. Vershinkin, workers G.K. Ulanov, I.S. Dukhov, and many others demonstrated true labor heroism. The repaired aircraft went to action one after the other right on schedule.

Somewhat later we were given the chance to reorganize the industrial repair process. Production sections and departments were distributed in buildings and between them. Specialization was employed: Each department was given responsibility for a certain aircraft type. Thus the first department, the largest and the principal one, repaired Pe-2 aircraft, the second repaired less known machines removed from production back in the prewar period (DB-3, DB-3F, VULTI), and the third repaired the TB-3. The fourth department involved itself with mechanical working of parts, and repair of hydropneumatic machine units and mechanisms in the control and landing systems. The staff of each department contained up to 10 production groups which repaired specific units and systems.

Aircraft that were flown to the FARM were directed to the proper department, where intermediate repairs were made. But those that arrived by train and required major overhaul were initially disassembled and subjected to fault detection. They were unpacked, and the volume of work was determined with the participation of the process engineer and a designer. First the parts, units, and machine units were restored, and then assembly, adjustment, and testing of the systems was conducted. On the flight strip the aircraft was subjected only to ground tests and preparations for return to the chast': While the front was nearby we could not test the aircraft in the air. Later, after the enemy was thrown back from Moscow, a flight was made after completion of repairs.

The collective that maintained the flight strip worked harmoniously. Flight leader S.T. Petrov, mechanic N.V. Belov, motor mechanics P.D. Zadachin and K.N. Stakhanov, master engineer P.A. Popov, and pilots A.N. Gratsianskiy and P.A. Sokolove had the deep respect of the aviation soldiers.

The motor vehicle transport shop deserves a good word. It helped out especially in the initial period of the operation of the workshops. Risking their lives, the energetic and persistent motor vehicle engineer-mechanic A.M. Valikov and a group of stalwarts picked up captured motor vehicles from the front lines and repaired them. Our drivers and suppliers made long trips, even all the way to the Volga, in search of spare parts for the aircraft on these vehicles. There they removed equipment and machine units from Pe-2 aircraft, which were loaded on barges and encrusted with ice.

The front aviation workshops returned close to 280 aircraft of different types -- Po-2, Pe-2, SB, Il-4, and VULTI -- to action. Up to 15 brigades that worked in combat chast' gave a second life to a great number of aircraft damaged in aerial battles.

The report signed by the commander and commissar of one of the aviation squadrons is a memorable, exciting document of those threatening, glorious years. The report discussed the irreproachable work of the FARM, and in particular of the group led by Senior Foreman M.A. Ovechkin. TB-3 aircraft No 2229, which was repaired by this group, made 274 landings without any sort of faults arising.

We are prideful in that our collective contributed its imprint into the destruction of the enemy.

DIVING EQUIPMENT

Engineer-Senior Lieutenant A. Smirnov

The AKA-60 one-man self-contained apparatus is designed to allow a diver to breath while working under water. The apparatus is built from nonmagnetic materials and can be used with GK-2, GK-6, and GK-SVU-A nonmagnetic diving suits.

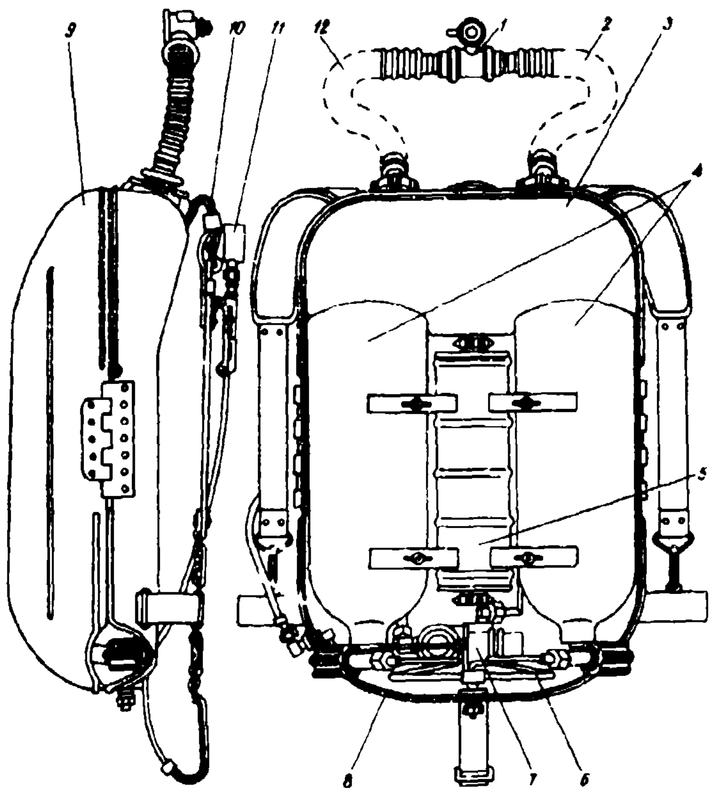


Figure 1

The apparatus consists of a valve box 1, inhalant hose 2, breathing sac 3, regenerative cartridge 5, two tanks with valves 4, connection fittings 6, regulator 7 with a gas feed mechanism and switch, housing 8, cover 9, harness 10, portable pressure gage 11, and exhalant hose 12 (Figure 1). With the exception of the portable pressure gage, harness, and valve box together with the inhalant and exhalant hoses, all of the units of the apparatus are in a rigid housing with a cover.

The AKA-60 operates with a nitrogen-oxygen mixture (with an oxygen content of 50±1 percent), and the exhaled gas is regenerated. With it a diver can breath by a closed (cyclic) system to depths of 40 meters.

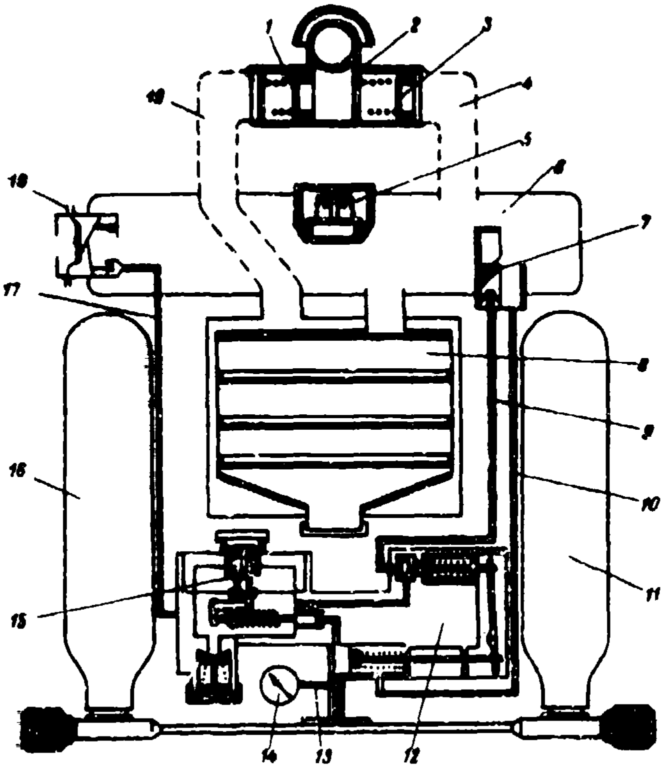


Figure 2

The gases move in the following way (Figure 2). The gas mixture exhaled by the diver moves through exhaust valve 1 located in valve box 2, and through goffered exhalant hose 19 to the regenerating cartridge 8 where carbon dioxide is absorbed. The purified gas mixture passes into breathing sac 6, and here it is enriched with oxygen by means of a constant supply of the nitrogen-oxygen mixture from tanks 11 and 16 through the gas feed mechanism 12. When the diver inhales, the mixture passes to his lungs from the breathing sac through the goffered inhalant hose 4, inhalant valve 3, and the valve box.

When the diver submerges the hydrostatic pressure on the breathing sac increases, as a result of which the volume of gas mixture contained in it decreases, since the sac is elastic. A mechanical lung 18 replenishes the "lost" gas volume. It is adjusted in such a way that gas begins to flow into the sac when a negative pressure equal to 90-120 mm Hg (with respect to external pressure) is generated in the lung. When a negative pressure arises in the breathing sac a membrane in the mechanical lung bends and, acting on a valve through a system of levers, causes the gas mixture to flow from the tanks through regulator 15 and hose 17 into the breathing sac.

When the diver begins to surface the hydrostatic water pressure on the breathing sac falls, as a consequence of which the gas volume within it increases. Safety valve 5 operates to remove excess gas from the sac.

An emergency acoustic alarm (a whistle), which operates when the pressure in the tanks decreases to 40-20 kg/cm², is installed in the breathing sac. When tank gas pressure falls to 40-20 kg/cm² the gas feed mechanism, which provides a constant supply of nitrogen-oxygen mixture to the breathing sac, switches the feed from channel 10 to the emergency acoustic alarm through channel 9. Once he hears the emergency signal the diver must stop work immediately and surface, following the decompression procedures.

The portable pressure gage 14 assists in determining the tank pressure and in providing constant visual control over the pressure when the diver is under water. It is fastened to the left shoulder strap of the harness. The portable pressure gage is fed with high pressure through hose 13.

The table below gives the working time of the AKA-60 apparatus with respect to depth. Time for diver decompression is not included.

Depth, meters	Pressure (atmospheres) on diver	Working time, minutes
10	2	120
20	3	120
30	4	90
40	5	60

The AKA-60 apparatus weighs 29 kg when the regenerating cartridge is uncharged (it holds 2-2.2 kg of absorbent chemical) and the tanks are charged to a pressure of 40 kg/cm². Its dimensions are 620x400x195 mm.

The diving outfit includes the AKA-60 apparatus, spare parts and instruments in a bag, a 15 kg breast weight, left and right counter weights 3.5-4 kg each, two weighted inner soles 1.6 kg each, a 9.5 kg weight belt, a device for transferring nitrogen-oxygen mixture from supply tanks to the tanks of the apparatus, and a spiral tube for charging the tanks of the apparatus with a compressor.

The AKA-60 apparatus is fastened over the diver's suit on his back with the harness. Before each dive the diver must perform a working test of the apparatus. To begin breathing from the apparatus he opens the tank valves and purges the "apparatus-lungs" system three times, as is done when an oxygen apparatus is engaged. Dives are made in accordance with working tables compiled for a 25 percent air-oxygen mixture.

When diving is finished the apparatus must be rinsed with fresh water, dried, and recharged. Proper employment of the apparatus, and the diver's sound knowledge of the devices and of the rules for equipment care are indispensable conditions for reliable operation.

The AKA-60 apparatus is safer to use than oxygen-using apparatus. It can be used to a depth of 40 meters, while gas-charged apparatus can be employed only to depths of 20 meters. The new apparatus also has advantages when compared to air tank breathing apparatus. The continuous operating time is much great.., and the time spent on decompression is significantly lower.

FULLY EQUIPPED TEACHING METHODS

Engineer-Captain 3d Rank Yu. Osetsimskiy

We were able to significantly intensify cadet training at the Red Banner Submarine Training Detachment imeni S.M. Kirov owing to such diverse technical resources as electrified diagrams, small and large training machines, working mockups, trainers, simulators, and slide projectors.

Electrified diagrams are an aid for deeper understanding of the theoretical foundations of equipment operation, and the structure and principles of operation of mechanisms and systems. Teaching machines, which are used in the stage of preparation for work on materiel, allow cadets to independently assimilate the instructions for switching instruments and machinery on and off. The small machine is designed for training by one cadet on the rules for employing individual channels or units, for example the transmitter or receiver of a radio station. We furnished classrooms with large machines at a rate of one for each training shift that was studying a particular model of equipment.

One of the large machines, which is installed in the office of the hydroacoustic station, has six programs on magnetic tape and allows a possibility for cadets to study the rules for operating both individual channels and the hydroacoustic station as a whole. If the cadet makes an error in turning on the station, the machine indicates to him which item of the instructions was violated and what action should be taken.

Working mockups help cadets to quickly gain facility in the features of operation of hard-to-get, remote, and hidden units. In order to teach cadets electromechanical specialties in remote control of the main submarine engines and of the propeller shaft line, Captain Lieutenant Ye. Solomatin created a working mockup of a submarine's propeller shaft line connected with engines and possessing a remote control system. Working permanent remote control equipment for the main engine, cadets employed the mockup to follow the whole course of switching operations for the propeller shaft line.

A submarine model situated in a translucent tank demonstrates surfacing, trimming, and careening in lessons on the control of submarines. The model is controlled simply and conveniently from a separate panel with the aid of a pneumatic system.

We have a very wide array of trainers. They are designed to impart cadets with the habits for controlling the equipment and using it in combat. A high-output radio transmitter trainer created by Warrant Officer F. Fedulov can be used to perform all operations foreseen by a program involving the switching on , alignment, and employment of the particular type of transmitter. It completely resembles a working model both with respect to its external appearance and the way the pointers of the monitoring and measuring instruments behave when aligning knobs are turned.

The great advantage of trainers that we see is that we can build as many as necessary, depending on the number of cadets. Besides, owing to the use of trainers we saved close to 15,000 kilowatt-hours of electric power in just 1969 alone.

Simulators are widely used to approximate the training conditions to those met on a ship. We divide them into two types, target simulators and noise simulators. The first make it possible to acquire skills without having to turn emitters on. The second allows cadets to assimilate the procedures and methods for working in the presence of active and passive noise.

Warrant Officer N. Semenov created an integrated simulator for a radar station. A signal resembling a real one is produced on the station's screen. At the same time two targets appear, which move across the screen in response to a programming device. The target images are produced in the presence of strong jamming conditions.

Automated mass training rooms help to save training time. The effectiveness of learning the block and functional diagrams of equipment, as well as the rules for its use and combat operation, has risen significantly. Thirty cadets, future radio operators, study together in one of the automated rooms. An instructor's control panel and 30 working places furnished with search display devices resembling real ones are situated in the room.

In the training mode, signals simulating radar operation are fed sequentially from the instructor's panel to the working places. The transmission of a signal is accompanied by an instructor's explanation recorded on tape. In the control mode the cadets are required to determine the parameters of several signals sequentially reproduced by the simulator. With the aid of a system of switches each cadet submits his answers into a memory, making it possible for the instructor to conduct an objective critique and assign grades at the end of the lessons.

Telegraph operators acquire the skills for working typewriters by the blind method in an extremely short time in the mass training rooms developed by Warrant Officer Zh. Polykovskiy. Each working place has a trainer that is connected electrically to an instructor's panel and to a signal display panel on which letters or digits alight. From the control panel the instructor manually or with automatic machines lights up digital and literal symbols on the display panel at a certain rate. In a darkened place the cadet reproduces the symbol by pressing the proper key on the trainer.

Mass training rooms make it possible to diversify the form of exercises. This raises the interest of the students toward the exercises and promotes the fastest acquisition of firm skills. They make it possible to program the process of skill development, and to attain step-by-step control --that is, to have flexible control over the course of training. The instructors receive extensive possibilities for analyzing the course of training thoroughly and to constantly improve their methods.

Not everyone can become a good sonar operator. Warrant Officer A. Gritsayuk, the senior instructor of the occupational selection office, helps to find the most suitable candidates.

We see great promise in the creation of rooms in which various technical training resources are centralized. They can be used for practical lessons on particular equipment within an integrated system. The study can shift gradually from the simplest problems to the more complicated ones.

$$M = \frac{n\alpha(t_1 + t_2)}{T},$$

where t_1 is the mean time spent by a cadet to perform all operations on the trainer, minutes, t_2 is the time needed to reset the trainer in its initial position, minutes, α is the number of repetitions until the operations are fully assimilated, T is the time allowed by the program for working out practical problems on a particular type of equipment, minutes, and n is the number of cadets being trained at the same time.

In this formula t_1 and t_2 are determined by selective statistical analysis. We selected several persons from each shift and did time-and-motion studies on their work. For this experiment it is best to use not less than one third of the cadets studying a particular specialty.

In our opinion an important condition for further development of the training base is the unification of parts, units, and power supplies for all technical training resources. This would not only simplify their operation significantly. It would also assure a sharp drop in time and expenses on material resources, spent in repair, since the assortment of the needed parts and units would be reduced sharply.

We consider its structural concepts and correspondence to esthetic requirements as the essential indices of the quality of any new technical training resource. A comfortably employed and handsomely structured trainer attracts greater attention from the students and helps them to study more diligently. This is why in the last few years in our training detachment before any sort of technical training resource is manufactured its sketches are evaluated at a meeting of efficiency experts. Permission for its manufacture is given only after all critical comments are considered.

Many years of experience in our collective convinces us that we should not interest ourselves in the creation of machines and devices designed solely for the control of knowledge. They can be used suitably, for example, for quickly testing the readiness of the whole group for practical lessons. The use of complicated technical training resources is justified only when large groups of specialists are being trained. If the group of trainees is small and they must assimilate many models of equipment, then the efforts and expenses for creating complicated trainers sometimes significantly exceed the useful return. The designing of all types of technical training resources and their manufacture must imperatively begin with a study of scientifically based methods for their employment.

There is yet another important principle: A developed, perfected technical training base hardly reduces but actually significantly increases thedemands for theoretical, special, and methodological training for instructors.

A PORTABLE DEVICE

Technical-Senior Lieutenant Z. Khuzin

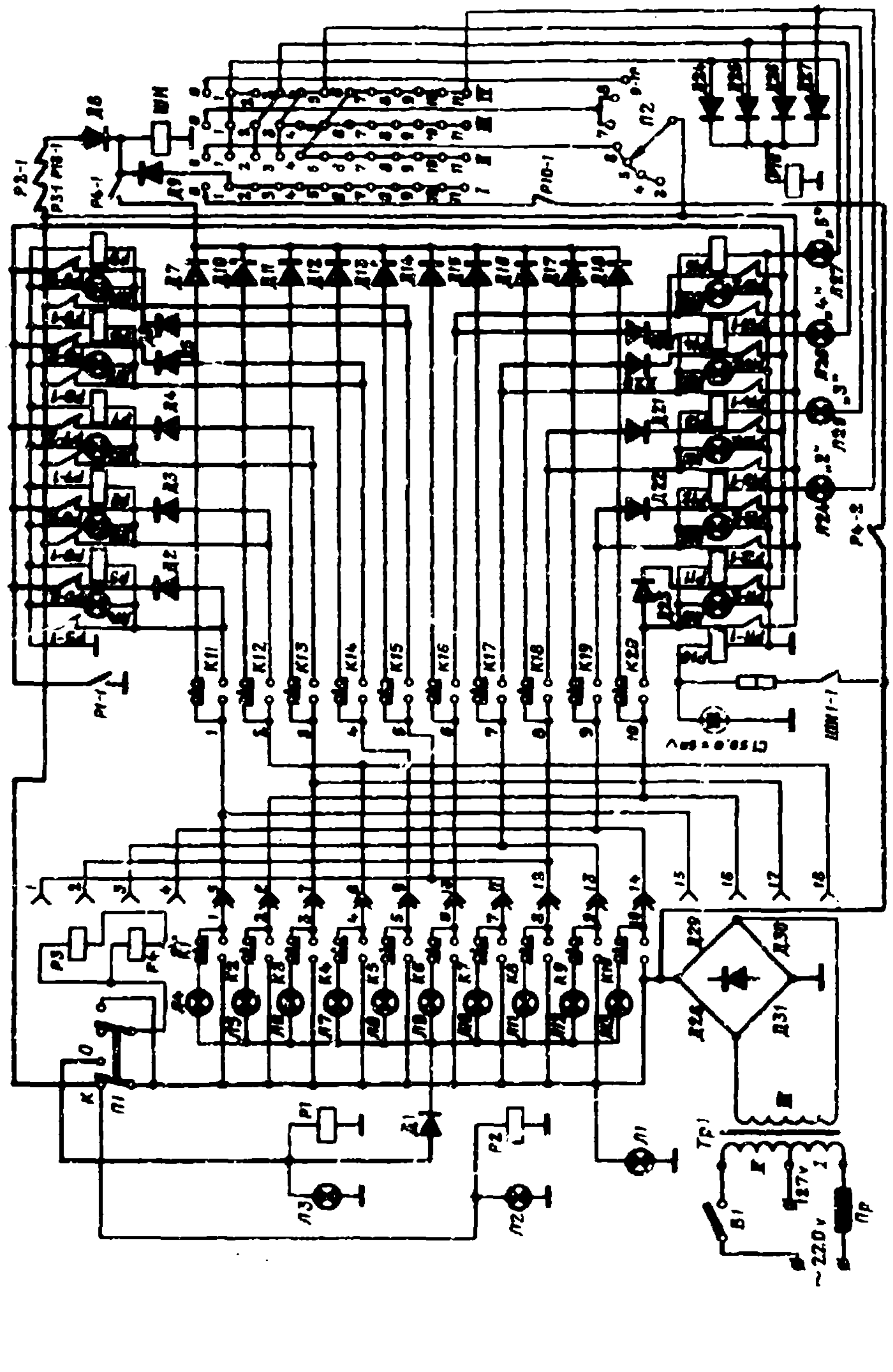
We employ a portable device that operates from a 220 or 127 volt ac circuit in teaching the principles of operation of complicated circuits. Its electric circuit (see Figure) consists of a power pack, an answer unit, a code setting mechanism, a question unit, and an error summator. The power pack rectifier is assembled as a bridge circuit, in which semiconductor junction-type diodes D305 are used as the rectifiers. The answer unit includes 10 electric incandescent commutator switch lamps Л4-Л13, 10 buttons K1-K10, and D226 diodes Д1-Д6, Д19-Д23.

The code setting mechanism is a common single-row plug connection with identical distances between the sockets and pins. All pins, from the first to the tenth, are connected with answer buttons K1-K10, while sockets 1-18 are connected with question buttons K11-K20. A connection of this design makes it possible to change the order of answer and question button hookup for each card, and it provides a possibility for getting different variations of card programming.

Variation No 1 is set by means of connecting the first pin with the first socket, the second pin with the second socket, and so on. Each subsequent variation up to the ninth inclusively can be obtained by moving the plugs and pins an identical distance. For example a connection of the first pin with the second socket, the second pin with the third socket, and so on produces the second variation. For variations 1a-9a the plug must be turned 180° such that the first pin coincides with the tenth socket.

The question unit is assembled from 10 lamps Л14-Л23 and 10 RP electromagnetic relays. The correct answers are registered by 10 buttons K11-K20.

The summator records the errors, adding the signals coming from the buttons through diodes Д7-Д18 into the coil of an ShI-11a step-by-step selector, and produces an evaluation of knowledge. Switch П2 has seven positions, each of which corresponds to the number of questions asked on a card. Relay P16 and diodes Д24-Д27 switch the step-by-step selector ШИ into the position corresponding to evaluation "5" in the question mode. Relay P10, capacitor C1, and resistor R stop and start the step-by-step selector ШИ, providing the necessary time delay when one of the answer buttons is pressed (a continuous signal is transformed into a pulse). Relays P1-P4 switch the circuit to one of the modes of operation.



To operate the device in the teaching mode, switch П1 is set at position "0": Lamp Л3 lights, and relays P1, P3, and P4 activate. When one of the question buttons is pressed the lamp of the proper answer lights. Let us assume that button K11 is pressed, corresponding to the fifth variation of the first question. In the case the current will pass through circuit contacts П1, diode Д1, lamp Л4, button K1, plug contacts 1-5, button K11, diode Д2, break contacts P5-2 of relay P5, closing contacts P1-1 of relay P1, negative pole of power supply. Lamp Л4 illuminates the answer for the given question. Answers are given to the other questions in the same way.

When switch П1 is in the neutral position, the current passes through closing contacts P4-2 of relay P4, break contacts P10-1 of relay P10, any one of the contacts of the first section of step-by-step selector ШИ, and diode Д9, to the coil of the step-by-step selector ШИ. Activating, it switches on it closing contacts ШИ1-1. Current from the power supply bus passes through contacts ШИ1-1 and resistor R to the coil of relay P10, which activates after a time delay. After this, contacts P10-1 break and the coil of step-by-step selector ШИ de-energizes, breaking contacts ШИ1-1. Current disappears from the coil of relay P10. The cycle continues until the brushes of the first group in the step-by-step selector assume the zero position and break the coil supplying circuit in the teaching mode.

In the control mode, switch П1 is set at position "K", signal lamp Л2 lights, relay P2 activates and closes its contacts P2-1. Current passes to the coil of the step-by-step selector ШИ through contacts P3-1, P2-1, and P16-1, and diode Д8. The selector's brushes assume the first position. Current from the power supply bus passes to lamp Л5 through any of the contacts of switch П2 and the first brush of ШИ. The lamp illuminates the answer of the respondent. Simultaneously a current passes through diode Д24 to the coil of relay P16. The contacts P16-1 break, and the coil of step-by-step selector ШИ switches off. The circuit is ready for questioning.

The student feeds the answer in as follows. First he presses the button for which the number corresponds to the number of the question, K11 for example. Then, selecting the correct answer in the left column of the card, he presses the answer button (button K1 in this circuit). Current from the power supply bus passes through connection terminals 1-5 and button K11 to lamp Л14 and the coil of relay P5, which self-locks with closing contacts P5-1. When button K1 is released lamp Л4 flashes (the question button should be released only after the answer button is switched off). If the wrong answer is given -- for example if button K2 was pressed instead of K1, then the current passes through this button, connection terminals 2-6, button K20, diode Д18, closing contacts P4-1, and to the coil of the step-by-step selector ШИ. Activating, it registers the error: The brushes move to the second position.

In order to repeat the questioning for this or another card the operating mode switch П1 must be shifted to the neutral position. Then the error summator again assumes the initial position.

The cards are made from blanks of identical dimensions. These are completed with questions and answers in accordance with a coding table. The sequence for filling out the cards can easily be determined with the help of the device itself. It is switched into the teaching mode. By pressing the question buttons one can determine the column in which the answer to the given question should be entered.

Each card has an opening that fits over a pin on the upper panel of the machine, and a coding legend in the upper portion. This legend is used to set the coding block of the code setting mechanism. The lower part of the card can be used to designate the subject being studied, the name of the part, chapter, and article. Such a designation facilitates the choice of the needed cards.

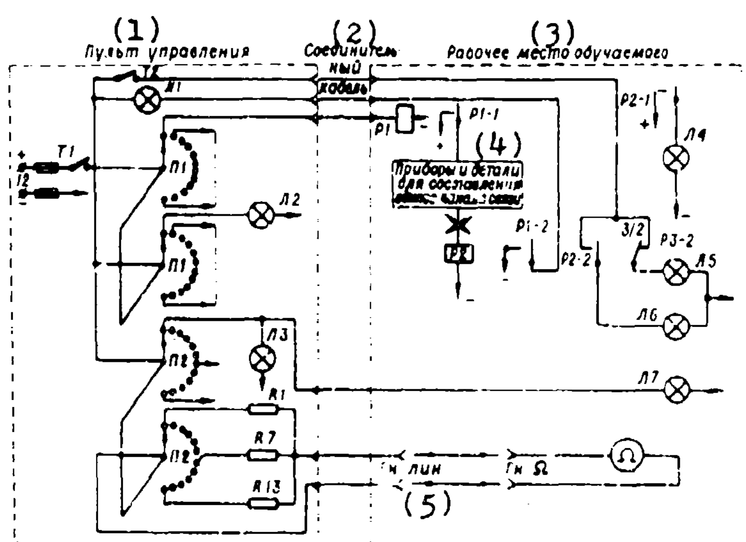
The student is given a "5" grade if he has made one error, a "4" for two errors, and a "3" for four errors. If the responses contain five or more errors he is given a "2" grade.

COMMUNICATION SPECIALIST TRAINER

Lieutenant Colonel A. Pavlovich

A special trainer employing programmed training has been developed and is being employed successfully at the Novocherkassk Higher Military Communications Academy. Its purpose is to raise the effectiveness of training long-distance communication mechanics and to give them firm practical skills, in the shortest possible time, in establishing and ganging communication channels.

It consists of a control panel and 6-18 student stations (see Figure). The control panel is a compact unit, on the front of which switches П1 for posing assignments involving the establishment of communication channels and П2 for posing assignments on changing line resistance and the resistance of its insulation are positioned. Installed in the same place are a signal panel that lights up the conditions of assignments transmitted to the stations, tumbler switches for turning power on, and lamps that automatically signal the fulfillment of an assignment to establish communication channels.



Key:

1. Control panel
2. Connecting cable
3. Student station
4. Instruments and parts for establishing one communication channel
5. [Expansion unknown]

The student station includes two working models of BKRP-11 units connected together by communication lines. Besides plugs and instruments, a signal panel that illuminates the names of the assignments that the student must fulfill is mounted on the front panels on the unit mockups.

In order to pose an assignment at the student station to establish a communication line, the instructor moves switch П1 to one of its fixed positions. At this moment the assignment name is illuminated at the student station by lamp Л4, and lamp Л2 lights up at the instructor's control panel. Using cross-connection cords the student makes the necessary connections. If they are made correctly, relay P2 at the student station triggers, closing the circuit of lamp Л1 on the control panel, which signals the fulfillment of the assignment. The instructor moves tumbler switch T2 to the "ON" position, and the word "CORRECT" (lamp Л6) lights up at the student station. If the connection is made incorrectly at the student station the instructor sets tumbler switch T2 at the "OFF" position, and the word "INCORRECT" (lamp Л5) lights up at the student station.

Similar operations are carried out to pose assignments on measuring line resistance and the resistance of its insulation. The conditions of these assignments are illuminated at the student station by lamp Л7, and by lamp Л3 at the control panel.

THE ABILITY OF A SHIP TO REMAIN AFLOAT DURING A CRUISE

Engineer-Captain 1st Rank V. Polyakov,
Engineer-Captain 2d Rank M. Tsiporukha

The navy's ships demand the maintenance of a high ability to float under any sailing conditions and under any sort of circumstances.

The basic elements of a ship's ability to remain afloat are, as is known, unsinkability, explosion and fire resistance, viability of weapons and machinery on the ship and, finally, the ability of the personnel to overcome damage. An ability to remain afloat is ensured not only by the design of the hull, armament, and machinery, but also by a whole system of organizational and technical measures. It is especially important to have distinct organization of service on the ship, to systematically monitor the condition of the ship's hull and its water-tight bulkheads, doors, and portholes, as well as the condition of technical resources employed to keep the ship afloat and their constant readiness for action.

In the period of preparation of a ship for sailing out to sea, the personnel make a careful inspection of the hull, and they eliminate the problems disclosed. And during the whole sailing period the personnel systematically monitor the hull's condition and take immediate steps to eliminate the problems that arise. Neither bends in the water-tight bulkheads, nor deterioration of the water tightness of a bulkhead's stuffing box, nor a malfunction of any one of the battening devices must escape the attention of compartment supervisors. Repair or replacement of parts must immediately follow the detection of a broken hatch cover, damage to its threads, and deterioration of the gasket. Those engineer-mechanics that take along several spare outfits of battening devices for portholes and doors when going to sea are doing the right thing. We must not forget the concepts promoted by S.O. Makarov: "During peacetime proper condition of bulkheads is most important, but during wartime it is of extreme necessity, and he who blurs his vision to malfunctions in his bulkheads, let him at least open his eyes before a war begins. It would be too late to open them when the ship begins to sink."

On long cruises systematic monitoring of the condition of valves, sluice valves, actuators, and couplings of water-pumping, drying, and other systems that guarantee unsinkability is of no lesser importance. During the cruise the hinges and

and threading of valve rods must be tested and lubricated daily, and they should be turned in accordance with all the requirements in the instructions, since improper rotation of valves and sluice valves within systems involving outside openings could lead to flooding of the compartment.

The readiness of portable water-pumping resources -- motorized pumps, electric pumps, and water-jet ejectors -- must also be tested systematically by actually turning them on. Careful attention must also be turned to whether or not gaskets are present in all removable connections of pumps and hoses, and to the condition of power cables, plugs, sockets, and junction boxes.

During a cruise a great number of exercises and lessons on maintaining unsinkability are held on ships with the participation of the personnel. When they are conducted the sailors fasten bulkheads and patch punctures, as a result of which their skills are maintained at a high level. However, it should not be forgotten that emergency lumber is used up in these exercises. Therefore an additional reserve of such material should be taken along when a ship goes to sea. This would make it possible to constantly maintain the outfit of beams, wedges, and plugs designated for use in emergency situations.

An object of constant concern on the part of officers during a cruise is the whole crew's strict observance of the rules for opening and closing hatches marked by the letters "Z" and "P". A hatch with the letter Z is opened only with the permission of the commander of the electromechanical combat chast', and after a report is made to the duty officer and the duty mechanic, who is obligated to make note of this in his log. An individual must be detailed to stand by an opened hatch. This would seem quite evident. But once on one of the ships the hold mechanics who opened a hatch leading to the coffer-dam and removed a portion of a pipeline that needed repair left the compartment without posting a guard at the open hatch. After a certain amount of time water began to come through it from the outside. It was only timely measures that prevented flooding of the compartment. When the ship returned to home port it was disclosed that the water had come through an air hole in the flap valve of the drying ejector installed in the coffer-dam.

Nor can any laxity be tolerated in regard to the timely closing of hatches with the letter P. It is locked at the commands "Prepare the ship for battle and for cruising," "Fasten the water-tight bulkheads," and when alarms are sounded. During cruising all of the ship's portholes, without exception, must be tightly sealed, and open doors and hatches must be ready for immediate closure. Therefore air and welding hoses and cables from portable electric instruments and ropes must not be fed through them without permission from the commander of the electromechanical combat chast'. Hatches should not be blocked up by any sort of implements.

Fire, especially in the munitions hold, the fuel compartments, or the power compartments, is obviously the most dangerous emergency on a ship. The high heat conductivity of a ship's metal structures, the limited size of compartments, encumbered access to some of them, and a relatively high air temperature in some compartments promote the spread of fire and make putting it out difficult.

The most probable causes of fire are clumsy and careless handling of flammables, violation of the rules for operating machinery and electric equipment, and violation of fire safety rules.

The ship's cook on one of the trawlers was filling the tank of a galley range with fuel. The tank flowed over, and the fuel ran onto a ventilation pipe and then fell on the heated grill. As a result there was a fire, and the galley equipment was damaged. Here the cause of the fire lay in the cook's carelessness, in his blatant violation of instructions.

It is rare, though it has occurred, that unintelligent simulation of a fire during exercises leads to a real fire. Therefore such simulating resources as a tray with tow and rags saturated with fuel can be used only on the upper deck in specially designated places approved by an order from the soyedineniye commander, but in no case can they be used within the ship's compartments. Fires must not be simulated near ventilation openings, munitions holds, ready-use ammunition lockers, next to fuel tank ventilation pipes, nor at the only exits from compartments. And, finally, in all cases fire fighting equipment (one or two monitors connected to hydrants and three or four fire extinguishers) must be held in readiness near the place where a fire is being simulated.

Faulty electric equipment is a dangerous source of fire. Most frequently fires arise due to the installation of nonstandard fuses into distribution boards. When moisture gets into lighting and switching equipment (lamp sockets, junction boxes, switches, and so on) the resistance of insulation decreases, and short circuits result. Mechanical damage to insulation or disintegration of rubber insulation on cables by fuel and oils can also lead to short circuiting and ignition. Therefore the monitoring of the condition of electric equipment on a cruise should be looked at not only as an important measure for maintaining equipment reliability, but also as an effective fire safety measure.

With respect to fire, operating boiler sections are especially dangerous. When boilers operate for a long time, the condition of their setting, especially the hearth, must be watched attentively and protected from damage. It is no less important to monitor the condition of the insulation of boilers, pipelines, and machinery operating off superheated steam. Tow, rags, wood, and other combustibles must not be allowed to touch intensely heated parts of boilers and steam pipes. When fuel pipes and pumps are being dismantled, containers or sumps must be placed underneath them to collect escaping fuel, since accumulation of fuel in the hold cannot be tolerated.

Welding work is sometimes done during cruises. It can be started only after the workers themselves and those involved with safety are carefully instructed. If cork insulation is present on the other side of a bulkhead to which something must be welded, the welding should not begin until the insulation is removed. Electric power lines in the vicinity must be disconnected and moved away. Although the melting temperature of lead is 327 degrees, rubber cable insulation covered by lead sheathing can become damaged at a temperature of 70-80°C.

All fire extinguishing systems -- carbon dioxide, liquid, and vaporous -- must be in complete readiness when a ship goes out to sea. Care should be taken beforehand about a sufficient supply of foam generator, and all foam and carbon dioxide fire extinguishers should be tested and loaded. Carbon dioxide isolating equipment and portable fans designed for smoke removal must be checked for proper operation.

In a cruise the personnel bear especially high responsibility for ensuring high readiness of technical resources, including spares.

The central bearing of an operating turbine-driven feed pump overheated during the cruising of one of the patrol ships. The shift was not able to convert to the reserve pump immediately because there was no lubricant in its bearing housings: It had to be fixed. The speed of the ship had to be reduced while the reserve pump was being prepared for start-up. This incident shows how important it is for engineer-mechanics to organize efficient monitoring of the condition of spares.

We should always strive to see that all technical resources being employed, including piping, are hooked up in accordance with the manuals for combat use of technical resources, and that the on-duty personnel know precisely the sequence for engaging and disengaging the equipment.

If these points are not observed, it would hardly be possible to avoid a serious break in the work of the power system. When time is lacking it is very difficult to deal with the numerous interweavings of piping and cables, find and close the proper valve, turn off the knife switch that shuts off the damaged section of electric cable, and then put the machinery back to normal operation. This is why it is so important that care be taken to see that metal templates be present on all sluice valves and valves, indicating the function of the fittings and the sequence for turning them off.

All pipes must have distinguishing colors and markings, and cables should be tagged properly. Naturally, successful use of all of these arbitrary symbols is possible only if the personnel are thoroughly familiar with them.

An important responsibility of the crew is to maintain emergency materials and instruments prescribed for repair of piping and cables in full readiness, and to know how to use them.

The history of the Great Fatherland War harbors numerous examples of personnel's successful struggles for the viability of technical resources. For example, on one of the destroyers the oil lines for the main geared-turbine units and the cables leading to fire control instruments were broken by the explosion of a shell during an artillery exchange with an enemy shore battery. The ship slowed sharply, and target indication for the weapons ceased.

The personnel began correcting the damage without delay. The turbine mechanics applied yokes and lagging to the damaged sections of the oil lines, they replaced part of the piping with a high-pressure fire hose, and the turbines regained full rpm. The electricians found the proper cables in the damaged section using the markings on the bulkhead and spliced them with junction boxes and cable lengths. The fire control instruments began working again, and the ship fulfilled its mission successfully.

In order to make work faster and to prevent errors in connecting extensions, the ends of the strands should be marked with colored thread -- red for plus strands, blue for minus strands, violet for first phase strands, yellow for second phase, and green for third phase. The marking can be done with tags. There should be descriptions at combat posts that indicate the strand number, the electronic equipment to which it belongs, the place of storage, its length, cross section, and the number of the combat strands by which it can be replaced.

PROPER STORAGE -- A GUARANTEE OF COMBAT READINESS

Engineer-Colonel V. Pisanko

The high combat readiness of armored equipment that has been packed for storage and furnished with desiccating material can be ensured, as is known, only if the proper types of technical maintenance are conducted on the machines at the right time.

In our unit the items of technical maintenance are satisfied strictly according to the plan. Basing ourselves on the results of annual inspections carried out by technical commissions under the directorship of deputy commanders of the technical chast', we ascertain the volume of work necessary for each vehicle before routine maintenance begins.

Just before the annual technical maintenance, repacking, and test runs, we hold lessons for the commission members, in which they study the technical specifications and learn how to compile repair notes properly for various brands of vehicles. At the same time the chairman makes the responsibilities of each commission member known precisely. He makes specific assignments as to which of them is to monitor the condition of the running gear, the body, and the gun turret, inspect the documentation for, the condition, and completeness of the kit of spare parts, tools, and accessories, which of them is to inspect the driving section and the combat section, the propulsion unit, and the power transmission, and adjust the actuators for controlling machine units and mechanisms, which of them is to inspect the condition of electric system and battery, fire-fighting equipment, hand-held fire extinguishers, and night viewing systems, which of them is to inspect the armament and tracking instruments, and which of them is to check out the communications systems. He orders one of the commission members to check for the presence and quality of fuel and lubricants, and the condition of filling equipment. We feel that such distribution of responsibilities among the commission members is most efficient.

Motor pool, production, and ancillary equipment is prepared beforehand here in order to ensure rapid, high-quality completion of the planned work involving preparation for storage and repacking of the vehicles. In addition, special stations are created. We have 11 such stations. At the first station inspection certificates are made up, and the fire extinguishers, fire-fighting equipment tanks, and engine starting system tanks are filled with compressed air. Steam-and-air valves are inspected and adjusted at the second station. Air cleaners and various system filters are rinsed out at the third station. The main clutches are overhauled at the fourth. At the fifth, the stud bolts of the engine's cylinder block heads are tightened. At the sixth the sealing materials are cut open, and the silica gel is dried and repacked, and at the seventh the tarpaulin articles are washed, repaired, and marked. Vehicle kits of spare parts, tools, and accessories are worked on at the eighth station. At the ninth station the monitoring and measuring instruments and the infrared equipment are inspected. Cooling fluid is prepared and supplied at the 10th station. And, finally, sheet metal work and coppersmithing are done at the 11th station.

A schedule is compiled for all stations, and each station is given industrial procedure cards in order to ensure smooth operation of the brigades, which are composed of repair specialists and crew members. The industrial procedure cards provide a list of operations and of the instruments and equipment that are to be used, and the specifications to be followed in completing the operations.

After the work on the vehicles is finished the commission members inspect the completeness and quality of the work, they make the necessary comments on cards destined for long-term storage, and they make notes on the plan for future vehicle maintenance. Then once again the condition of electric circuits and systems designed for charging batteries with small currents is inspected, and the presence and proper completion of all documentation is checked. The commission gives tests to specialists responsible for the work of systems for charging batteries with small currents. He who passes the test is permitted to fulfill his responsibilities by chast' order.

Many years of experience have convinced us that beginning with the second year of storage it is suitable to inspect the condition of electric circuits (with the exception of the starter and stabilizer circuits), as well as that of contact panels and terminals, junction blocks, and outside lights, and to clean them when necessary during the course of annual technical maintenance. Wire terminals must be resealed. Rubber sheaths that have breaks or cracks, and those that are peeling due to the effect of fuels, lubricants, and solvents that have fallen on them should be wound with either PKhL-20 polychlorvinyl ribbon, after which the sheaths can be pulled over wires painted with shellac or bakelite varnish, or with electric rubberized insulation ribbon. Cotton gauze saturated with shellac or bakelite varnish can be applied over the ribbon. We note that the points at which wires are fastened down must not be oiled, painted or, worst of all, treated with solvents.

In hot and moist areas, beginning with the third year of storage the condition of lubricant in the bearings of the running gear's bogie wheels should be checked during annual technical maintenance. To do this, two armored hoods of the bogie wheels are removed from each side of the vehicle.

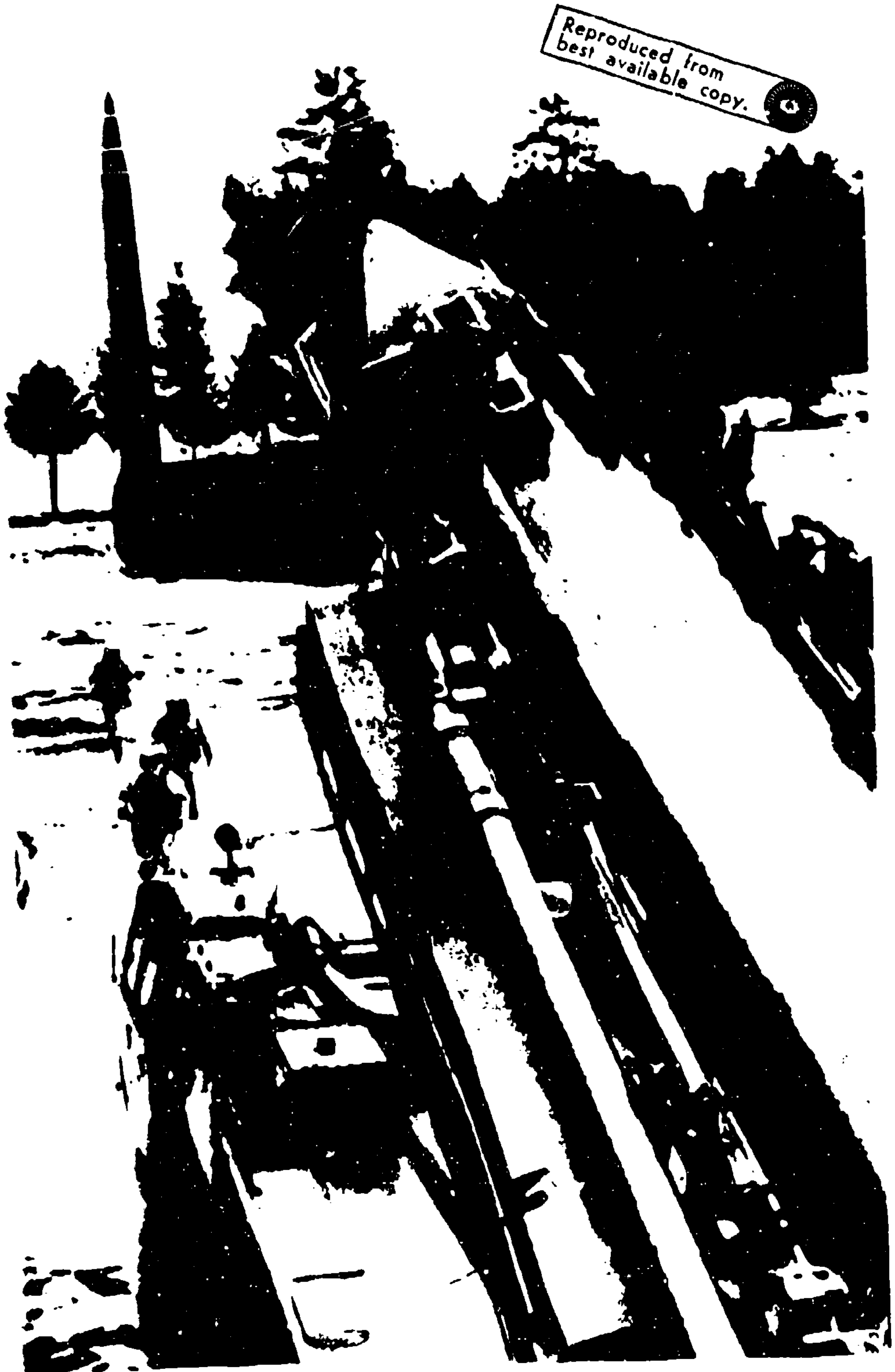
Sometimes it happens that after two or three years of storage the hose joints begin to leak fuel, oil, and coolant. To prevent this trouble we paint the hose joints and select them by diameter and rubber type. The diameter of the rubber hose joint must be 1-2 mm less than the diameter of the nozzle over which it is fitted. A clamp 10-15 mm wide is placed within 5 mm of the end of the hose joint. The hose joint is watched during installation to see that the thickness of its walls does not decrease by more than 30 percent as a result of deformation of the rubber.

As experience has shown, the sealing method completely protects machine units, parts, and machinery within the body from corrosion. We can ensure good condition of the external surfaces of the armor, running gear, and gun turret, which are continually subjected to precipitation, dust, and sharp changes in air temperature, principally by precise, diligent fulfillment of routine technical maintenance operations, and by high-quality undercoating and complete painting of the vehicles.

Points of damage are touched up following a specific procedure. First of all rust and old paint are carefully removed with metal brushes or emery paper. The cleaned surface is rubbed with rags and blown by compressed air. Then any grease is removed: The surface is rubbed with a rag wetted with white spirit, and then again with a dry rag. VL-8 or 138 primer is applied without runs as a thin layer to the surface prepared in this manner. The time between cleaning and primer application must not exceed 2-3 hours. Carefully mixed paint at a ratio of 400-500 grams per square meter (if two layers are to be applied) is applied to the dried primer.

We have special stations for vehicles that require complete painting. Brigades of three people work there according to a special schedule approved by the deputy commander of the technical chast'. The deputy commander notes the painting of the vehicle had been done on the permanent record card, and he records the day and year.

In our opinion the fulfillment of the recommendations enumerated here would ensure an improvement in the condition of armored tank equipment in the forces, and it would help to maintain the equipment in constant combat readiness.



Each training exercise is held in conditions close to those of combat

ADVICE

Engineer-Colonel V. Presnov

"Can a 6-STEN-140M battery explode," asks Senior Lieutenant F. Nurislamov, "if a heightened concentration of oxyhydrogen gas is formed as a result of a malfunction of the RRT-24 controlling relay?"

Engineer-Colonel V. Presnov answers this question.

In some cases a high concentration of oxyhydrogen gas (a mixture of hydrogen and oxygen) could be generated in a battery. A 4 percent hydrogen concentration is enough to be dangerous. The cause for appearance of oxyhydrogen gas is profuse gas evolution (battery "boiling") during charging.

How can we prevent or significantly reduce gas evolution during the use of batteries in vehicles, and thus prevent the danger of an explosion, which could occur if the gas meets an open flame?

As is known, vehicle batteries are charged with a constant voltage. In this case as the battery charges the charging current decreases automatically, since

$$I_{\text{з}} = \frac{U_{\text{з}} - E}{R}.$$

It is evident from the formula that the size of the charging current is determined (under otherwise equal conditions) by the size of the charging voltage, which in turn depends on the adjustment of the voltage regulator in the RRT-24 controlling relay.

If the voltage regulator maintains a potential of no more than 28 volts, then the process of charging a 6-STEN-140M battery goes on with almost no gas evolution, and all of the electric energy is used up in charging the active material. Under such conditions the concentration of oxyhydrogen gas is negligibly small, and the battery cannot explode.

During operation, after a time the voltage regulator falls out of adjustment and maintains a potential that is higher than 28 volts. This results from insufficient temperature compensation. Then the charging process is accompanied by profuse gas evolution, since in this case part of the electric energy is expended on electrolysis of water. The appearance of this undesirable phenomenon is especially probable in summertime, when batteries are used in high temperatures.

It is simple to adjust the voltage regulator. The tension on the springs must be weakened. It would be desirable to maintain the potential at 27 volts during the summer. In addition, strict observance of safety rules is necessary, of course, and it should be seen that open flames or chance sparks are not permitted near the batteries.

Fulfillment of these most simple recommendations will completely exclude the possibility of explosion of a 6-STEN-140M battery.

WITHOUT WAITING FOR HELP FROM THE WORKSHOP

Colonel V. Prokov'yev

When engineering vehicles are used over a long period of time, malfunctions of electric equipment cannot be ruled out. They are caused primarily by the natural wearing of parts. Moreover as a result of vibrations and dynamic loads to which the vehicle is subjected, contacts are sometimes damaged, wires are damaged, and terminals break.

Each driver must know how to detect and eliminate these very simple malfunctions.

First of all we remind the reader that it is easier to prevent the majority of faults than it is to correct them. This is why vehicle inspections should include a careful inspection of the condition and reliability of fastening of external and internal lighting fixtures, light signals and horns, monitoring and measuring instruments, fuses, batteries, generators, starters, and terminal contacts.

After the vehicle's circuitry is turned on the charging level of the battery and the circuit voltage should be determined. Each time during such inspections the air holes in the battery plugs should be cleaned out, and the batteries themselves should be wiped with a dry rag. If electrolyte happens to fall on the battery, the battery must be wiped with a cloth wetted with 10 percent soda solution.

The electrolyte level, which should be 8-10 mm above the safety shield, must be checked by necessity every 10-15 days, and every five to six days when the temperature is above 30°C. When necessary, distilled water can be added (but not electrolyte!).

During scheduled technical maintenance the condition of the commutator is checked. When necessary it is rinsed with gasoline and blown with compressed air. For the starter it is necessary to attend to the condition of the teeth of its gears and the rim of the governor. The gap between their faces must be checked (4-4.5 mm). All work foreseen in the applicable manual for the vehicle's employment must definitely be carried out.

It stands to reason that we cannot guarantee that no faults would arise during travel or while the vehicle is working. Therefore the driver should concern himself to see that he possesses a monitoring lamp, pieces of wire, a knife, and insulating tape.

One of the possible faults is a break or a poor contact in the circuit. In this case most frequently a wire breaks within undamaged insulation, and it cannot be found by inspection. The search is simplified significantly if a monitoring lamp furnished with a probe is employed (Figure 1). It is not difficult to make one in any workshop. A flexible wire is connected to the vehicle body by an alligator clip, and the probe is applied to circuit terminals, beginning near the power supply and working toward the consumer, or the other way around.

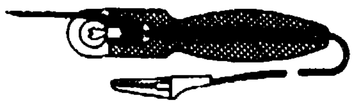


Figure 1. Monitoring Lamp with Probe

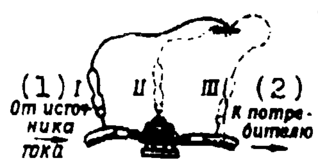


Figure 2. Detection of a break in the circuit with the monitoring lamp. The numerals show the sequence in which the lamp is hooked up.

Key:
1. From power supply 2. To consumer

Having disclosed the portion of the circuit in which no conductance is evident, we check it out in detail to find the point of the break. First of all the ends of the wires next to terminals and the places where they are connected to the terminals are inspected (Figure 2). If the fault is not found, then the whole wire is checked. For this, the probe of the monitoring lamp is stuck through the insulation at certain intervals. This is done until the section with the damaged core is found. The job can be done without probing also by replacing a section of the circuit with any sort of conductor.

Figure 3. Testing the connecting resistance at a terminal by comparing two readings on a voltmeter (a), and by direct measurement (b)

The condition of terminals is tested with a voltmeter possessing a scale registering up to 15 volts (Figure 3). First it is hooked in front of the contact being tested (on the side of the power supply), and then right after it. The instrument readings should be identical. If a decrease in voltage is detected, its value should be registered more precisely with a millivoltmeter. A drop in voltage means that a significant connecting resistance has arisen in the contact, a consequence of intensive oxidation or mechanical damage.

During operation of the equipment mechanical damage to insulation is also possible, as a result of which a bared wire can occasionally touch the vehicle body and cause a temporary short circuit: The current bypasses the consuming components and grows to its highest value.

Short circuiting is an accidental case. It rarely arises unexpectedly -- for example when the vehicle undergoes intense shaking. More frequently it is preceded by a gradually increasing current leakage as a result of partially damaged insulation. Such damage can also be detected by external symptoms. In such a case lamps burn dimly, and damaged wires heat up noticeably. Overheating leads to further damage to the insulation, and it can burn through. Therefore the fault must be eliminated in time (the wire or a part of it should be replaced).

As is known, fuses are installed in some circuits to prevent overloads. A burnt out fuse and nonfunctioning consuming components are symptoms of the fact that the short circuit arose namely in the circuit that has shut down. But what if it arose in a circuit without a fuse? Then the symptoms would be the sudden shut-down of all consuming components and an odor of burning rubber. The pointer of an ammeter on the instrument panel deflects sharply as far as it can into the "discharge" direction. In this case the first thing to do is to disconnect the battery and then all of the consuming components. The battery can be reconnected only after the short circuit is found and eliminated.

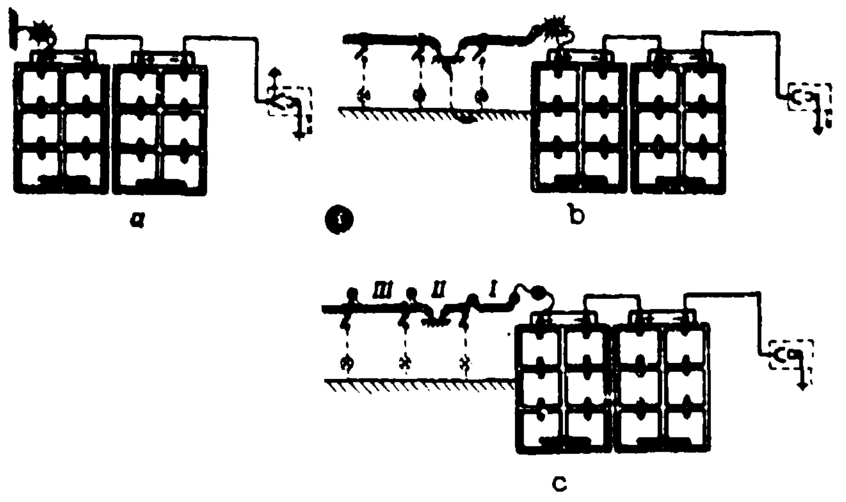


Figure 4. Detection of a short circuit within a circuit: a -- load is switched off and the lamp lights; the short circuit is within the switch. b -- the switch works properly; the short circuit is within the circuit. c -- the lamp shuts off when lead I is switched off; the short circuit is in section II.

It is best to begin the search in the section between the battery and the switches (Figure 4). First the leads connecting the battery to the consuming components are disconnected. The terminal of the monitoring lamp is connected to the battery's plus terminal, and the probe is rested against the vehicle body. The lamp should not light. If it does light up, then the battery switch is faulty, or a short circuit had occurred in its circuit.

After it is made sure that the switch works properly, it is switched off, and the next test is made: The probe is rested against the disconnected battery lead. If the lamp lights, then obviously there is a short circuit somewhere in the line. In order to find the place where it arose we switch off individual sections of the circuit until the monitoring lamp turns off. After finding the damaged wire we inspect first of all those places where it passes through openings in metal parts or where it is fastened to the vehicle's body. By necessity the places where the wire terminals are fastened are inspected, since contact with the vehicle body is possible there also.

If a short circuit is not detected in the circuit between the battery and switch, then the consuming circuits are connected to the battery one at a time. When the damaged circuit is switched on the monitoring lamp burns brightly, but current does not get to the consuming component. In a properly functioning circuit the monitoring lamp (its capacity should not be less than 25 watts) is dim.

As we can see, it is not so difficult to find the simplest forms of damage in electric circuits, and to eliminate them. With a little training every member in the crew (squad) of an engineering vehicle could correct the faults.

In order to accelerate the process the energy of the electric field arising between the part surface and the core of the electromagnet (the instrument) is used additionally. To do this, the part and the magnet core are electrically connected with a pulse current generator (Figure 1). When the ferromagnetic powder is fed in, the circuit between the instrument and the part closes. Electric discharges that promote more intense fusion of the grains and micro-irregularities arise on the part surface. The rate of the process is 100-150 cm³ per minute.

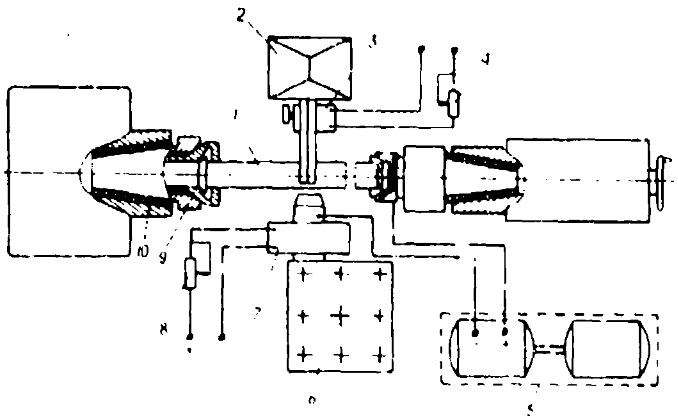


Figure 2. Part Strengthening Device

Key:

1. Worked part
2. Tank with trough
3. Vibrator
4. Rheostat
5. MGI-2 generator
6. Tool holder
7. Electromagnet
8. Rheostat
9. Collet chuck
10. Textolite bushing

In order to strengthen the track pins of a BAT track layer by this method, we designed a special device (Figure 2). The worked part is fastened by a collet chuck containing textolite bushings on a lathe (a 1K62 tool is used) or on the center of a special stand. Then the part is connected electrically with the positive pole, and the core is connected to the negative pole of an electric current pulse generator. An electromagnet, the core of which is positioned a certain distance away from the part, is placed into the tool holder. The coil of the electromagnet is powered from a rectifier hooked into the circuit through a variable resistance. The ferromagnetic powder is fed into the gap between the part and the core through the trough from the tank. The trough is rigidly connected to a vibrator, a direct current electric motor with a small eccentric mounted on its shaft. The motor rpm and, consequently, the vibrating frequency are controlled by the rheostat. The quantity of powder fed in is guaged by changing rpm and vibrating frequency, as well as by varying trough tilt. The part is constantly cooled by an emulsion, which promotes a decrease in the height of micro-irregularities in the strengthened layer.

By experiment it was established that the optimum rotating speed of the part should be 19.5 rpm, and the longitudinal movement of the tool holder and electromagnet should be 0.26 mm per turn. The size of the gap between the magnet shoe and the part is adjusted within 0.85-1.5 mm, and the potential of a free-running generator is set at 26 volts. The ferromagnetic powder -- ferroboron (grain sizes 0.21-0.25 mm) -- is fed at a rate of 5 grams per minute. Such a combination promotes the creation of a 0.1-0.15 mm layer on the pin surface, and of a diffusion layer that is not less than 0.5 mm on the side. Tests on pins strengthened in this way showed that their wear resistance is twice greater than that of ordinary pins. This result allows us to see promise in the employment of this method to work various parts of engineering vehicles that operate in an abrasive medium.

THE MILITARY CONTROL AND CHECK POINT

Engineer-Lieutenant Colonel V. Puchkov

The principal task of meteorological units is ensuring the accuracy of measuring system readings, by means of comparing them to model (standard) instruments. Special testing units -- the monitoring and measuring laboratories (KIL) and the control and check points (KPP) -- carry out the monitoring and accounting of measuring systems and check them out on schedule in the troop chast' and institutions. In their work they are obligated to follow the orders, manuals, and directive instructions of the reference measurement service, as well as the GOSTs [All-Union State Standards] and the instructions on inspecting instruments. These documents are as indispensible to them as the model instruments and testing equipment.

It is best to locate the KPP on the ground floor of a major building, in a space with sufficient natural illumination and steam heating. It is recommended that isolated rooms be present for locating working places at which the basic types of measuring systems are tested, and that there be individual rooms for repair, receipt, and return of the instruments. The space must be furnished with ventilating and electric power supply systems, as well as with a grounding circuit that electrically connects all electric devices and control panels.

The KPP is equipped with testing instruments according to the standards developed with a consideration for the types of measuring systems employed within the chast'. Personnel of the check point are permitted to work on jobs involving the testing and marking of measuring instruments only after they undergo special training and pass the examinations (tests) within the Checker Training Program of the USSR Ministry of Defense. Those who pass the examinations receive a certificate or a diploma that gives them the right to check instruments. Certificates are ordinarily issued when examinations are passed only on working instruments or specific types of instruments.

The first stage of organizing the checking consists of planning the KPP work with a consideration for the brands of the resources to be checked, their quantity, the time they were last checked, and the remoteness of the location of podrazdeleniye with respect to the permanent check point. The plan is compiled by the point chief and approved by the chast' headquarters. Extracts from it are obligatorily sent to podrazdeleniye commanders with sufficient lead time. The frequency of checking is established by the Measuring Instrument

Inspectorate of the USSR Ministry of Defense. The time between checks can be changed only if it is shortened.

Instruments that are mounted on equipment should be checked during the repair period independent of the time since the last check. Instruments that the KPP cannot inspect with its own facilities are sent to special laboratories of the Ministry of Defense or to laboratories of the State Inspection.

In the podrazdeleniye numerical accounting of measuring systems is used in order to facilitate control over equipment condition and ensure timely checking. The date and checking results are entered into an accounting journal. An exchange pool, the content of which the point chief is obligated to know and keep adequate, is created in podrazdeleniye in order to ensure efficient replacement of measuring systems that malfunction during use. The exchange pool as well as the spare parts, instruments, and attachments are checked at the same time that instruments mounted on equipment are checked. Malfunctioning instruments are repaired by KPP specialists. If they cannot be repaired they are sent to repair enterprises. Usually minor repairs are conducted at the KPP -- replacement of individu[illegible] parts of a mechanism, cutting and mounting of glass, and [illegible] on. For this, the point is provided with a repair kit o[illegible] tools, spare parts, and accessories and the necessary expendible materials. If work is to be done at remote podrazdeleniye it is furnished with movable resources on vehicles. The mobile groups as a rule include a specialist for each basic type of measurement and a repair foreman. Before leaving, the mobile point is prepared. It is inspected, and its equipment is checked for adequate functioning and completeness. It is recommended that a small quantity of instruments (primarily those that malfunction most frequently), a repair kit of tools, spare parts, and accessories, expendible materials, and technical documentation be taken along. The commander of the podrazdeleniye to be visited by the group is informed of their trip beforehand so that the instruments could be prepared for checking in time. When it arrives at the podrazdeleniye the vehicle should be placed as close as possible to the power sources and instruments. The vehicle is leveled at its parking place, and the correctness of the hook-up of its equipment [illegible] the power sources is checked.

[illegible] of working places involves unpacking the equipm[illegible] its operability, and collecting the needed GOSTs, [illegible] and methodological directives. The personnel tha[illegible] the instruments remove them and submit them for checking. We recommend that the checking begin with instruments that do not require disassembly. It is better to check the instruments in unitypic lots. This method makes it possible to reduce the time for circuit assembly and disassembly.

The KPP specialists enter the checking and repair results into the accounting journal. Useable instruments are marked, and a certificate of checking is issued for model instruments. A certificate of scrapping is issued to the podrazdeleniye commander for unuseable equipment, and it is removed from the systems in which it was installed. When the work is completed the chief of the mobile checking group brings his remarks to the attention of the podrazdeleniye commander and makes his recommendations on how to eliminate the disclosed deficiencies in the condition of measuring equipment.

In addition to inspecting the condition of measuring instruments and monitoring the observance of the schedules for their checking, the KPP specialists monitor the precision of the characteristics of their own equipment and model measuring instruments with special care.

Maintenance of precision characteristics is achieved primarily through fulfillment of the basic rules for operating and storing model measuring resources. Special attention should be given to monitoring whether or not the equipment is checked on time, whether temperature and humidity conditions are considered when instruments are stored, whether the instruments are protected from the effect of direct solar radiation and heat from heating systems, and from the settling of dust and moisture. Model checking resources must be employed only as they were designed to be. They cannot be left unwatched after being turned on. Outside of the shelter they can be transported only in specially equipped boxes and cases, and they should not be moved at a speed greater than that allowed. One of the specialists must accompany the equipment. Portable checking systems can be stored only in heated buildings.

Technical maintenance of the checking equipment of mobile systems has its own peculiarities. They stem from the difficulties arising in the course of storing mobile systems, and especially in the period when they are operated at the podrazdeleniye. Therefore special attention should be allotted before the mobile checking unit leaves to the installation of thermometers, standard cells, reference barometers, and piston gages and dead-weight test apparatus. In order to prevent damage to standard pressure gages, a slight excess pressure should be created in them before travel begins. During the winter the work of heating and ventilating systems and signalling systems must be inspected before each departure, and all equipment should be checked for proper operation after it is moved. Mobile checking systems that have been operated for a long time are subjected to preventative maintenance, the days and hours of which are stipulated by the senior man of the mobile group.

The list of preventative jobs established by the instructions for operation of checking systems and the one provided in technical descriptions do not encompass all of the maintenance work completely. Therefore it is necessary to follow temporary instructions developed by the checking units, in which the personnel possess a great amount of practical experience. Normally the volume of preventative jobs is distributed with respect to the frequency at which they must be carried out -- that is, daily, weekly, monthly, quarterly, semiannual, and annual.

We recommend that external inspections and removal of dust and moisture be conducted daily. Once a week the operability of set-ups and control panels, the condition of cables and plugs, and fluid levels should be inspected. The hermetic nature of various systems and presses and the state of insulation resistance should be checked once a month. Thermostat circuitry and the calibration of standard thermometers should be checked, and lubricant in rubbing parts should be changed once a quarter. During semiannual technical maintenance the dead-weight test apparatus and piston gages should be disassembled completely in order to find faulty parts and to replace or repair them. Annual technical maintenance includes the whole volume of work defined by the list, including inspection of model instruments, the resistance value of insulation in electric circuits, and so on. The time necessary to fulfill a particular operation by a checking unit should be defined in each specific case on the basis of accumulated practical experience.

The results of preventative maintenance are noted in the same journal that contains the list of jobs, the times for their fulfillment, and the names of the persons completing the jobs and those providing control. The journals can be maintained for individual types of equipment or for groups of checking systems. As experience in the work of checking units has shown, timely fulfillment and high-quality control over technical maintenance for measuring equipment provide possibilities for maintaining it in constant readiness for use.

FROM THE HISTORY OF EQUIPMENT

(Unattributed Article)

Military Telephone Communication

In Russia, telephone communication first appeared in 1877 along railroad and State telegraph lines. On 18 December of the same year telephone instruments were hooked up to the military telegraph lines.

Field Telephone

The first field telephone handset accepted into the Russian armory was created in 1897 by Professor of the Engineering Academy Colonel Shulyachenko. The design of the instrument was so successful that it was adopted by a number of foreign firms for mass production.

The First Aircraft Cannon

Thirty-five years ago, in 1936, Soviet designers V.G. Shpital'nyy and S.V. Vladimirov created the first domestic automatic aircraft cannon, the ShVAK. It was 20-mm caliber, it had a firing rate of 800 rounds per minute, and it weighed 42 kilograms.

Cannon Signalling System

The first model 1914 antiaircraft cannons included a special device by which the gun layer signalled that the cannon was on target and ready for firing. The signalling system was composed of a disk connected by a cable to a pedal on the footrest of the pedestal. When the pedal was depressed the disk rose above the sight. This device significantly eased the work of a battery (platoon) commander during firing.

NOISE SUPPRESSOR ADJUSTMENT

Engineer-Lieutenant Colonel I. Sutyrin

Experience in operating an R-860 radio station installed on helicopters convinces us of the need for highly precise adjustment of the activation threshold for the noise suppressing circuit. If the threshold rises the high sensitivity of the receiver cannot be employed fully. Its lowering could cause self-initiated shut-down of the noise suppressor when the aircraft is in the air, and the noise amplitude on the receiver output could attain 20-25 volts. This condition has a negative effect on the working ability of servicing personnel. Moreover, when the activation threshold lowers the intelligibility of the received signal worsens. Cases also occur in which the noise suppressor is not even able to switch on the low-frequency amplifier, even if the signal at the receiver input is of sufficient magnitude, and communication is broken.

The main feature in the operation of the circuit we are examining, the principal component of which is an electromagnetic relay, is that the switch-off voltage is four to five times lower than the switch-on voltage. During adjustment this fact should be given the first consideration, and the activation threshold should be fixed in accordance with the minimum value for the voltage necessary to switch off the relay. This value should be higher than the maximum noise level value encountered in flight. Inasmuch as the noise level at the receiver input does not exceed 2-2.5 microvolts, the tolerable minimum noise suppressor relay switch-off voltage must be lower than 3 microvolts. The allowable minimum relay triggering voltage must be five times higher -- that is, 15 microvolts (Figure 1). When setting the activation threshold, one must check it at not less than four points within the operating range.

The noise level at the receiver's intermediate-frequency amplifier and the magnitude of voltage pulsation in the radio station's power supply have a great effect on the precision at which the activation threshold is set. Heightened noise levels and power supply voltage pulsation lead to a lowering of the suppressor activation threshold (Figure 2). If during adjustment the station's power supply has a significantly high level of voltage pulsation, then the activation threshold is set too high. This means that the noise suppressor would switch on the low-frequency amplifier only when strong signals arrive at the receiver input. The receiver's sensitivity worsens. Consequently during threshold adjustment the allowable noise level at the receiver output must not exceed 25 volts.

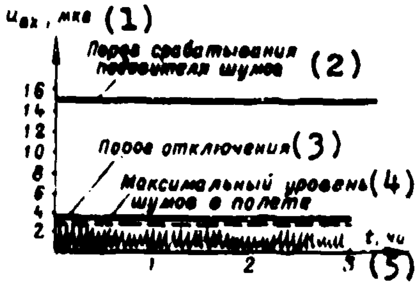


Figure 1

Key:

1. Input voltage, microvol .
2. Noise suppressor activation threshold
3. Switch-off threshold
4. Maximum flight noise level
5. Time, hours

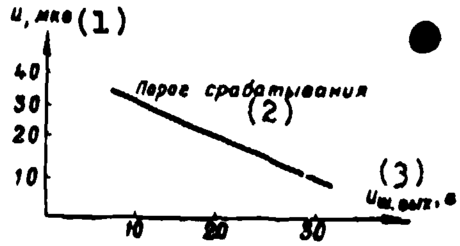


Figure 2

Key:

1. Voltage, microvolts
2. Activation threshold
3. Output noise voltage, volts

The noise suppressor is also highly sensitive to changes in the voltage of the radio station's power supply (Figure 3). Therefore its activation threshold must be set at a potential that is close to the value of the voltage in the helicopter's on-board circuitry. If adjustments are made when the voltage is below standard, then the activation threshold would be low and, as had been mentioned previously, this could cause self-initiated switching off of the suppressor circuit when the helicopter is airborne.

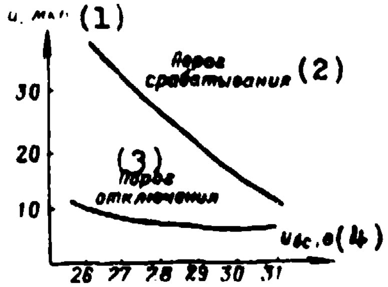


Figure 3

Key:

1. Voltage, microvolts
2. Activation threshold
3. Switch-off threshold
4. On-board circuit voltage, volts

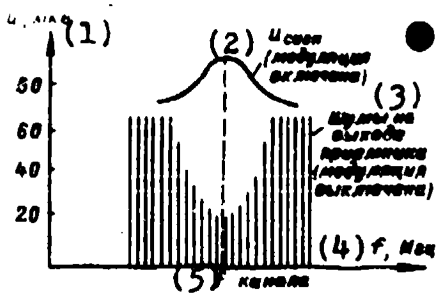


Figure 4

Key:

1. Voltage, microvolts
2. Signal voltage (modulation on)
3. Noise at receiver output (modulation off)
4. Frequency, megahertz
5. Channel frequency

Precise alignment of the radio station's metric wave generator with respect to the frequency of the channel being checked is necessary for precise adjustment of the activation threshold. This is done when an instrument connected to the receiver output displays maximum values. Even a small deviation of the radio station's channel alignment frequency can be allowed, since the activation threshold of the noise suppressor would be heightened. This is explained by the fact that when small deviations in generator frequency exist the noise level at the intermediate-frequency amplifier's output rises much more quickly then the rate at which the signal amplitude decreases (Figure 4).

A knowledge of these features of adjusting and aligning a radio station's noise suppressor circuit would help servicing personnel to avoid errors that lead to breaks in communication when the aircraft is airborne.

THE SEARCH FOR MALFUNCTIONS

Engineer-Colonel A. Gagin,
Reader, Doctor of Technical Sciences

As experience has shown, the time spent on searching for faulty components in complicated armament systems frequently exceeds the time necessary to correct the faults that are detected. This is explained by the fact that the condition of the system is ordinarily evaluated on the basis of a highly limited number of its working parameters. Even if an automated control system that analyzes a significant number of parameters is employed, additional studies have to be made anyway in order to find the faulty components, since such a system can only disclose the faultiness of a whole functional branch or a removable block. This is why we need effective methods for seeking and eliminating faults, methods that military engineers and technicians can use.

The procedure for searching for some of the most frequently encountered malfunctions is given in the manuals. But this is not enough. After all, deviations of monitored parameters from tolerable limits, a heightened noise and vibration level, and smoking of the motor, for example, could all be symptoms of malfunctions. As a rule, a highly specific combination of these symptoms corresponds to each type of malfunction. Therefore it would be suitable to develop, on the basis of experience, a more detailed list of possible malfunctions for each type of equipment, and to indicate the symptoms typical of these malfunctions.

Special tables (matrices) greatly simplify the search for malfunctions. One has been developed (Table 1) for use with an hydraulic system with unadjustable pumping productivity and an automatic relieving system (Figure 1).

In this example the parameters that can be monitored are the pressure of the working fluid in the system's pressure line, the nature of the automatic relieving system's working cycle, and the time pressure increases when the hydraulic accumulator is filled. By employing a few of such parameters we can easily determine whether or not the system is functioning properly. However, it is not always possible to disclose the faulty component because the diagnostic symptoms of a number of malfunctions are similar to each other. For example, internal leaks in all of the consuming components, in the reflux valve, and in the air space of the hydraulic accumulator are all manifested by a deviation of the same parameter -- the frequency of activation of the automatic relieving system. Thus it is necessary to make further inspections in order to locate the point of malfunction precisely: Various theories for the causes of the malfunction must be checked through.

Table 1

Malfunction symptoms	Possible malfunctions									
					Leak in:		Internal leak in:			
	Complete inoperability of pump	Wear of pump's rocking unit	Pump drive damage	Safety valve malfunction	Hydroaccumulator air space	Reflux valve	Automatic relieving system	Consumer 1	Consumer 2	Consumer 3
Pressure cannot be generated in system	1	0	1	0	0	0	0	0	0	0
Maximum working pressure in system is low	0	1	0	1	0	0	1	1	1	1
Frequency of automatic relieving system activation is great	0	0	0	0	1	1	0	1	1	1
Time for pressure to increase when hydraulic accumulator is being filled is great	0	1	0	1	0	0	1	1	1	1

In developing the program for seeking malfunctions we normally employ a list of hypotheses on the possible causes. The list is compiled from a table that correlates conditions with symptoms. We also use data on the operating reliability of the system's components and on the labor expenditures necessary for testing each of these hypotheses.

In order to determine the searching program it would be suitable to first construct a chain of hypotheses (Figure 2), and then a list of additional tests that would be necessary to evaluate different versions on where the trouble might be. In this case it is sometimes possible to check whole groups of components simultaneously with one inspection. For example, system -- for example, with the section containing components 5, 6, 7, and 8. If it is operating properly, then one of the halves of the remaining section -- for example, components 3 and 4 -- is inspected. It could happen that this section of the system is also operating properly, and so one of the remaining components, 2 for example, is checked. It is by the results of such an inspection that the faulty component is located. In this way not more than three checks are needed for these or any other faulty components in the system, though in each case the searching program would be different. The decision for making a subsequent test is made in dependence upon the results of the preceding test.

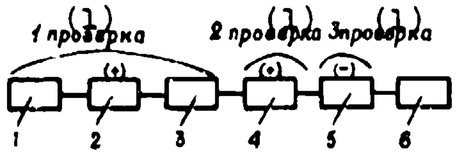


Figure 3. Testing Sequence Using the Dichotomous Method

Key:
1. Test

However, not all systems are amenable to group testing of different hypotheses. Therefore a sequence for testing each one of them is foreseen in the searching program. The searching time is normally minimal if the tests begin with the most probable hypothesis (on the basis of operating experience). The efficient testing sequence is defined by the condition

$$\frac{q_1}{\tau_1} > \frac{q_2}{\tau_2} > \cdots > \frac{q_n}{\tau_n},$$

where q_i $(i = 1,2...n)$ are the conditional probabilities that the particular hypotheses are true, τ_i $(i = 1,2...n)$ is the time needed to make the i-th test, and 1,2...N is the testing sequence for N hypotheses on the causes for the particular malfunction.

This is called the "time-probability" method. Using statistical data, we can define approximate values for q_i as the ratio between the number of malfunctions n_i for the i-th component, and the total number of all malfunctions n:

$$q_i = \frac{n_i}{n}; \quad n = \sum_{i=1}^{i=N} n.$$

But if the data necessary for calculating the values for q_i are absent, then, considering all hypotheses equally probable, we make the tests in the sequence in which the time needed to carry them out increases.

Frequently when searching for malfunctions we must employ the dichotomous method in combination with the "time-probability" method. The former is usually used in the initial stage, while it is still possible to factor the system into sections containing functionally interconnected components and admissable to one overall test.

As an example let us examine the way in which a malfunction seeking program is constructed for the hydraulic system shown in Figure 1. We assume that it was detected during an inspection that the maximum pressure of the working fluid had become significantly below standard. According to the data in Table 1 such a malfunction could result from wear of a part in the pump's rocking unit, inoperability of the safety valve, and internal leaks in the automatic relieving system or in one of the consumers.

In order to test the hypotheses on malfunctions in the pump and safety valves and to detect leaks in the automatic relieving system, it is sufficient to replace each of these units by working ones, and then check the system's operation. To test the hypothesis that any one of the consumer branches has a leak, we can monitor the working ability of the main hydraulic line in each case. It is also possible to test three hypotheses simultaneously by, for example, shutting off the pressure line feeding all of the consumers.

Possessing values for the conditional probabilities for the appearance of malfunctions $q_1, q_2, \ldots, q_i$, which were found experimentally and summarized in Table 2, and data on the time necessary for testing each of the hypotheses $\tau_1, \tau_2, \ldots, \tau_i$, we can compute the values for q_i/τ_i for each of the hypotheses. Even though the highest value for this term (0.19) belongs to the third hypothesis, in this case it would be expedient to start not with it but with the group of hypotheses 1, 2, 3, using the dichotomous method. For example, for this section of the system,

$$q_{sec} = q_1 + q_2 + q_3 = 0.6;$$

consequently

$$\frac{q_{sec}}{\tau_{sec}} = 0.5.$$

If this section is the faulty one, then a maximum of two more tests need be made in order to find the faulty consumer branch. The tests should be made in a sequence with decreasing values for q_i/τ_i -- that is, first the fourth hypothesis is checked, and then the fifth.

Table 2

Quantitative indices	Hypotheses on malfunction causes					
	Wear of pump rocking unit	Faulty safety valve	Internal leak			
			Automatic relieving system	Consumer 1	Consumer 2	Consumer 3
Conditional probability of malfunction, q_i	0.20	0.13	0.27	0.20	0.13	0.07
Time to test hypotheses, τ_i (hours)	2.0	0.8	1.4	1.2	1.0	1.0
q_i/τ_i	0.1	0.16	0.19	0.17	0.13	0.07

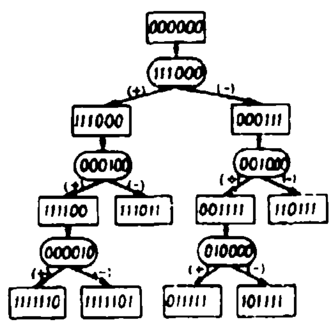


Figure 4. Logical Malfunction Locating System

If the section containing the consumer branches is working properly, then in accordance with the "time-probability" method we must test hypotheses 3 and 2.

Thus not more than three additional tests are necessary to locate any malfunctioning component in the system.

The malfunction searching program is sometimes shown in the form of a logical system (Figure 4), the so-called "search tree." In this diagram the rectangles represent the condition of the system, and the rounded compartments represent the tests. The condition of each component or the operation required to test it is entered within each rectangle or rounded compartment. A properly working state corresponds to 1, and a faulty condition corresponds to 0. If a component must be checked, a 1 is entered into the rounded compartment, and a 0 is entered if it need not be checked.

Since we can assume that any one of the six components is the malfunctioning one before the malfunction searching program is started, the initial state of the system consists of six zeros. The rounded compartment reflecting the first test contains ones in the positions for components 1, 2, and 3: These components are included in this test. Two arrows leave the rounded compartment, one with a plus sign and the other with a minus sign. In the first case the tested section is working properly, and in the second it is malfunctioning. Therefore, ones are entered in the positions for components 1, 2, and 3 in the rectangle indicated by the plus arrow, and zeros are entered in the positions for components 4, 5, and 6, since the malfunctioning component is among them. And zeros are entered in the positions for components 1, 2, and 3 in the rectangle indicated by the minus arrow.

If the tested section of the system is operable, then component 4 (left branch of the diagram) should be tested, and if it is malfunctioning, then component 3 (right branch of the diagram) should be checked. There are two variations possible for each test. If the first test is negative, the malfunctioning element should be sought, and if it is positive, then another test must be made. Thus the logical system shows us what must be done at each stage of the search, depending on the results of the preceding test, and the arrows indicate the way in which each of the malfunctions should be searched. In this case the maximum number of tests necessary for detecting the malfunctioning components does not exceed three, and it will not exceed two if component 3 or 4 is the malfunctioning one.

As we can see, the search for malfunctions arising during the operation of combat equipment is simplified significantly with the assistance of logical systems.

ATTENTION: RAILROAD CROSSING

Lieutenant Colonel A. Furman

The railroad crossing -- a level intersection of a highway and railway -- belongs to the class of route segments along which heightened attention is required from drivers of transport resources. This is explained by the fact that even though a vehicle takes only 10-15 seconds to get through a crossing, a situation that threatens the safety of movement could arise at any moment.

Depending upon the mode of operation, railroad crossings are divided into guarded and unguarded. A warning sign is placed before an unguarded crossing (Figure 1): "Railroad crossing without barrier." In accordance with the new rules, cross-shaped road signs stating "Beware of train" could also be positioned before the crossing. The driver bears full responsibility for traveling safety at such a crossing.

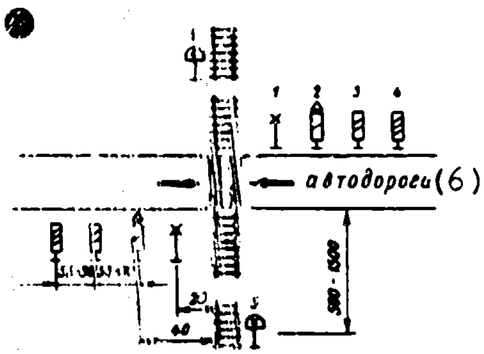


Figure 1. Plan for Positioning Road Signals and Signs at an Unguarded Crossing

Key:

1. "Beware of train" sign
2,4. "Railroad crossing without barrier" signs
3. Additional sign
5. "Whistle" sign (for train operator)
6. Motor road

Before driving onto the unguarded crossing the driver must make sure that neither a train, a single locomotive, nor hand car are approaching the crossing. In this case it is best to stop the vehicle, turn off the engine so that it does not drown out the noise of an oncoming train, and get out of the cab. It is especially important to do this when visibility is poor (at night, in rain, during a snowfall, or in fog). These recommendations pertain primarily to drivers of military vehicles for which the field of vision is limited.

When a barrier is raised, vehicles are permitted to move single file only with a speed of not more than 15 kilometers per hour.

If a group of vehicles approaches a crossing the commander either posts a temporary traffic control detail or controls the column himself, depending upon the situation.

In any case the road guards must have flags during the day and lanterns with red and green light at night.

We remind the reader that one cannot drive onto a crossing, especially a two-track crossing, immediately after a train passes: It should be made sure that another train is not following the first one or advancing from the other direction.

Electrified sections of railroad cannot be crossed by vehicles over 4.5 meters high. If antennas mounted on vehicles exceed this height, they must be removed. It is recommended that the condition of hitching devices be checked on towing vehicles, and that cargo is reliably secured in open trucks so that it is not lost on the crossing.

Many years of experience testify that road accidents occur at unguarded crossings most frequently with single vehicles lagging behind columns, the drivers of which had lost their way and were hurrying to overtake their podrazdeleniye. In such a case they often try to run a crossing right under an oncoming train's nose, so to speak. Frequently this results in serious consequences.

At times some drivers of lagging vehicles raise barriers by themselves when trying to overtake their column. They justify their actions with the idea that the train seems far away and that they would have time to cross. Such handymen should be told in no uncertain terms that they must not do this, nor can they overtake a vehicle within 100 meters of a crossing. A vehicle must move at constant speed over a crossing. Gear shifting, disengagement of the clutch and, moreover, passing and stopping are not allowed. But what if a vehicle in front has stopped (gotten stuck) on the crossing? There can be only one answer: Help its driver. However, before helping, the

the engine of one's own vehicle must be turned off, and the vehicle must be put in gear. In no case can such a vehicle be passed by driving onto the tracks. Any sort of maneuver on a crossing is permitted only with the consent of a railway worker or a traffic controller.

At guarded crossings movement goes on under the supervision of a railway employee, whose orders on the track crossing procedures are binding on both the drivers and the traffic controllers. As is known, "Railroad crossing with barrier" signs forewarn such crossings, in accordance with the Rules for Movement Along the Streets of Cities and Populated Centers and the Roads of USSR. In addition a triangular sign with the words "Beware of train" is positioned at the road edge at a guarded crossing, and if the crossing is equipped with an automatic barrier a yellow sign with the words "Attention! Automatic barrier." is located there. We note that some crossings equipped with automatic light signals can be converted into unguarded crossings. A sign with the words "Guard removed from crossing" warns the driver of this.

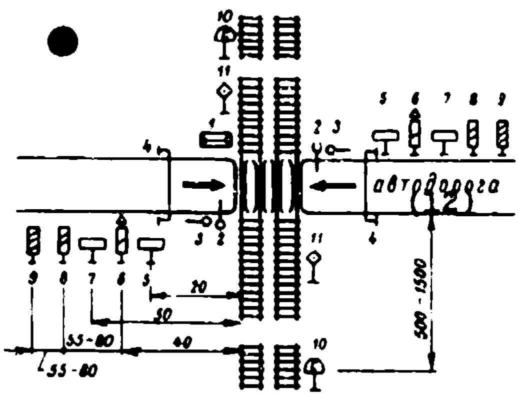


Figure 2. Equipment of a Guarded Railroad Crossing

Key:

1. Crossing guard kiosk
2. Automatic barrier
3. Spare barrier
4. Loading guage
5. "Beware of train" sign
6,9. "Railroad crossing with barrier" signs with additional notices
7. "Attention! Automatic barrier" sign
8. Additional sign
10. "Whistle" signal
11. Holding signal
12. Motor road

Guarded crossings are also furnished with barricading devices (barriers), light and sound signals, and other devices to ensure safe passage of vehicles over tracks (Figure 2). Today automatic barriers are finding wider and wider use. They operate in the following way.

As long as the tracks are unused the barrier's boom is raised vertically, allowing vehicles to pass without hindrance. A warning bell informs the crossing guard that a train is approaching while the train is still 1,000-1,200 meters away. Simultaneously the light signals begin operating: Red lights begin to blink on a signal post and on the barrier's boom. From this moment on, vehicle crossing is not permitted. Vehicles that are on the tracks must get off the crossing completely, and those approaching the crossing must stop not less than 5 meters away from the barrier.

Fifteen to 20 seconds after the signals are turned on the barrier boom begins to descend. As soon as it assumes a horizontal position the sound signal is turned off, and red lights on the boom turn on. The blinking lights on the signal posts facing the road continue to operate. After the train passes, and if a train is not coming from the other direction, the barrier rises automatically, and all red lights turn off.

The automatic equipment makes it possible to control vehicle movement without manning. In such a case the crossing guard assumes a monitoring function only. If an unforeseeable jam occurs the guard turns on stop lights mounted along the tracks to signal the train operator that he must stop.

If a vehicle suddenly stops on a crossing and the engine cannot be restarted, it should first of all be towed or manually pushed off the tracks. We remind the reader that when help is not available a vehicle can be rolled off by engaging first gear (or reverse) and turning the crankshaft over with the starter, or with the starting lever of a passenger car. It is important not to panic, and to act without delay, decisively, and energetically.

If it is not possible to remove the vehicle from the tracks quickly, all measures should be taken to warn the operator of the approaching train. Someone should run toward the train and signal it to stop. If there is a second person, he should run along the tracks in the other direction 1 kilometer away from the crossing.

Precise fulfillment of the established rules for going over railroad crossings is a guarantee of safe travel, both for trains and for wheeled and tracked vehicles. Therefore in our opinion a study of the system for positioning road signs and signals and of the operation of automatic signal systems at crossings must be one of the obligatory subjects of driver training.

AMMUNITION STORAGE AT GUN EMPLACEMENTS

Engineer-Colonel B. Bodunkov

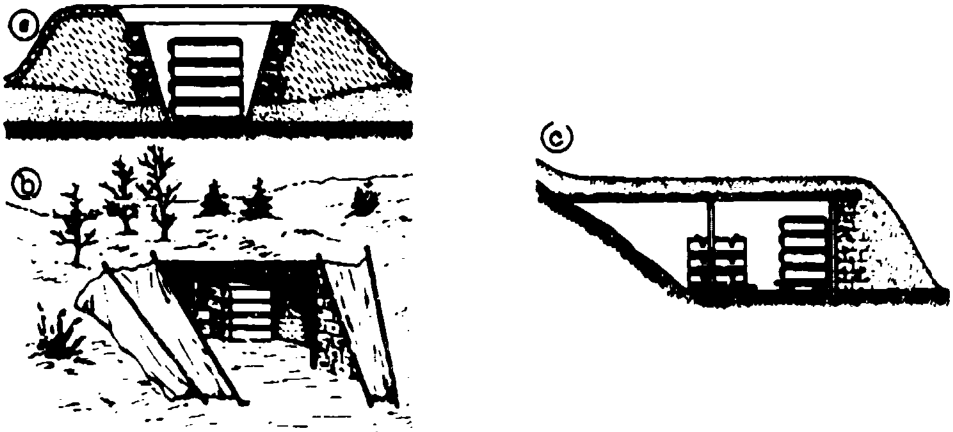
In equipping an artillery firing position one must also consider the simplest earthen or wood-and-earth shelters for ammunition. In such cases niches and shell cellars are prepared, and if time is highly limited trenches are dug or surfaces are enveloped with earth fill. All of this is done not only to protect ammunition from bullets and shell fragments, but also to protect it from the direct effects of precipitation.

Storage of ammunition in ditches, communication routes, and trenches constructed for sheltering personnel is categorically prohibited.

In selecting a place for an ammunition shelter we begin with the principle that the ammunition must definitely be decentralized. This is why two to four shelters are built at each firing position. A fourth of the ammunition is placed in shelters built right within the gun dugout, and the rest must be 15-30 meters to the rear or somewhat to the side of the dugout. One niche is sufficient for storing individual rounds for antitank and antiaircraft weapons and shells for small caliber mortars, while two are required for storing ammunition for medium and high caliber weapons and mortars. The niche dimensions depend on the form of ammunition: Shells with up to 122 mm caliber inclusively are stored in niches 130 cm wide (the size of the niche entrance), 110 cm deep (lateral penetration into the ground), and 100 cm high, while ammunition for weapons and mortars with a caliber of over 122 mm is stored in 170x120x100 cm niches.

In loose, unstable soil the walls of the shelter are fortified with boards, brushwood, or other materials at hand. This is done by pounding in stakes at the corners or positioning posts with transverse spacers. The surfacing is fastened to the stakes (posts) with wire. The cavity between the surfacing and the earthen walls is filled with earth. A covering of light poles or branches is laid on top, and then a layer of earth -- clay is best -- is spread over the covering. The fill is evened with the breastwork of the dugout and camouflaged to match the local background. A wooden lining is laid on the bottom of the niche. If the wood is unavailable a layer of crushed rock or gravel not less than 10 cm thick is spread there. It is recommended that the entrance be covered by a tarpaulin or wooden shield. If the ammunition to be stored is unsealed, the niche floor is covered with tarpaulin (roofing felt) or brushwood, and only then is the wooden lining positioned. In this case the niche must definitely be covered with a wooden shield. Water collecting sumps with a 40x40 cm cross section and 60-70 cm deep are dug into the trenches leading from the gun emplacement to the niches. If the position is constructed on an incline of a hill, water removing channels are dug along the gun dugouts.

As was already noted, most of the ammunition, which is positioned a certain distance away from the gun dugout, is stored in shell cellars. Each such cellar is a 170 cm deep and 80 cm wide (on the floor) trench containing one or two niches with 200-550x100-120x120 cm dimensions on the side walls. A stairway is built down into the trench (stairs are dug out and fortified with materials at hand), and a water collecting sump is built into the trench itself. Part of the trench together with the niches is covered with branches, the surface of which is filled with a layer of earth 40-60 cm thick and flush with the overall breastwork of the celler. The structure is camouflaged, and at the first opportunity the walls are fortified with materials at hand.



Snow shelters: Filled type (a), in a gulley (b), at the side of a precipice (c)

If the time for outfitting a position is limited or if there are no materials about to make any sort of coverings, ordinary trenches with a circular protective breastwork are dug. Shelters of the filled type are built in places where the ground water level is high. In this case ammunition boxes are stacked on a flooring. A stack is surrounded by an earth fill which must exceed the height of the top box by not less than 20 cm. The shelters are camouflaged on top with netting or any available materials. If the ground has frozen to a sufficient depth the protective embankment is made from snow. Blocks are cut from well packed snow, loose snow is simply raked, and the vertical surfaces of the embankment are fortified with wattle, brushwood, or other materials.

The weapons crews build the shelters. The average labor need for preparing niches and trenches is 12-15 man-hours, and 25-35 man-hours for shell cellars, depending on their dimensions.

CREATIVE INITIATIVE IS EXPANDING

Lieutenant General Engineering-Technical Service N. Grebennikov

As noted in the Directives of the 24th CPSU Congress, one of the conditions for the greatest increase in the rate of scientific-technical progress includes extensive development of creative initiative among laborers, and all-possible improvement of invention and efficiency work.

The party congress's directives received a great response from the country's antiaircraft forces. Enthusiasts of technical creativity are perfecting the training materials, improving the organization for use, repair, and care of materiel, they are creating resources for small-scale mechanization, and introducing elements of scientific organization into military labor. In just last year alone military inventors developed several thousand valuable proposals, many of which have been recognized as inventions. Eighteen invention claims, two of which have already received patents, were made in the Baku Antiaircraft District alone.

A desire to encompass all aspects of troop life and activity is typical of the work of military inventors. For example out of the total number of proposals submitted for the year in the chast' in which Engineer-Lieutenant Colonel A. Kazinets organizes efficiency work, 40 percent help to increase combat readiness and improve the quality of military training, 25 percent are directed toward improving the equipment and armament, 25 percent are directed toward improving the resources and procedures for employing, repairing, and caring for equipment, and 4 percent affect an improvement in personal and medical services for the personnel.

We will discuss only some of the most interesting inventions. Special racks have been introduced into most chast' that make it possible to reduce the time needed for issuing articles significantly and to increase their guaranteed storage life. With these racks there is absolutely no need for building additional heated storage buildings. The simulation equipment proposed by the group of inventors headed by Engineer-Major Kunitsyn helps to save on the stock of combat equipment and to speed up the training of crews for combat. Without relying on aircraft or the atmosphere itself we can use the simulators to integrally and autonomously train radar station and combat control post crews.

The innovations dealing with the engineering equipment needed at emplacements, their camouflaging, radio remote control, and so on, developed by the group of efficiency experts chiefed by Colonel A. Babushkin, have great value.

Engineer-Major Yu. Arbuzov did some important work. He discovered a possibility for increasing the distance for transmitting radar information employing existing resources. As a result the authenticity of the information was raised, and the time for transmitting it decreased.

The elements of scientific organization of labor are being introduced into the work of the engineering-technical service with the active participation of efficiency experts. Owing to this the work of many chast' goes on according to dispatcher network schedules, equipment is prepared for use by methods that employ grouping and flow lines, the operating reliability of materiel is predicted and malfunctions are detected by the most advanced methods, a tool monitoring system has been introduced, comprehensive tests are made on special test stands, and systems and equipment are checked on such stands.

The potential of technical maintenance chast', both at permanent and in field positions, has expanded significantly with the introduction of some efficiency proposals. Last year because of the cooperation of efficiency experts the total labor expenditures involving repair work decreased by 8 percent as a whole, while the time needed for conducting this work decreased by 5-6 percent. In some cases these figures are significantly larger. For example the time for conducting repair work in one of the antiaircraft force services decreased by 23 percent on the average over the last few years. The number of equipment malfunctions decreased noticeably, and the average working time per malfunction increased.

Hundreds of devices that simplify personnel training -- trainers, simulators, working mockups -- are being created by efficiency experts. All of them satisfy modern requirements. For example, special training equipment for coordinating the work of crews was developed by a group of inventors led by Engineer-Colonel P. Shlayen. Under the leadership of Engineer-Captain E. Shokol', a group of inventors designed a trainer that can be combined with a fighter controller's screen. It is used for comprehensive training for radar station and command post crews, flight leaders, and pilots. As a result the time needed for training the personnel decreased by three to four times, and the drain on the life of real equipment was reduced to a minimum.

efficiency and invention work are evaluated at meetings and conferences dedicated to summarizing combat and political training, and at assemblies of military councils. The decisions of the military councils are brought to the attention of all personnel.

The results of efficiency and invention work, which are obligatorily publicized in orders, are summarized once a year, and twice a year in some cases. These orders indicate the achievements and deficiencies, and they pose new tasks. Attention is also devoted to problems involving material and moral stimulation. The best chast' and podrazdeleniye are awarded rotating prizes, banners, cups, and pennants, and individuals who make the most valuable proposals are given the honored title of best efficiency expert or best inventor of the chast', soyedineniye, or military academy. As a rule, active organizers of efficiency and invention work as also rewarded through orders.

A great significance is imparted not only to the control over the activity of inventors, but also to the channeling of their creative thought. Presently there are no chast' in which thematic assignments for efficiency experts and inventors for the year or the training period are not made. And we should give credit to the commissions on inventions. These assignments are basically completed with success owing to their persistent efforts. The practice of issuing individual assignments to specific efficiency experts and creative collectives is being employed. Also, planning schedules are compiled for developing the proposals made by efficiency experts, monthly drives are held to collect and introduce proposals dealing with specific subjects, creative groups or brigades that work out the most urgent and difficult problems in combat readiness and training are created, and competitions dealing with specific subjects are held.

Special significance is imparted to the conditions under which the inventors must work. Efficiency expert rooms and corners have been created in many chast' and podrazdeleniye in order to allow them to work fruitfully. They are furnished with the needed equipment, materials, instruments, and technical literature.

Creative activity cannot be productive without a well organized system for exchanging experience. Therefore conferences and assemblies of efficiency experts and inventors, in which chast' and podrazdeleniye commanders must participate, are held annually in all chast' and podrazdeleniye. Exhibitions of the best efficiency proposals and inventions are timed to coincide with such meetings. All that is valuable and of interest to other chast' is selected and introduced on a wide scale. Instructional meetings for chairmen and secretaries of *chast'* and *podrazdeleniye* commissions on inventions also have great benefit.

The popularization of invention and efficiency work plays an important role in encouraging personnel to participate in technical creativity. With this purpose efficiency expert display stands are provided, radio broadcasts are made, and illustrated newspapers are published in all *soyedineniye* and *chast'* and in most *podrazdeleniye*. Certificates and monetary rewards for the introduction of efficiency proposals are presented as a rule before the ranks or at meetings of the personnel.

However, deficiencies and omissions can still be found in the organization and conduct of invention and efficiency work. There are *chast'*, for example, in which the commissions on inventions are too structured in their approach to developing the thematic assignments and do not always consider local needs. Other times the deadlines for introducing valuable proposals are put off, and decisions on the scale and the deadlines for introduction are not clear or specific enough. Not all proposals of high enough quality to be considered inventions are detected, and patents for them are not always applied for in time.

How are we to eliminate these deficiencies?

First we plan to intensify control over the state of technical creativity, especially in those places where it is not organized as it should be. We plan to do everything possible to disseminate the experiences of the best creative collectives as widely as we can.

Work directed toward timely collection and rapid introduction of the most valuable proposals needs to be improved. With this purpose a technical information system will be organized. It will allow us to disseminate valuable proposals efficiently, as well as to prevent redundancy in the solutions developed. This means that we can eliminate nonproductive expenditures of creative labor and resources.

The number of inventions could greatly increase if public patent groups are created, composed of well trained specialists who are able to capture the essence of the completed projects, formulate the patent applications properly, and provide preliminary evaluations of the inventions. They could help the personnel to a deeper understanding of the principles of patent and invention rights and the principal documents dealing with inventions. Seminars, lectures, and consultations can be employed for such purposes.

The development of socialist competition in the realm of technical creativity in response to the requirements posed in the Decrees of the CPSU Central Committee on improving the forms of invention and efficiency work, the elimination of existing deficiencies, and dissemination of the best experiences will help the inventors in the country's antiaircraft forces to attain new creative achievements.

FROM THE HISTORY OF EQUIPMENT

(Unattributed Article)

Antiaircraft Machine Guns

The first Soviet antiaircraft weapon, designed by M.N. Kondakov and added to the Red Army inventory in 1928, was simple, operated reliably, and allowed all-around firing. It was a 1910 model Maksim machine gun system mounted on a special tripod.

The N.F. Tokarev system four-barrel antiaircraft weapon, which was mounted on motor vehicles, railroad flat cars, and boats, was adopted into the inventory in 1931. This weapon was effective against low-flying aircraft and possessed a relatively great firing power.

Armor-Piercing Shell

In 1872 mining engineer A. A. Iznoskov began tests on a steel shell designed to be fired at armored ships and boats. The shell was manufactured at the Sormovskiy plant. During the tests the shell pierced an 11-inch plate without destroying its integrity.

TEST STAND

Engineer-Captain 3d Rank V. Mikhaylichenko

One of the important problems in repairing automatic adjusting systems is reducing the number of full-scale tests that have to be made by means of widely employing test stands. Such stands make it possible to model the operating modes of a system's components and to test them in these modes before they are reassembled.

The stand developed by us for performing dynamic tests on variable ship diesel engine speed regulators is distinguished by high indices and, from our point of view, efficient use of the output of power equipment. The following principle lies at the foundation of its operation. The system that is to be tested, a speed regulator (PC), is a collection of components, one of which is to be tested, and others that are not tested. By means of an analog computer the latter are substituted by a mathematical model (Figure 1). Input converter $П_1$ and output converter $П_2$ are put into the system to gang the MM (mathematical model) together with the speed regulator being tested. The purpose of the input converter is to match the mathematical model with the PC input. It changes the physical nature of the signal (it converts changes in electric potential into changes in the speed of rotation of the regulator's shaft) and amplifies it. The converter is designed in the form of a slave system, and its input signal is shaped by the mathematical model. The output converter converts the regulator's output signal (mechanical movement of the fuel pump's rack) into an electric potential that is fed into the mathematical model.

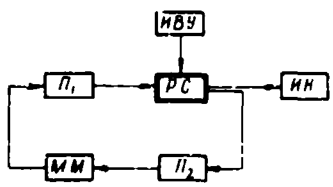


Figure 1. Stand Diagram

External effects on the PC (vibration, for example), are generated by the external conditions simulator (ИВУ) if they are not included in the mathematical description of the section of the system not being tested. In the stand developed by us a pneumatic vibrator mounted onto the PC and aligned to a particular frequency simulates the external conditions (vibration). The load simulator (ИН), which reproduces a load on the PC output, is built in the form of a spring device that simulates the reactions of the fuel pump to signals coming from the PC.

As is evident, the stand is a composite model of an automatic engine rpm adjusting system. The flow and the design of the stand make it possible to completely reproduce the PC's working conditions without the participation of the actual components in the automatic adjusting system that are not subjected to testing.

We consider problems involved in designing converter $П_1$ peculiar and most complex. In particular, one of the features of its operation is the difference in the relative values of the PC's moment of inertia in the real system and in its model. For example, if within the automatic adjusting system the relative moment of inertia of the PC is negligibly small, in the model it is as high as the moment of inertia of the system. This has a significant effect on the dynamics of the converter's operation and, consequently, on the model as a whole. The selection of design of the converter and its components is affected by this circumstance.

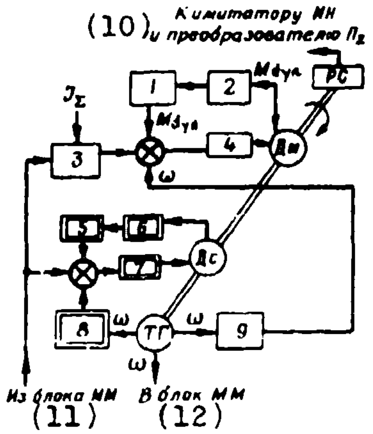


Figure 2. Input Converter Design

Key:

1. Dynamic moment feedback unit
2. Moment pickup
3. M_T generating unit
4,7. Power amplifier
5. Moment compounding unit
6. Moment pickup
8. Speed feedback unit
9. Speed compounding unit
10. To ИН simulator and converter $П_2$
11. From MM block
12. To MM block

To attain a high following precision converter Π_1 is built in the form of two independent composite systems (Figure 2): A speed following system (the components outlined with double lines) and a moment following system (the components outlined with a single line).

The speed regulator being tested is connected by a shaft to the motors of both systems. The signal generated by the mathematical model passes directly to a comparing unit, in which it is compared with the signal fed from the speed feedback unit, and reproduced in the form of an engine shaft rotation speed.

Moment compounding, which is achieved with a moment pickup and a compounding unit, eliminates the effect of changes in moment on the reproduction of rotation speed at the regulator shaft. Speed compounding with a speed pickup and a compounding unit eliminates the effect of rotation speed on the reproduction of the dynamic moment. The unit that generates the required dynamic moment M_T is constructed out of series analog computer components. A signal proportional to M_T passes from the output of this unit to the comparing unit, where it is compared with the moment on the engine shaft.

Inasmuch as the speed and moment following functions are fully separated, the load on the motors of the two systems is statically distributed in such a way that the slave motor $Д_c$ of the speed following system is loaded by the moment of resistance of the speed regulator and the frictional torque of the motor $Д_m$ of the moment following system (Figure 3). Motor $Д_c$ is selected on the basis of this condition as well as on that of the prescribed range of speeds. The stability of the static characteristics of $Д_c$ and $Д_m$ relative to each other is fully ensured for the whole range of rated speeds. A difference in rigidity of the characteristics of motors operating on the same shaft is of no consequence. That is what distinguishes the proposed system from a two-motor drive, which requires motors with identical characteristics.

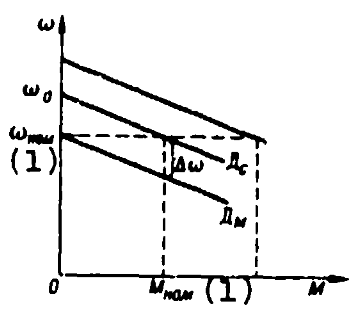


Figure 3. Motor Characteristics

Key: 1. Rated

The results of experimental research on an experimental model of the test stand using a dynamoelectric converter $П_1$ allow us to conclude that the introduction of dynamic moment compounding eliminates fluctuations in speed when the load is changed, and that compounding of the regulator shaft's rotation speed has a positive effect on the nature of moment changes. Converter $П_1$ is capable of working signals with an acceleration of 270 radians per second per second with a mean square error of speed reproduction equal to 0.01. The basic functions of converter $П_1$ are carried out by EMU-50AZ dynamoelectric amplifiers and DI-13 electric motors.

In order to improve the dynamic indices of the stand even more, we created a converter with power amplifiers built out of KEP-16x2-103 series thyristor converters. The principal characteristics of the $П_1$ converter were found to be high: The static error did not exceed 0.5 percent, overshooting was practically absent, and the range of frequencies for the reproduced signal expanded noticeably.

In our opinion the best version of the $П_1$ converter consists of two independent following systems -- a speed following system and a moment following system -- and power amplifiers in the form of thyristor converters. The possibility for reproducing large accelerations significantly expands the sphere of application of the stand in testing repaired adjusting systems.

As an example, let us examine the procedures for aligning the speed regulator of an auxiliary diesel engine using the dynamic testing stand. The regulator is filled with clean oil, the arrow of the feedback link is moved to the maximum position, and the needle is turned aside. The modeling stand is started up. It begins to vibrate, which helps to remove air from the regulator. This operation is carried on at low rpm for one minute. Then the feedback link arrow is set at the minimum, and the needle is turned back until vibration of the motor stops. If necessary the link arrow is shifted two or three divisions toward the maximum, and stability of the stand's operation is attained by adjusting the needle. Then, after reducing the electric motor's rpm, the tie rod is pressed slightly and then released. The stand should restore the rated rpm (in the same way as with a real engine).

The following procedure should be used to align a PC with a load. The stand is loaded to 50 percent capacity at rated rpm. The adjustment for the degree of cyclic variation should be in its zero position. Then the stand is loaded to 100 percent capacity, and the drop in rpm is recorded. The rpm should be raised again by adjusting the degree of cyclic variation, after which the load is reduced to 25 percent. In this case the rpm should increase by the same amount that it dropped when the 100 percent load was applied. If the rpm increase is greater, then the knob of the cyclic variation adjustment is manipulated until the increase in rpm equals the decrease. Such a range of the degree of cyclic variation corresponds to 2-2.5 percent of the rated rpm, and this is fully allowable.

In the last stage of testing the stand is again loaded to 50 percent capacity. Then first an increase in the load is made, followed by a decrease (to 50 percent). The time of the restoring process is attentively monitored both during reduction and augmentation of the load. The rpm should change as little as possible (both when increasing and decreasing). This is very important when diesel engines are operating in parallel.

ORDERS SECTION

(Unattributed Article)

Orders

25. Major Yu. Barabanshchikov: We are interested in an indicator for the traveling speed of a practice target towed by a powered winch.

It must allow the exercise instructor to determine the target's traveling speed at any moment.

Order Fulfilled

Captain B. Mal'tsev (No 4, 1971) became interested in a special device that would test parameters foreseen by specifications for AB-1, AB-2, AB-4, AB-8, and AD-30 electric power machine units. Engineer-Colonel A. Alekseyev answers his request.

The enumerated types of electric machine units are complex electromechanical devices. The basic parameters characterizing their condition and working ability are the insulation resistance and structural soundness, rated output (kilowatts), the rated values for voltage (volts) and current frequency (cps) and their stability in the face of unchanging and changing (from 0 to rated and from rated to 0) loads, as well as when Cos φ changes from 0.8 to 1.0; the time for attaining new fixed values for frequency and output voltage after a sudden change in load, the load transferring ability, the rate at which they can be started up and handle a load, parallel operation with other electric machine units and in permanent circuits (for the AD electric machine units), the protection against overloads and short circuits, and others.

The manufacturing plant tests all of these parameters to see if they meet the specifications on specially equipped test stands that have an adjustable load, monitoring and measuring equipment (with a precision class not lower than 1.0 or 1.5), and ancillary devices. Climatic tests are conducted in special moisture, heat, and cold chambers. Mechanical durability tests are made by moving the machine units on motor vehicle trailers over dirt roads and highways with different surfaces. The rated output parameters of the electric machine units are maintained within the limits of the warranty period specified by the technical documentation. When the units are operating with real loads (on-sight), their principal parameters are evaluated by the readings on monitoring and measuring instruments. As a rule, electric machine units that are in storage are spot checked.

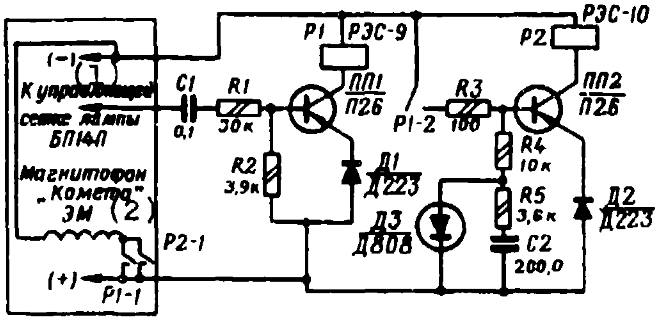
There are as yet no special devices for checking the parameters of electric machine units when they are operating. Presently projectsare underway in scientific research institutes and industrial plants to find methods for reducing the amount of testing necessary, and to develop equipment that can be used to diagnose the condition of electric machine units.

REPORTS FROM INVENTORS

(Unattributed Article)

Voice Control of Tape Advancing Mechanism

A transistorized device proposed by Soviet Army employee A. Malenko makes voice control of a tape recorder's tape advancing mechanism possible. The device operates on the principle of an electronic switch. As soon as speech is produced the voltage of the sound frequency passes from the amplifier of the tape recorder, which is in the standby mode, to the base of transistor ПП1 and turns it on. Relay P1, mounted in the collecting circuit of this transistor, triggers, and turns on the tape winding mechanism with the first pair of its contacts. When they close, the second pair of contacts on relay P1 form a feeding circuit for relay P2, the contacts of which block the first pair of contacts on relay P1. A time relay causes the tape to move for 5 seconds after speech stops. If the pauses between words and phrases exceed this time the tape winding mechanism turns off, and the recorder returns to the standby mode.



Key:

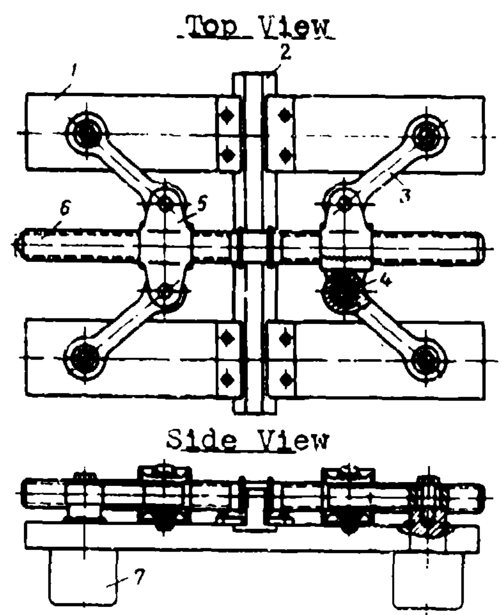
1. To control circuit of tube BP14P
2. EM Kometa tape recorder

There is no need to introduce additional control units and design changes into the tape recorder. Mounted on a separate plate, the device's overall dimensions are 90x60x30 mm. The consumed power is 500 milliwatts.

Recognized as an Invention

Proposed by Engineer-Colonel M. Bezborod'ko and Engineer-Captain S. Bereza (invention patent No 293680), a device for tightening the track chains of transport vehicles differs from the known types in that the tightening screw is positioned parallel to the strips, and a guide for the strips and their catches is mounted on the tightening screw perpendicular to its axis. Such a design prevents twisting of the links when wide track chains are being tightened.

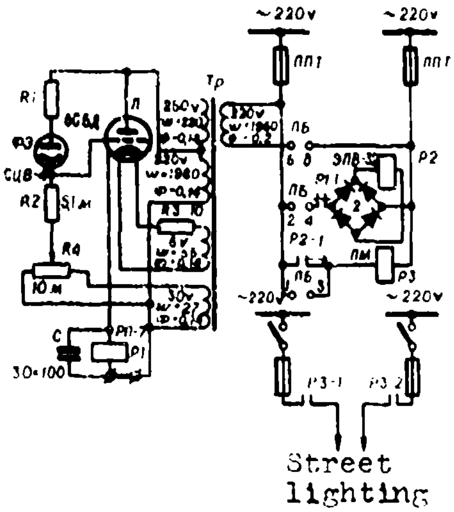
The device consists of strips 1 with catches 7, tightening screw 6 with right and left thread and positioned parallel to the strips, nuts 5 wound onto the screw, which are connected to the strips through tie rods 3 by knuckle joints, and a reference guide 2 for these strips, mounted on the screw. Bearings 4 are located in the tie rod joints.



When the working screw is turned manually or with a wrench, the nuts move and bring the strips with their catches together, thus forcing the ends of the track chains together. At the same time the links and the pins holding them together move parallel to each other, making it easier to connect the links of the track chain.

Automatic Light Switch

A device for automatically turning lights on and off, reports Engineer-Lieutenant Colonel A. Rusnyak, helps to save on electric power. Photocell Ф3 serves as a light intensity indicator. It is included in the circuit of tube Л. Polarized relay P1 is in its cathode circuit.

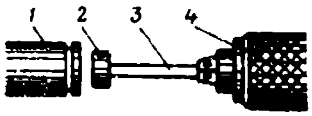


The level of illumination at which the electric current of the photorelay changes the current to tube Л is adjusted by a rheostat. When the photocell is illuminated, tube Л is operating, relay P1 is on, and its contact is broken. When the photocell is darkened the current to the tube decreases, relay P1 turns off, and its contact closes, turning on a P2 time relay. The contact of this relay controls a magnetic starter P3, which turns on the lighting circuit. In order to reduce pulsation in relay P1, its coil is shunted by capacitor C. In order to avoid triggering of the circuit during chance, short-term changes in photocell illumination (such as from a lightning bolt), relay P2 works with a contact breaking delay of 0.5-1 seconds.

The device is powered by a 220 volt circuit through transformer Тр.

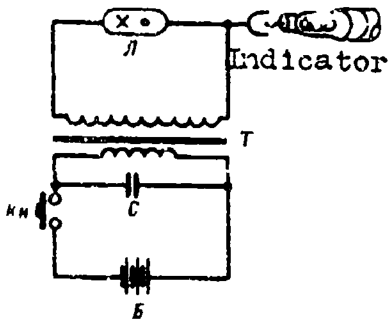
Fine Finishing Device

Extended service Master Sergeant N. Filippov proposed a device that can be used to fine-finish the working surfaces of motor vehicle hydraulic brake cylinders. It consists of a shaft 3 and finishing heads 2 of various sizes. When a brake cylinder 1 is to be fine-finished, the shaft with mounted heads (felt) is secured into the chuck of a manual or electric drill.



Neon Lamp Tester

Engineer-Major V. Koz'yakov proposed an instrument for testing the neon lamp of a high voltage indicator employed in servicing transformer substations and electric power lines with a voltage of 6-35 kilovolts. The instrument is compact (no larger than a pocket flashlight), simple in construction, and safe to use. It is capable of generating 1,000-1,500 volts, which is enough to light a neon lamp indicator.



The instrument's housing contains a KBS-0.5 battery Б, transformer T, a 0.05 microfarad condenser C, button Кн, and a neon monitoring lamp Л.

The transformer's core is 20x20 mm in size, the primary coil contains 60 windings of 0.2 mm diameter wire, and the secondary coil has 3,000 windings of 0.1 mm diameter wire.

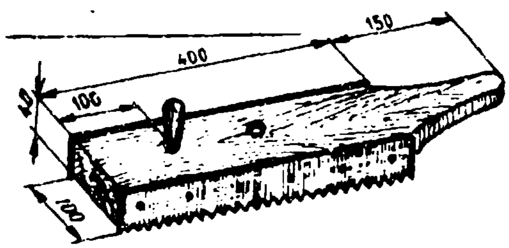
The button disconnects the primary coil of the transformer. The breaking frequency can be three to five and less per second.

An opening into which the indicator being tested is inserted is made on the side of the instrument housing.

In order to test an indicator's neon lamp, the indicator is inserted into the opening on the instrument housing's side, and the button is pressed several times. The monitoring lamp and the indicator's lamp should both turn on.

Groove Cutting Device

A device for cutting grooves for the cross beams of permanent aerial communication line poles, as reported by Senior Lieutenant V. Dorogov, makes it possible to significantly reduce the time necessary for completing this operation. It is a wooden block with a handle. Two saw blades are attached to the sides of the block with wood screws in such a way that their teeth project 16 mm beyond the block's face. A 5-7 mm diameter hole is drilled into the center of the block and is used for marking the point at which to drill the hole for the bolt that fastens the cross beam.



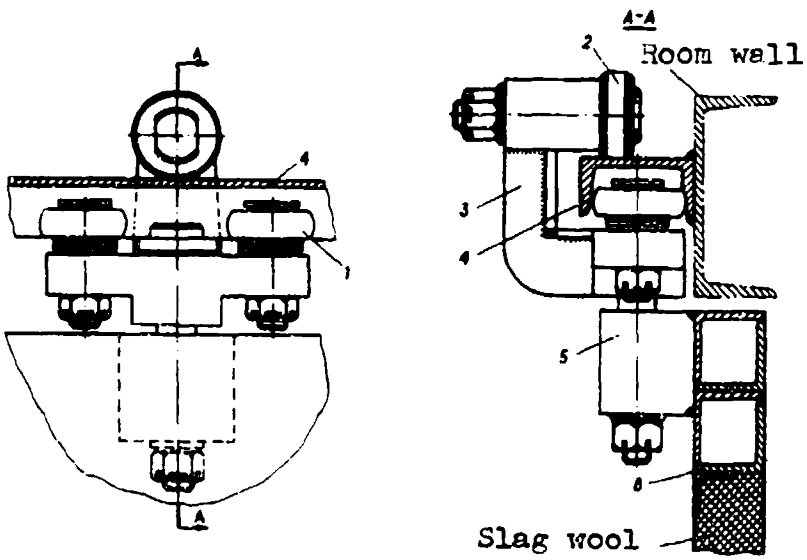
To make work easier a wooden handle is fastened to the block 100 mm from the front edge.

Pneumatically Operated Gates

Penumatically operated gates designed by efficiency experts of the chast', reports Engineer-Senior Lieutenant V. Kozlovskiy, are used in vehicle washing and painting rooms.

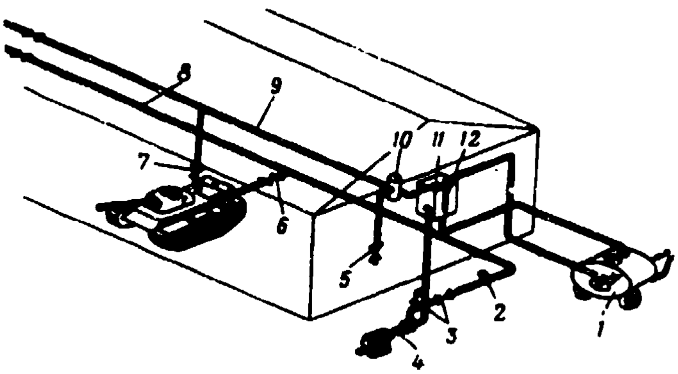
The frames of both gate halves, which are welded out of No 50 corner iron, are faced with sheet steel. Their internal cavities are filled with slag wool. Each half consists of a large door 1,200 mm wide and a small door 750 mm wide. A bracket with rollers is fastened to the upper part of the small door, and an opening for a pulley block is made in the lower door if the gates are to be installed above the room. The doors are connected to each other by a loop that extends the whole height of the gates and made from 100-120 mm long 3/4 inch piping. The pipes are placed on a rod and welded through one to the small and large doors.

Guides made from No 8 channel bar are positioned above each gate half. They are fastened to the wall of the room by steel corner plates. The unit that connects the gates to the guide consists of a ball bearing 2, connected to bracket 3, two rollers 1 that move along the internal surface of the guide 4, and supports 5 welded to the smaller door 6. The upper part of the large door is united by a system of levers to the lower part of a vertical shaft, which in turn is connected by a lever to a pneumatic cylinder mounted on a bracket that is fastened to the ceiling of the room. The cylinder has a 160 mm diameter. The play of the piston rod, which equals 435 mm, allows the gates to be opened by 3,800 mm. Compressed air is fed to the cylinder from the shop air line through a ½ inch pneumatic cock. A restrictor that controls the air feed is installed so that the gates would open smoothly.



Tank Engine Warming System

A system developed by Engineer-Major D. Taz'ba makes it possible to maintain tank engines ready for starting without the need for preliminary warming. It includes a VMG-40-51 permanent water-and-oil heater 1, to the boiler of which pressure 8 and return 9 lines are connected. The cooling systems of 16 vehicles are connected in parallel to these lines. The drain at the bottom of the tank is connected to the pressure line, and the neck of the radiator is connected to the return line. Shut-off cocks 6 and 7 and valve devices are installed into both pipe lines. In addition an expansion tank 11 with a 400 liter capacity and furnished with a meter 12, a condenser, and a fluid collecting vessel is included in the pressure line.



The system's main pipes that pass through the parking area are covered with heat insulation. In order to prevent loss of antifreeze, before it is employed the system, connected to the vehicles, is flushed with hot water to which a three-component anticorrosion additive has been added. Then the water is drained out, and the system is filled with antifreeze.

During operation, fluid is fed from the expansion tank by centrifugal pump 4 into the system's pressure line. The pressure in it is controlled by valves 3 in response to pressure guage 2 up to 1.1 mm Hg.

Air is removed from the system through air collector 10 and cock 5, and the fluid is drained through draining taps. To facilitate draining the return pipe line is installed at a small angle (up to 5 degrees) in the direction of the last vehicle.

The heating schedule is selected in reference to the air temperature and the number of vehicles being serviced. If we assume that a 15-45°C cooling fluid temperature would ensure reliable engine starting, then when the air temperature is 30°C the heater must be turned on for 5 hours with a 4 hour interval to maintain this temperature range. In this case the fuel expenditure would be 15.4 liters per hour.

If there is an urgent need for starting a tank's engine the crew closes cocks 6 and 7, turns off the pipe line nozzle leading from the return line, and screws in the steam-and-air valve. Then they cover the tank's drain, disconnect the pressure line, and plug the drain opening. They start up the engine only after making sure that fluid is present in the cooling system. The crew spends no more than 9 minutes to fulfill these operations.

FOR YOUR NOTEBOOK

(Unattributed Article)

Contact Electric Welding

Contact electric welds are made by electrically heating the point at which metals are to be joined and, at the same time, applying a squeezing force perpendicular to the plane of contact. Contact electric welding is categorized as butt, spot, relief, and seam.

Butt Electric Welding

Parts to be welded are fastened by copper clamps to which the terminals of the welding transformer's secondary coil are attached. Pressure at the joint between the parts to be welded is created by a force that moves one of the clamps.

Butt welding can be done by two methods -- resistance and flashing. When resistance welding is used the metal in the joint area does not melt. The parts are pressed together, and the current is turned on, resulting in intensive heating of the parts where they are in contact. The parts become welded together.

With flash welding the current is turned on, and the parts are moved toward each other until an electric contact is achieved at the butt ends. The ends of the parts heat up intensively until they fuse, after which they are pressed together with a rapid application of pressure (at the same time that the current is turned off) and become welded together.

Butt welding is employed in lengthening structural parts, connecting parts made of differing metals and alloys (for example, the welding of tool steel to ordinary steel), building parts with enclosing profiles (rings, welded frame units), welding steel to copper and brass, welding copper to brass, and so on.

Relief Welding

In relief welding the parts are pressed together between the contact plates of a welding press (or of a sufficiently powerful spot welder on which the upper electrode moves vertically), where the plates are joined by a transformer. Projections are initially stamped out of one of the parts at points to be welded. After sufficient heating the projections fuse, and the parts become welded together.

Relief welding gives good results when welding parts made of low-carbon steel and nonferrous alloys with low electrical conductivity and high mechanical durability (siliceous bronze, for example). It is used principally in mass production.

The basic condition for achieving high-quality results is precise preparation of the parts: All projections should be equal in height, and the parts must lie together firmly when assembled.

The welding facility power necessary for relief welding is within the range of 25-27 kilovolt-amperes per projection (for low-carbon steel), depending upon the thickness and shape of the parts. The compression needed per projection is 100-500 kilograms. Sometimes a welding cycle employs variable pressure, which increases during upsetting by 50-100 percent in comparison to the pressure applied during welding. Relief welding provides good results when the welding current is turned on by several successive pulses using a synchronous contact breaker.

Allowances for Automatic Welding of Sheets and Thin-Walled Piping by Continuous Flashing (for two parts, in mm)

Sheet or pipe wall thickness	Total allowance	Flashing off allowance	Contraction allowance
1,2	5,0	3,0	2,0
2,5	13,0	10,5	2,5
3,0	16,0	12,5	3.5
4,0	17,0	13,5	3,5
5,0	19,5	15,5	4,0
6,2	22,0	17,0	5,0
10,0	24,0	18,5	5,5

Spot Welding

Spot welding can be either two-sided or one-sided. In two-sided welding two or more parts are pressed together between a spot welder's electrodes. When the current is turned on the parts heat intensively at the point compressed between the electrodes. Because of the high conductivity of the electrodes, which are usually copper, the surfaces of the parts touching them heat up more slowly than do the internal layers. The heating continues, as a rule, until the metal in the central and hottest zone melts. Then the current is turned off, and the pressure on the electrodes is released. After the fused metal crystallizes a spot weld forms, which in cross section has a lenticular cast center.

In one-sided welding the current from the transformer's secondary circuit is distributed between the upper and lower sheets. In this case the welding is done by the fraction of current passing through the lower sheet.

Low-carbon cold-rolled steel, hot-rolled low-carbon steel (after the surface is specially cleaned), and 18 percent chromium, 9 percent nickel stainless steel weld well with this method. It is also satisfactory for low-carbon steel with protective surfacings (better with zinc and lead plating, worse with tin, chromium, cadmium, and aluminum plating), heat-resistant chromium-nickel steel (25 percent chromium, 20 percent nickel), aluminum alloys such as duraluminum, AMts and others, and brass; siliceous bronze, and nickel and its alloys (Nichrome, Monel metal, melchior, and others). Aluminum, copper, and its high electrical conductivity alloys weld poorly with this method.

Recommended Minimum Distances for Contact Spot Welding

Thickness of one part, mm	Minimum spot spacing, mm		Minimum distance from spot center to edge of part in direction perpendicular to applied force, mm	Minimum distance from spot center to edges and flanges, mm
	welding two parts	welding three parts		
1	15	20	6	8
2	25	30	9	12
3	30	40	10	18
4	40	50	12	25
6	50	70	15	30
8	60	100	20	40

Seam Welding

Seam welding is done by a continuous row of partially superimposed spot welds. The parts to be welded are lapped and pressed together between roller electrodes. The rolling of one or both rollers is forced. Current passes to the rollers from a transformer. After the parts are pressed together the current is turned on immediately, and the parts begin to move. Current is fed continuously (continuous welding) or as short pulses spaced apart (intermittent welding). The proper sequence of pulses and pauses of a fixed length is achieved by a contact breaker. Intermittent welding produces higher quality joints and is the principal method for seam welding. The best results are achieved with cold-rolled low-carbon and thin stainless steel (18 percent chromium, 9 percent nickel). Good welding is attained with carefully cleaned hot-rolled low-carbon steel, siliceous bronze, and some aluminum alloys (duraluminum, AMts aluminum-manganese alloy).

The limiting thickness of the parts being welded depends on the electric and mechanical power of the welding equipment. Parts of the following thicknesses can be welded on machines up to 150 kilowatt-amperes (for welding steel) and up to 300 kilowatt-amperes (for welding nonferrous metals): Pickled steel -- 2.0 + 2.0 mm, hot-rolled steel -- 1.75 + 1.75 mm, stainless steel -- 1.50 + 1.50 mm, siliceous bronze -- 1.50 + 1.50 mm, duraluminum -- 1.50 + 1.50 mm.

FOR DEEP WATER WORK

Engineer-Captain 2d Rank V. Yeliseyev,
Candidate of Military Sciences

Raising sunken ships, installing and replacing equipment on the bottom of seas and oceans, and rescuing personnel of ships that suffered mishap are a partial list of problems being studied intensely in the last few years by specialists in foreign navies. This is explained by the fact that the imperialists are seriously staking their expansionist plans on naval equipment and on the use of the ocean depths for warfare.

It has long been recognized that the pneumatic and mechanical instruments still being used by divers and aquanauts, as well as welding and cutting apparatus, are becoming less and less useable at great depths. In order to overcome water pressure, for example, air must be pumped to pneumatic instruments at very high pressure. When hoses are increased in length their buoyancy increases, as a result of which an air hose tends to raise the instruments to the surface. Long ropes and hoses encumber a diver and make his work difficult. In this regard development has begun abroad of deep water technical systems that would provide an aquanaut with power right at the place where work is to be done. For example, by order of the engineering construction laboratory of the U.S. Navy a special transport vehicle has been built at the underwater research center that supplies aquanauts with compressed air and hydraulics for underwater work. It is a frame made of 40 duraluminum pipes 37 mm in diameter (Figure 1). The apparatus has neutral buoyancy in water owing to a hollow duraluminum sphere. Two cylinders 300 mm in diameter at the top of the structure serve as containers for silver-zinc batteries and provide additional buoyancy. Submersible electric motors totalling 10 horsepower rotate four screw propellers. Two of them are designed to propell the apparatus forward at a speed of up to three knots, and the other two are used for steering and turning. The apparatus can two six aquanauts and carry a net load of up to 500 kg. Its maximum working depth is 240 meters, it weighs 800 kg, and is 2.5 meters long, 1.9 meters wide, and 1.7 meters high.

One of the most frequently performed operations under water is the patching of holes and raising various objects off the bottom. In the past, holes were patched by welding or bolting. Both of these methods required great expenditures of time and power. Presently special pin fastening pistols are being used in underwater work. Their principle of operation is identical to that of pin pistols used in industry. They fire tempered steel pins. The barrel of the pistol used by U.S. aquanauts, for example, is not rifled and contains a breech mechanism. Ordinary powder and a detonator are used for firing.

Figure 1. BTV Deep Sea Transport Vehicle

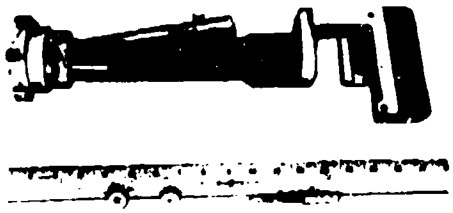


Figure 2. NUD-38 Pin Fastening Pistol

The NUD-38 underwater pistol penetrates soft steel plates up to 12.5 mm thick by 6.3 mm diameter pins (Figure 2). It can be carried by one aquanaut and used down to depths of 60 meters. Work is underway to make the pistol so it can fire at the maximum possible depth to which an aquanaut can dive (180 meters).

A heavier pistol has been created and tested in the USA. Pins with a 9.5 mm diameter fired by it penetrate NU-80 steel sheets 25 mm thick. The pistol can be operated automatically or by remote control. It can also fire a hollow pin into soft steel plating up to 12.5 mm thick. This is needed in cases when compressed air must be fed through the pin cavity into compartments to add buoyancy.

Raising objects from out of the water is made very difficult by such an operation as strop fastening (especially with a smooth hull as, for example, that of a submarine). In the USA a new lifting device is being developed that consists of two cross-shaped straps with a freely rotating lifting eye in the center. In order to fasten the eye to the outer plating the device is brought close to the object being raised, and contact is made with four magnets. Then eight pins (one at a time or simultaneously) are fired through openings previously drilled into the cross-shaped straps. The rated lifting capacity of the device is 10 tons, but in reality it has supported a force of 22,680 kg without tearing away. A device with a lifting capacity of 25 tons is being developed.

Independent air supplies are being designed in connection with the creation of technical resources for raising large objects from great depths. One such source is a disposable hydrazine generator. Hydrazine passes to the generator from a fuel tank, into a chamber containing a catalyst, where hydrogen, nitrogen, and ammonia are formed. These gases are fed into pontoons, as a result of which the latter attain a positive buoyancy and raise objects fastened to them to the surface. Presently the gas generators being used in the USA make it possible to raise objects weighing up to 100 kg from a depth of 300 meters. Gas generators for raising objects weighing up to 150 kg from a depth of 5,500 meters are being developed.

Polyurethane foam is being employed extensively for raising ships. The cannon used to feed foam into an object consists of a mixing chamber, flow regulators, starting valves, and a nozzle for injecting the mixture into a compartment (Figure 3). Tar and a catalyst are fed into the cannon under pressure by two hoses. Each hose has a regulator that fixes the rate at which each component of the mixture moves. A solvent is fed through a third hose to clean the foam cannon after use.

Figure 3. Foam Cannon

The tar and catalyst pass into the mixing chamber through special vortex generators, where they are mixed fully. The pressure within the chamber is significantly lower than that in the tanks containing the mixture components. As a consequence the freon dissolved in them vaporizes at a low temperature, ensuring better mixing of the components. For the foam to be sufficiently strong it must be kept under water for a few hours. This way the gas contained in the foam bubbles would not escape after the object is lifted out. Premature lifting of the object to the surface could cause the bubbles to burst, and some of the gas would be lost, as a result of which the positive buoyancy would decrease.

Foam was used successfully to raise several ships in relatively shallow areas. For example, a destroyer was freed from shallows in the western part of the Atlantic Ocean, and an aircraft fuselage was raised from a depth of 60 meters.

There is a proposal for future use of a new device called a hydrodynamic winch in rescue operations and in raising heavy objects from great depths. It is a large cylindrical body divided internally by a great quantity of longitudinal partitions into wedge-shaped compartments that fan out to the periphery from a central axis. Pumps with counter weights and controlling units are installed along it on bearings. The bearings keep the pumps vertical while the main structure rotates.

During operation of the winch, a current of water is directed through a system of valves from one wedge-shaped compartment to the pumps, from which the water current passes through a distributing receiver into the wedge-shaped compartment situated above. As a result a moment is generated that causes the whole winch to rotate. In this case the lifting strops are wound onto grooves on the cylinder's outer surface. Plans exist for hydrodynamic winches of various sizes and with lifting capacities up to 10,000 tons. Such powerful winches can raise large ships from the bottom.

All sorts of manipulating devices occupy an important place in underwater work. While the first models were precise copies of manipulators designed for work with radioactive substances, today special manipulators are being manufactured which can endure tremendous external pressure and withstand the agressive action of sea water.

When a limited range of operations is to be fulfilled with manipulators, specialists consider it best to use all-purpose working heads and collections of the necessary instruments. For example, the all-purpose head of the manipulator on the DSRV deep sea emergency rescue vehicle, which can work at depths below 1,000 meters, is supplied with a collection of instruments designed for removing damaged structures near the rescue hatch of a submarine, and for removing mud from the coaming surface of the hatch (Figure 4). In addition the cable of the rescue buoy can be cut and removed with the manipulator, and the cable of the rescue apparatus can be connected to the hatch cover.

The manipulator is mounted at the botton of the apparatus just in front of the transfer shaft. The manipulator's working radius is 3.35 meters. The all-purpose head has six degrees of freedom. In addition the end link can move forward. A hydraulic excavator (or wire brush) is mounted on the head.

The levers of the manipulator are activated with a plunger-type toothed rack and geared rotating executing mechanisms. A special control unit equipped with a handle coordinates the movements of the operator's hands with the movements of the instrument held by the manipulator.

The grasping device is moved out and back by a switch in the upper part of the handle, and the grip is opened and closed by a switch mounted on the back side of the controlling handle. The manipulator is turned from the vertical to the horizontal position with a switch located on the housing of the control unit. Two other switches are also located there, designed for switching on the control circuit in such a way that when the manipulator is rotated 90 degrees there would be a spatial correspondence between the movement of the control handle and the movement of the manipulator. Rotation of the manipulator by 90 degrees significantly increases the possibilities for performing various mechanical operations.

The design of the manipulator makes it possible to change working instruments without having to raise the apparatus to the surface. The outfit of instruments includes a grasping device, a gunpowder pistol for fastening pins and making holes, and a high-rpm centrifugal hydraulic pump, which serves as the actuator for the hydraulic excavator, the dynamic wrench, and the drill (for the wire brush and cleaning machine).

It stands to reason that the American command is interested not only in rescuing the crews of sunken submarines. One of the most important tasks posed to deep sea apparatus is the testing of new naval weapons. In this case the arms race has attained a scale never seen before in the USA. Such apparatus will be used to install, test, check, and replace various types of underwater objects. Two deep sea working devices, the Tartl and Autek [transliterations], have already been built for these purposes, and they will be used on the firing range belonging to the Atlantic center for testing and evaluating underwater weapons and equipment.

FLOATING AIRSTRIP

(Unattributed Article)

An airstrip created by an American firm is designed for use in swamps and rice fields. It is assembled from aluminum plates 2.4 meters long, 1 meter wide, and 15 centimeters thick. All parts, with the exception of the frames, are fastened together with glue. Each plate consists of 750 cells filled with polyurethane, which increases buoyancy, durability, and strength of the airstrip.

RESOURCES FOR UNDERWATER SABOTAGE

Engineer-Captain 1st Rank A. Smukul

Imperialist states, and chiefly the USA, have placed all the achievements of modern science and technology at the service of their agressive purposes. The military-industrial complex is conducting a continuing arms race. Significant space within the whole arsenal of offensive resources has been devoted to the development of underwater sabotage systems.

Surprise is an indispensable factor for successful use of underwater sabotage systems, which as a rule focus on submerged or partially submerged targets. In addition to having the usual types of explosive cartridges, they are equipped with specially designed delayed action explosive charges.

The designs of various models of explosive charges are dependent upon their purpose. Every time the weight, dimensions, and shape of the charge is selected on the basis of the nature of the target to be destroyed. Floats are attached to a charge so that it could be transported more easily by a swimmer. When necessary they can be deflated. Threaded openings are made in the charge housing for connecting a special fuse.

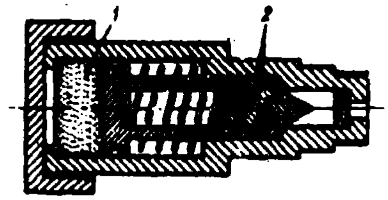
With some exceptions all fuses are delayed action and are furnished with a protective device. When an attempt is made to remove the fuse from the charge, it explodes.

Fuses are categorized as static, dynamic, and combined (Figure 1). Static fuses operate without the use of energy from an outside source and are employed when an explosion must occur after a certain time period. Chemical or mechanical action devices that keep the fuse's firing pin cocked are designed for this purpose. There are three chemical action static fuse models. In the first type, acid gradually eats away a wire that maintains the firing pin in cocked condition. When the wire breaks the detonator is struck, and an explosion occurs. In the second model (Figure 1a), acid permeates through porcelain, combines with a potassium chlorate and sugar mixture and ignites it. The burning mixture causes the detonator to ignite. In the third model (Figure 1b) a pill that is soluble in water is placed between the upper cap of the fuse and the piston. After the pill dissolves completely a spring acts on the piston, which frees the firing pin as it moves toward a stop. The time delay for such models is determined by the rate of wire disintegration, of acid permeation through porcelain, or of pill dissolution.

a)

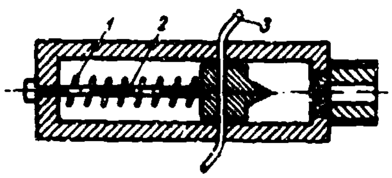
Chemical, with porcelain delay: 1. Acid; 2. Porcelain

b)



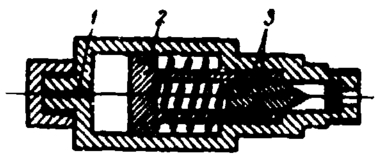
With dissolving arrestor: 1. Dissolving pill; 2. Catch

c)



Mechanical, with wire arrestor: 1. Spring; 2. Firing pin; 3. Wire

d)



Pneumatic: 1. Opening; 2. Piston; 3. Catch

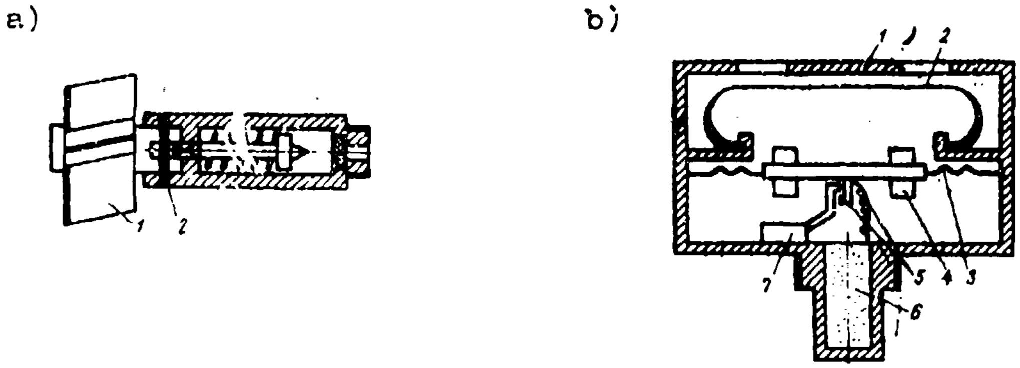
Figure 1. Static Fuses

Mechanical action fuses work in a different way. In one of them (Figure 1c) a compressed spring breaks a lead wire of specific cross section, and the firing pin is released. The force of the spring is known, and therefore all that is necessary is to install a wire of the needed cross section. In a second model (Figure 1d) a piston moves by spring action and forces air out of a calibrated opening. At the end of the piston's movement the firing pin is freed, the capsule is pierced, and an explosion results. The delay is determined by the rate at which air is forced out by the piston.

In contrast to the static type, dynamic fuses operate under the effect of external forces. When a ship moves a flow of water passes over the ship's hull and, naturally, over a charge that has been fastened to it. The water flow forces the fuse's screw propeller to rotate. When the force of the propeller attains a certain value a special device that arrests the firing pin in cocked position breaks, and the firing pin operates (Figure 2a).

The working parts of hydrodynamic fuses (Figure 2b) are situated in a protective housing, the upper part of which is made in the form of a grating.

When the ship is standing still the membrane is under constant hydrostatic pressure, which is in equilibrium with the air pressure in the fuse's two chambers (air passes freely through valves in the membrane). When the ship begins to move the pressure below it decreases so rapidly that air does not have a chance to pass through the membrane valves. As a result the difference in pressure in the two chambers attains a large value, and the membrane rises, closing the contacts of an electric circuit. For the detonator to explode the contacts must be closed for several seconds.



Fuse with propeller: 1. Screw propeller; 2. Membrane

Hydrodynamic: 1. Protective housing; 2. Diaphragm; 3. Membrane; 4. Contact device; 5. Electric detonator; 6. Detonator; 7. Detonating battery

Figure 2. Dynamic Fuses

Combined fuses are employed when it is necessary that a charge fastened to a moving ship explodes after a certain time period. Such a fuse combines the exploding mechanisms of a piston-type static fuse and a dynamic fuse operating with the force of a rotating screw.

Special devices that hinder deactivation are installed on the charges. There are several types of such devices. Mechanical antidischarging devices are usually installed in cartridge locking devices or in front of them. The principle of operation of the device is based on the fact that the firing pin is released when the piston moves as far as it can go under spring action. In cocked position the piston is arrested either by a clamping screw or by the target itself.

Hydrostatic antidischarging devices (Figure 3) are positioned usually on the end of the cartridge opposite the fuse. The membrane and spring are graduated for various hydrostatic pressures. A swimmer adjusts its position in dependence upon the depth, which he determines from a depth guage at the point where the charge is to be fastened. If someone tries to lift the charge to the surface the hydrostatic pressure on the membrane decreases, it bends out, the contacts of the electric detonator close the circuit of the detonating battery, and an explosion occurs.

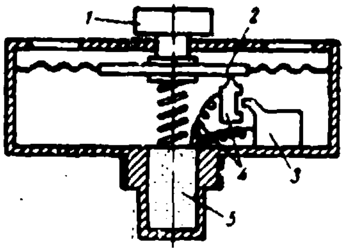


Figure 3. Hydrostatic Antidischarging Device

Key:

1. Adjusting key
2. Membrane with spring
3. Detonating battery
4. Electric detonator
5. Detonator

Devices that trigger in response to physical fields generated by a swimmer while he moves (acoustic field) or by his equipment (magnetic field) are also used as antidisarming devices. Little is written about the design features of these devices. Only cases in which swimmers blew themselves up trying to approach charges they found have been mentioned in the foreign literature.

Various types of fasteners are used to attach charges to sabotage targets. Charges are attached to protruding parts of targets with so-called tourniquet fasteners, and by magnetic fasteners to targets made of magnetic metals (steel, iron). They consist of several powerful magnets that hold the charge against the target. Several types of sucker fasteners are also known.

Tourniquet fasteners are ordinarily used for attaching heavy charges, while the rest are used for lighter ones, as well as when the target possesses no protruding parts.

The suit of an underwater saboteur differs little from light diving equipment or the suit of a sporting diver. It consists of a wetsuit, SCUBA, and mask. As is evident from the publications of the foreign press, the greatest discomforts to underwater saboteurs are cold and damage to their outfits -- damage to the wetsuit and problems with the SCUBA.

Problems with an underwater saboteur's outfit that need to be resolved include body heat insulation, reliability of the breathing apparatus, extending the underwater time, communications, and orientation. These problems are not essentially new. They are being studied by specialists who are developing resources that would make it possible for a man to stay underwater for a long time. Therefore the foreign military specialists are making wide use of the achievements of diving science and underwater sports with respect to equipment, and of the results of experiments with underwater laboratories.

Considering the experience of World War II, foreign naval specialists are attempting to employ various types of detectors and explosive devices, located in the path of probable movement of saboteurs at different depths, in addition to the existing resources for protecting harbors, bases, and ships from attack by underwater saboteurs (mine and net barriers).

Defense systems against underwater saboteurs are divided into passive and active. Passive systems employ resources that detect and destroy in response to magnetic and acoustic fields generated by transporters and by the equipment of underwater saboteurs. A magnetic detector consists of an inductance coil, contact breaker, and galvanometer. When a metallic mass with its own magnetic field approaches the detector, the potential of the ground magnetic field changes, and a difference in electromotive force is generated. The direct current arising as a result is transformed by the contact breaker into an alternating current. Passing through the transformer it activates the galvanometer's indicator, registering the presence of a threat.

Hydrophones usually serve as acoustic detectors. A sonar receiver and emitter are located in their upper section, which rotates 360 degrees. The appearance of a threat is registered by a hydrophone station located on shore and connected to the detector by a cable.

Active defense systems employ ships and cutters furnished with modern resources for fighting underwater saboteurs. There are plans for adding detachments of combat swimmers equipped with underwater rifles to antisubmarine defense ships and boats. They are to engage in hand-to-hand combat with underwater saboteurs.

The aggressive tendencies of the military leaders of imperialist states are well known to the Soviet people. They are directed primarily against the countries of the socialist camp. Therefore, in addition to other measures, a study of all offensive resources possessed by imperialist states helps to protect our navy from the sabotage of aggressors, if they decide to infringe upon the safety of our Motherland.

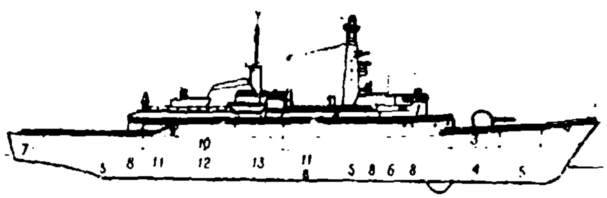
ESCORT VESSEL

(Unattributed Article)

The English ministry of defense has allotted 8 million pounds sterling for the construction of a new type 21 double shaft escort vessel designed for action in any sort of weather as a component of convoy escorts and large warship <u>soyedineniye</u>.

The ship's displacement is 2,500 tons, its maximum speed is 34 knots, and its range is 4,500 miles at 18 knots. The crew consists of 170 individuals (a possibility is foreseen for holding 192 individuals).

The vessel's hull, which was designed with the aid of an electronic computer, reflects an optimum relationship between speed and navigability. Just below the wheelhouse the upper deck contains (see Figure) the bridge 1 and a compartment 2 for radio reconnaissance and control equipment. The hull contains: A firing compartment for a turret-mounted weapon 3, a munitions hold 4, ballast tanks 5, a sheltered standby command post 6, a tiller compartment 7, liquid fuel tanks 8, hangar 9, power and damage control station 10, generator compartments 11, main engines 12, and a machine room 13.



The main combined power plant includes two gas turbine and two diesel engines. The electric system includes four diesel generators. The ship's machinery is furnished with remote control.

The ship's armament includes an Mk 8 114-mm automatic turret-mounted weapon, a launching pad for four sea-to-air missiles, two Erlikon [transliteration] 20-mm sub-machine guns, and two three-tube torpedo systems. The ship's outfit will also include a WG-13 helicopter carrying torpedos and air-to-ship rockets. Automated systems have been developed for controlling the artillery and rocket armament.

Construction of the ship is planned for completion in mid-1972.