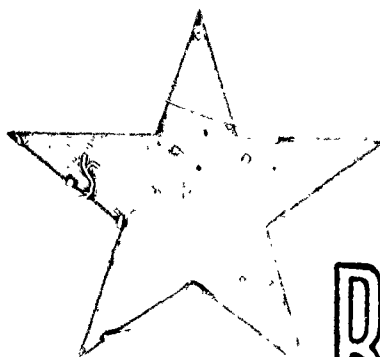
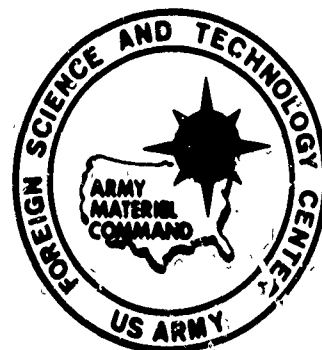


FSTC-HT-23-1610-72

# Техника и вооружение

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### KEY WORDS

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**LINKED**

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

- chast'** [voinskaya chast'] - Administrative, line, and supply unit (yedinit'sa) 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

	Page
In the Military Districts, Groups of Forces, and Fleets . . . . .	2
The Innovators . . . . .	5
Patent Information . . . . .	9
Electric Motors of the Five-Year Plan . . . . .	16
Expenditures Are Amortized . . . . .	21
Work Places . . . . .	26
With A Consideration of Technological Features . . . . .	29
Preliminary Totals . . . . .	32
The Heirs of Combat Glory . . . . .	33
Radioisotopic Generators . . . . .	37
Power Steering Units . . . . .	43
Electronics in the Service of Aeroflot . . . . .	47
Automatic Regulator . . . . .	51
New Megohmmeters . . . . .	54
Tank Machine Guns . . . . .	60
Fuel Pump-Regulator . . . . .	63
Contemporary Teaching Means . . . . .	67
The Tank Proving Ground Command Post . . . . .	74

	Page
To Those Studying the Tracked Self-Propelled Ferry . . . . .	80
Birth of the Guards . . . . .	82
Determining the Economic Efficiency of Scientific Organization of Labor . . . . .	84
The Chast' Acquires A Vehicle . . . . .	89
From the History of Equipment . . . . .	94
Storage Preparations . . . . .	97
Laying Communications Lines . . . . .	101
Sharpening Electric Tools . . . . .	104
Hungarian Tank Personnel . . . . .	110
Nerves of the Front . . . . .	113
Servicing Chemical Equipment . . . . .	116
Helicopters in the Fall . . . . .	120
From Rationalization to Inventiveness . . . . .	123
Requests Department . . . . .	127
The Efficiency Expert Relay . . . . .	129
For Your Notebook . . . . .	136
Missile Warheads (pp 46-47) . . . . .	Not translated
Literature for Tank Personnel . . . . .	141
1971 <u>Mashinostroyeniye</u> Publications . . . . .	144
Hydraulic Power Steering Unit of the GAZ-66 Vehicle . . . . .	147

Technology and Armament, No. 9, 1971

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IN THE MILITARY DISTRICTS,  
GROUPS OF FORCES, AND FLEETS

(Frontpiece)



Red Banner Far East Military District. Major V. Kulagin, the deputy commander of the separate repair and reconstruction battalion for political matters, ably and inspirationally conducts studies with the troops on learning the decisions of the 24th CPSU Congress. Entering into socialist competition, the repair workers obligated themselves to reach the goal of having each third man become outstanding and every second man to master a related specialty.



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Red Banner Kiev Military District. Engineer Lieutenant V. Blintsov, an electrical and special equipment repair engineer, is one of the leading officers in the podrazdeleniye. On his initiative, the work area which he supervises was modernized according to the requirements of scientific organization of labor. This made it possible to raise repair quality and labor productivity.

Order of Lenin Leningrad Military District. Senior Lieutenant V. Malyshev not only achieves outstanding results in firing, but also gives much attention to the training of his subordinates. A device which he developed, to significantly improve training conditions in weapon sighting, is widely used in the chest'.



Red Banner Belorussian Military District. Specialist First Class Captain Technical Service V. Sosnin is the chairman of the commission on inventions in the chst'. An active efficiency expert, he has made many valuable suggestions which have helped to reduce the time period in performing adjustment and repair operations to aircraft equipment.

## THE INNOVATORS

(p 1)

The great plans to create a material and technical base for communism and to strengthen the economic and defensive might of the country as planned in the 24th CPSU Congress give rise to mighty energy on the part of the people. Socialist competition to carry out this year's tasks and those of the Ninth Five-Year Plan is expanding everywhere and is enriched by valuable patriotic beginnings. Under the supervision of the Lenin party, the Soviet people, with inspired labor, are developing a society in which, as L. I. Brezhnev stated at the Congress, one can live well and breathe easy.

It can be stated with complete confidence that in carrying out the historical plans of the beloved party, the personnel of the armed forces are also making a worthy contribution. The Soviet fighting men see their duty to dependably protect the creative labor of the people and not for a minute to weaken vigilance and readiness to repel at any moment the attack of an aggressor from wherever it may emanate. Adhering to the slogan: "The year of the 24th CPSU Congress — a year of outstanding training and service," they are assiduously mastering the first-class weapons entrusted to them and are strengthening themselves morally and physically.

Another remarkable trait in the character of the Soviet fighting men is their desire toward technical creativity. Now you will not encounter a chaste or ship in which inventive and efficiency expert concepts have not been developed. The skillful army and navy personnel to whom the feeling of the new is inherent and who by rights can be called innovators, are fruitfully carrying out very important tasks associated with maintaining constant combat readiness and in raising the quality of field, naval, and air skills.

Devices to ensure precise troop control, training devices which help save motor resources and fuel, devices which reduce the time to service and rehabilitate machines — all this and much more are the result of the undeniable talent and skillful hands of the innovators. It is most heartening to note that the scientific and technical maturity of many of them helps find the ways to improve existing models of arms. A number of very singular innovations developed in the army and navy have



found their use in the national economy. The inventors and efficiency experts of repair podrazdeleniya and enterprises took to heart the announcement carried in our magazine concerning competition to introduce the most rational equipment for the work places of metalworkers, lathe operators, journeyman radio repairmen, electrical assemblers, and welders according to the requirements of scientific organization of labor. The totals of this competition will be drawn up at the end of this year. But even now, judging by the incoming correspondence, it is possible with great satisfaction to note the growth in labor productivity and standards and a very specific economic effect.

Many of the military collectives have come up with significant achievements in inventive and efficiency expert activities. What are the causes of this? The causes are that the one-man commanders, political organs, and party and Komsomol organizations deeply understand and actively support all that is leading, all to which the future belongs, are decisively opposed to adherence to the old which brakes forward movement. The initiative of innovators is always commended, the material potentials are developed to check their scientific and technical ideas, and favorable conditions are made to replenish their ranks.

In this respect, the chast' and soyedineniye of the Group of Soviet Forces in Germany can serve as examples. In just the past year, the inventors and efficiency experts have submitted more than 20,000 suggestions, of which more than 10,000 were realized. Worthy of approval were the tactical field panels which, in quick time, transmit information on targets destroyed during firing, tank proving ground panels which register the slightest infractions of the Rules of Driving when overcoming obstacles, and various devices which help to improve personnel training.

There is something to be learned and something to be gained from the innovators of the Order of Lenin Leningrad Military District. Their creative efforts resulted in an increase in the traffic capacity of training sites, an improvement in the reliability of individual types of apparatus and a reduced time of preventative maintenance, the development of a system to fix and record firing practice results, improvements to company tactical sets, the equipping of firing ranges with targets, and imitation of "enemy" fire under night cover conditions. The aktiv in this district has also made many other technical decisions which bring great usefulness to combat training.

The Directives of the 24th CPSU Congress point out the need to widely expand the creative initiative of the workers for the technical improvements in production, to facilitate in every way an improvement in efficiency expert and inventive activities. This instruction also is fully applicable to the armed forces. One of the most important tasks of main and central directorates of the USSR Ministry of Defense and of the command elements of military districts, groups of forces, and fleets is to make the innovator movement even more encompassing and to establish the situation in all collectives which would imbue them to bold searches

and openings. In this connection, the experience of the Order of Lenin Moscow Military District is worthy of dissemination. A district committee for efficiency expertise was formed and is called upon to efficiently resolve matters concerning innovative activity among the troops.

Among the problems which have a direct bearing upon inventiveness and efficiency expertise, a most vital one is that of improving scientific-technical and patent information. In no other way but by its absence can we explain the appearance of suggestions which only repeat those which have already been carried out. There also are cases in which suggestions worthy of general approval are used only in that chaise longue or that ship where it was first launched. This shortcoming not only hinders the introduction of the progressive, but also infringes on the rights of authors for additional remuneration because of the expanded scale their ideas have gained.

Unfortunately, there are also shortcomings which artificially hold back the desire of the military servicemen to turn to technical creativity, to make their contribution into the development of the training-material base. This primarily is the inexcusable delays in time of reviewing submitted suggestions, the too general thematic tasks to the innovators, and the decisions made by commissions on inventions from which it is difficult to understand who is to introduce a recommended suggestion and when.

The Directives of the 24th CPSU Congress contain instructions that the realization of inventions and openings would be implemented in short time. This is understandable. The further strengthening of the economic and defensive might of the government is in direct relationship to how quickly introductions of modern achievements in science and technology are made. The time has come that the task of one-man commanders, political organs, and party and Komsomol organizations be that of decisively moving perspective developments forward, maintaining the dissemination of the work results of inventors and efficiency experts under unweakening supervision.

The CPSU Program and other party documents emphasize the importance of material and moral stimulation of the effort of inventors and efficiency experts. Skilled individuals in the army and navy have their activity rewarded in this form. Large sums are expended from the means allocated to organize inventive and efficiency expert activities in the armed forces in the payment of awards. The one-man commanders have the right to award valuable presents and certificates to innovators, to announce commendations in command orders, and so forth. We must continue in every way to raise the significance of moral incentives, surround the leading personnel with respect and praise, and disseminate their know-how.

Weighing their capabilities and initiating socialist competition, the inventors and efficiency experts in the army and navy have set the goal for themselves to complete the first year of the Ninth Five-Year

Plan with high indexes in creative effort. This goal will be reached. This will be their new and weighty contribution into the matter of raising the combat readiness of our glorious armed forces.

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## PATENT INFORMATION

(pp 2-4)



R. Vcherashnyy, candidate of technical sciences, director of the Central Scientific Research Institute of Patent Information and Technical and Economic Research.

The Directives of the 24th CPSU Congress for the five-year plan of developing the USSR national economy during 1971-1975 plan a broad program to accelerate the rate of scientific and technical progress. In solving this task, a great contribution is made by inventors and efficiency experts. Just these figures are indicative of this. During the past Five-Year Plan, more than 15.6 million inventions and efficiency expert suggestions found their application in the national economy, which made possible a significant improvement in many branches of industrial production.

The Directives of the 24th CPSU Congress open new and broad possibilities to develop the invention movement. This will be facilitated by improved scientific and technical information, a systematic transmission to interested branches and enterprises of data on scientific and technical achievements and leading experience in the fields of techniques and technology, in the organization of production and control. Patent information is called upon to provide particularly efficient assistance in seeking the most effective technical decisions.

Its importance is determined by the daily needs of society. A new invention is born every five minutes in the world; each year more than 350,000 patents covering 100-120,000 inventions are issued each year and 150-200,000 persons become inventors. The technical content of inventions becomes more complex, their differentiation by branches of technology becomes more and more difficult. Moreover, the differences in the systems of patent laws and classification of inventions and the practices of their application in various countries complicates overcoming the language barriers and requires an orderly information system. Without it, it is impossible to efficiently introduce scientific and production-technical achievements into the national economy, protect the domestic prestige in the development of new equipment, the proper regulation of the rights to protect work performed within the framework of international collaboration, and the placement of competitive domestic production into the world market. It is therefore not by chance that the Directives of the 24th CPSU Congress make mention of raising the incentive role of patent matters.

The party and government always give great attention to improving information systems in our country. The small, interdepartmental commission on purchasing foreign literature, created on the initiative of V. I. Lenin, has now grown into a huge net of information organs in which thousands of specialists are at work and a new type of scientific activity was born — scientific information, and a new category of specialists-informants appeared.

According to the decisions of the Soviet Government, the Central Scientific Research Institute of Patent Information and Technical and Economic Research (TsNIIPI) was formed within the USSR Council of Ministers, which was assigned the task of coordinating work on organizing a patent information system (SPI) in the country.

A series of difficulties were encountered during the initial phases: the country did not have the necessary experience, the state fund of the All-Union Patent-Technical Library (VPTB) did not have an exhaustive volume of documentation, there was a lack of patent materials at the enterprises, and there was a shortage of qualified cadres of patent experts. In a short period of time, it was necessary to develop the principles and methods to handle patent documentation, systematize the huge retrospective fund, teach a large army of design engineers and project engineers how to use the appropriate materials, plan the ways of

overcoming language barriers hindering the study of such documentation, and so forth.

However, the advantages of the socialist systems — and primarily the planned handling of the USSR national economy — provided the favorable and objective conditions to establish a union-wide centralized SPI in the country within the shortest period of time.

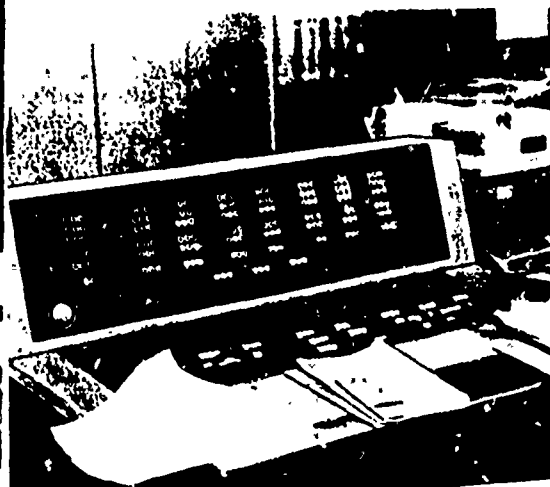
Its fundamental intent is to efficiently make available to each scientist, engineer, and technician, the necessary technical, economic, and legal information on new technical decisions protected by patents in many countries of the world.

In order to provide the USSR's national economy with patent documentation, a network of patent funds was created within the framework of the SPI. There is signal information on all new inventions, a reference-information service is under implementation, and patent services are made available to enterprises and organizations in the USSR. The central patent fund which is in the All-Union Patent-Technical Library is the storehouse for all materials of the USSR's national fund and also the fund of other countries. The State Patent Fund of the USSR was developed on its base and is a unification of all funds belonging to state organizations, namely: central, branch, territorial, and special ones used in the interests of state patent expertise.

Territorial patent funds have been created in 29 of the largest industrial centers in the country including Leningrad, Gor'kiy, Rostov-na-Donu, Khabarovsk, Sverdlovsk, Yaroslavl, Ivanovo, Kiev, Kharkov, Lugansk, Minsk, Alma-Ata, Tbilisi, Riga, Yerevan, Tashkent, and other cities. On the average, the volume of each fund is 1.5-3 million invention descriptions. These are also widely used by inventors in the Soviet army and navy. For example, many officers in the chest' and military training institution of the Kiev garrison visit the territorial patent fund located in the Ukrainian Scientific Research Institute of Information. In 1970, 175 persons from the Military Academy imeni Mozhaysk visited the Leningrad patent center in order to study new technology items.

Branch patent funds are created at enterprises, in organizations, and in central branch organs of information including military training institutions. Thus, the fund of the Red Banner Military Academy of Chemical Protection contains several thousand descriptions of domestic and foreign inventions.

Sending out its information signal on new inventions, the TsNIIPI publishes various indexes (systematic, alphabet-name, numerical) and special bulletins on changes taking place during the year in the national patent funds.



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Information-search systems, complex automated information processing systems, electronic digital computers, automatic systems for indexing and selective distribution of signal information — all of this today is at the service of our country's patent activities.

Actually, the information signal is a periodically published item in the Russian language containing the basic data on inventions (designation, short resume, and one of the sketches). The information is published in subject issues according to the international classification of inventions.

This information is studied at enterprises where necessary materials are taken out and an order forwarded for copies to the central information organ (or main patent center) which duplicates them (particularly through the Patent enterprise) and dissemination of copies of invention descriptions to the enterprises.

In the performance of expertise, the information signal is used to obtain reference data necessary to conduct various types of retrospective analyses of patent documentation.

The USSR has a reference information service and patent service in order to satisfy the requests of individual enterprises and organizations. Information as to the introduction of inventions, data on the availability of a patent file, requests to have necessary translations made, searches made in the fund, and so forth, may be efficiently received through the appropriate TsNIPI services, the Patent enterprises, through the VPTB, and through the central branch and territorial interbranch information organs. Some subjects (alloys, lasers and masers, analogue-digital converters, and others) are searched by electronic computers using the information-search system. In all, more than 220,000 documents have been fed into the electronic computer memory. In the next few years, the scope of problems carried out by the information-computer center of the TsNIPI will expand considerably and new search systems will be put into use (for example, on radar, electronic computers, and so forth).

The successful use of the SPI in the country requires that the TsNIPI resolve a multiplicity of various problems. In particular, one is the establishment of a complex system of automated processing of patent documentation which will make it possible to expedite issuing information to consumers. The need for a broad introduction of means of mechanization and automation into patent-information activities is the result of the great size of the fund, the continuing increase in the flow of new incoming documents, and the need for an annual expertise to be made of more than 100,000 invention requests.

The bibliographic information preparation and search service, automatic systems of indexing and selective distribution of signal information, the electronic computer translation of foreign patent documentation, and others are part of the complex system of patent documentation automated processing and handling.

The technical and economic investigations performed in the TsNIPI are of great practical significance. Their goal is to determine the principles of using patents and other documentation to form the technical policies of branch industries, including forecasting of equipment development. Considering that prognosis is one of the preparatory stages of scientifically based planning, the TsNIPI has recently been giving much attention to the development of a methodology to use patent information to forecast equipment development.



The favorable sales of Soviet inventions abroad and the successful use of obtained patents requires a thorough analysis of foreign patenting methods which is impossible without a deep study of appropriate information and primarily of patent statistics which will help reveal the laws in the development of foreign patent operations against a background of general administrative competition and the structure of foreign economic ties. For this reason, legal, methodological, and other studies are also performed in the TsNIPI.

The VPTB holds an important place in the overall patent information system; it performs the completion and scientific processing of the state fund of the USSR and foreign countries.

It justifiably takes its place in the same rank with such universally known storehouses as the State Library imeni V. I. Lenin, the State Public Scientific-Technical Library, the State Public Library imeni Saltykov-Shchedrin, and others. The state patent fund of the USSR is concentrated in it -- a collection of descriptions of inventions of different countries collected over many years. Of the 13 million descriptions counted for the world fund, more than eight million are stored on the shelves of the VPTB and, moreover, hundreds of new documents come in every day.

The foundation of the USSR VPTB is the fund of domestic and foreign patent documentation, calculated at the present time at more than 36 million printed units of 54 pages. Moreover, nearly one million requests for inventions submitted in the USSR are stored in the VPTB.

The basic direction in the scientific-methods activity of the VPTB is that of rendering assistance to libraries, organs of scientific-technical information and patent departments in scientific library-bibliographic activity, the solution of vital problems in the theory and practice of bibliography and librarianship, and the dissemination of leading experience of libraries, territorial and branch organs of scientific-technical information, enterprises, and organizations. The VPTB does this by preparing and conducting all-union and occupation-type assemblies and seminars, provides individual and group consultations, and so forth.

The dissemination of informational activity is carried out by one of the largest specialized production-polygraph enterprises, Patent, which was developed in 1966 and is now wellknown not only inside the USSR but also abroad. Because of the services of this enterprise, hundreds of thousands of engineers, scientists, inventors, and efficiency experts, including the military ones, now have the possibility, without turning to the VPTB, to obtain copies of patent materials necessary for work.

The Patent has a wide network of affiliates in the capitals of the union republics and in major industrial centers, has large electrography and microphotocopying shops which are able to produce 500 million microphotocopy frames, 20 million pages of electrophotographic copies, and more than 120 million imprinted sheets of printed matter annually.

The activity of the enterprise is determined by the place which it holds in the all-union system of patent information. It has the mission of filling the branch and territorial funds, duplication, copying, and dissemination of literature, and of providing patent services to enterprises, organizations, and individuals.

The Patent workers, on a cost accounting basis, fill out request materials for suggested inventions, industrial samples and trademarks, and patent clarity of export items. Their task also includes rendering assistance to enterprises in solving organizational and methods problems associated with patent and license activities. A special department is engaged in processing documentation to patent Soviet inventions abroad. Its workers provide comprehensive assistance in the compilation of descriptions of inventions and the preparation of graphic materials according to the laws and regulations of the country in which the given invention is to be patented, in translating the requests of domestic inventors into foreign languages, in reprinting the texts of descriptions, in editing, and other activities.

In order to ready qualified specialists, a Central Institute to improve the qualifications of supervisory personnel and national economy specialists in patent activities and Higher State courses to raise the qualifications of supervisory engineer-technical and scientific workers on matters of patent and inventions have been created and are in operation in the Committee on Matters of Inventions.

In the past three years, several thousand national economy specialists, including many military specialists, have gone through retraining in the qualification improvement system.

Large and responsible tasks face the inventors and efficiency experts in the new Five-Year Plan. V. I. Lenin stated that socialism is unthinkable without equipment built according to the latest word of science. This is why the matter of providing the multi-thousand army of scientific and technical workers with information on the most important achievements in all fields of the national economy is an important contribution into the successful implementation of the decisions of the 24th CPSU Congress.

## ELECTRIC MOTORS OF THE FIVE-YEAR PLAN

(pp 4-5)

The following is stated in the Directives of the 24th CPSU Congress: "To master the production of a new series of electric motors for general industrial application with improved weight, technological, and operating indexes, and with a wide range of power to include small motors and micromotors. To support the development and series production of electric motors, electrical apparatus, and cable items with consideration for the specifics of agricultural production." Our correspondent, Engineer Colonel L. Karnozov, asked the chief design engineer of the Moscow Electrotechnical Plant imeni Vladimir Il'ich, candidate of technical sciences and laureate of the state premium, V. I. Radin, to describe the work of design engineers in resolving these problems and also to describe some of the products manufactured by the plant.

At the present time, industry is producing a large amount of various types of electric motors. Some of them are very expensive to produce, complex in operation, and most important, no longer respond to modern requirements.

Currently, several organizations headed by the All-Union Scientific Research Institute of Electromechanics under the supervision of academician A. G. Iosif'yan are developing a unified series of 4A electrical motors intended for mass production. Along with this, the task has been set to improve the technological indexes of the electric motors and at least cut the labor consumption for their production in half.

It is necessary to mention that the requirements presented to the machines of this series were reviewed by representatives of the CEMA countries. The newest electrical motors will be developed with a consideration for the industrial interests of all countries in the socialist community.

Our plant has been commissioned to develop motors of three sizes with a power of more than 100 kilowatts. We have already designed and built models which are currently undergoing factory testing.

All of the machinery will be produced in two types: closed and protected. For the first time in the world, we will be using a completely new system of ventilation in the closed type electric motors, with the result that in their technical-economic indexes, they now considerably surpass the best models of foreign firms. Whereas earlier only the stator of motors of this power was ventilated, air is now also blown through the rotor. This has reduced the heating of windings by 30-40 percent.

The protected type machines also have a new look. They have a welded construction. This has sharply reduced labor consumption and metal consumption. But the main advantages are that we have been able to develop a totally extraordinary bedplate. Its design fundamentally changes the technology of manufacturing the machines as a whole.

The new machines are extremely convenient in operation. All one has to do is to open the upper housing to inspect the condition of the rotor, the bearings, or to remove dust from the windings. The production of these electric motors will begin in 1973 and the entire 4A series will be assimilated by 1975.

Our A3 series of electric motors have also received a high rating; they are currently under production. They were the first in the country to receive the state quality emblem. State quality emblems were given to 18 types of electrical machines produced by the plant. The collective is proud of the fact that the plant's products are currently exported to 67 countries in the world.

Speaking of the work of design engineers, we cannot avoid mentioning the achievements made by the entire plant, since we design engineers are only a small part of this huge collective.

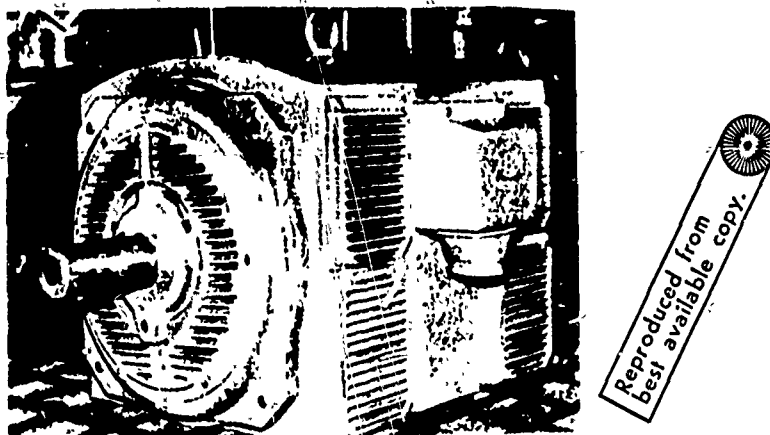
The five-year task to increase labor productivity was fulfilled ahead of time, on 20 November 1969, because of the persistent daily work to raise production quality, to introduce the latest achievements of science and technology into production, to improve technical processes, to mechanize production, and to make use of interproduction potentials.

In preparing a worthy greeting for the 24th CPSU Congress, the plant's workers also completed the five-year task of production volume ahead of schedule. During the Eighth Five-Year Plan, the plant's collective manufactured hundreds of millions of rubles worth of products, including above-plan by several million.

Because of the high indexes in socialist competition in honor of the 50th anniversary of the Soviet Government, the plant was permanently

granted the Memorial Banner of the CPSU Central Committee, the Presidium of the USSR Supreme Soviet, the USSR Council of Ministers, and the All-Union Central Trade Union Council. In marking the 100th anniversary of V. I. Lenin's birth, the plant's collective, as the winners in the All-Union socialist competition, received the Lenin Jubilee Honorary Certificate. The Jubilee medal "For valiant labor in marking the 100th anniversary of V. I. Lenin's birth" was given to 775 shock workers of communist labor and production innovators. On 4 January 1971, the Order of the October Revolution glistened brightly on the plant's banner alongside of the Order of Lenin and the Order of Labor Red Banner.

For 14 months in a row now, the plant has won first place and the challenge Red Banner as winners in the All-Union socialist competition among enterprise collectives of our branch of the national economy.



The 200-kilowatt electric motor of the unified 4A series.

The design engineers of the plant have also made a noteworthy contribution into these successes. It is impossible to mention everything, but it is necessary to pause on some of the works carried out on world standard levels. For example, the AKP electric motor, developed for the powerful presses of the Volga Motor Vehicle Plant, is worthy of attention. Italian firms were initially against installing these machines, but comparative tests performed in Italy showed that our motors surpassed foreign motors in all indexes. As a result, the Italians not only refrained from delivering their electric motors to the Soviet Union, but began to purchase our motors to re-equip the presses in Italy.

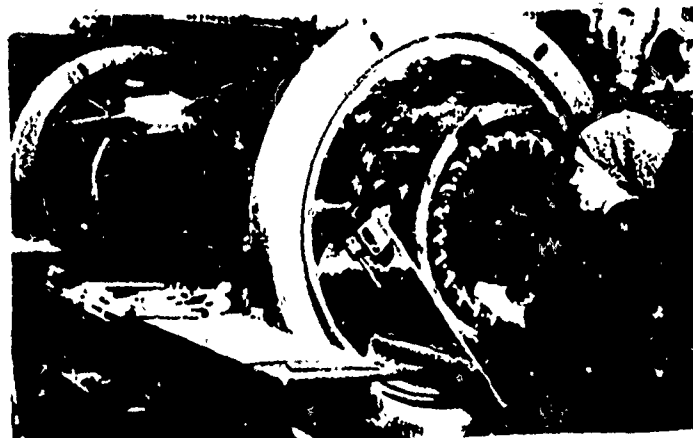
The powerful VASV electric motors are used in the nonreducer drives of cooling tower fans which were built to cool spent water and which are used at chemical plants and thermal electric power plants. If we take into consideration that in the entire world, and including the USSR, the cooling tower fans which make but several tens of revolutions per minute always had only reducer-type drives, then we must admit that this work by

the plant's design engineers is a great step forward in the matter of cooling tower construction.

The essence of the problem lies in the following. A fan, with blades which sometimes reach a diameter of 20 meters, is installed above the cooling tower water reservoir. A high-revolution electric motor is mounted in the upper part of the cooling tower which is several dozen meters in height. A very long shaft, which has to be supported by a large number of bearings, leads down to the reducer.

We were able to develop powerful low-revolution electric motors. Their weight is relatively low because they are cooled by the water which passes through the hollow rods of the rotors. These machines are installed at the bottom of the cooling tower, right at the fan, rather than at the top. There is no longer a need for cumbersome transmission and complex reducers whose service life do not exceed 2,500 hours.

The drive now operates for 25,000 hours and the economic effect is counted in millions of rubles. The power of the largest electric motor is 800 kilowatts and it makes only 75 revolutions per minute. These machines are now being widely used in the USSR as well as abroad.



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Turn-over device to place the stator into the housing of an electric motor.

As we know, the 24th CPSU Congress devoted great attention to the development of agricultural production.

In association with this, we were given the task to ensure the development and series production of electric motors and necessary electrical machinery, taking the specifics of agricultural production into account. In solving it, this year we will manufacture a series of ABP gasoline-electric units for the distant pastures. They will help to pull water out of wells. Even now, the plant is manufacturing small electric power plants of 2.4 and 8 kilowatts which are widely used for the electrical shearing of sheep.

Thus, our plant's collective is carrying out the tasks set by the 24th CPSU Congress.

## EXPENDITURES ARE AMORTIZED

(pp 6-7)

Engineer Colonel (Reserves) A. Lopatin,  
chief of the office of scientific organization  
of labor and production control

Information on competition to introduce the most rational equipping of work places announced by the editorial office of the magazine "Technology and Armament," the Department of Inventions of the USSR Ministry of Defense, the Central Council of the All-Union Society of Inventors and Efficiency Experts [VOIR], and the director's office of the Exhibition of Achievements of the National Economy of the USSR [VDNKh] reached our enterprise just after we had begun reequipping work places according to requirements of the scientific organization of labor [NOT]. Business-like discussions were underway at the shop NOT councils, at the [kul'man] of the technical department's design office, and directly at the work places as to what the equipment should be like, studies were made of the results of test model use, and suggestions reviewed pertaining to their improvement. Naturally, the greatest activity in these discussions was on the part of the efficiency experts -- the active members of the NOT councils and creative work teams.

An element of competitiveness was introduced into this work of introducing rational equipping of work places and the activity of production efficiency experts and innovators became even more enlivened.

Now, when a significant part of these concepts have been implemented and proven in practice, certain totals may be drawn up as to the participation in this competition and to share the experience of equipping work places of leading professions with progressive gear. For example, in developing the work place for a lathe operator, particularly for a general-purpose lathe operator, use was made of the experience gained by VOIR members during temporary duty assignments at the USSR VDNKh, at industrial enterprises, and in specialized scientific-research organizations.

Moreover, for several years now our enterprise has been a constant subscriber to prospectuses, catalogs, cards, information bulletins,



thematic plans, and other informational publications of the State Scientific Research Institute of Scientific and Technical Information, the LTsBTI [Leningrad Central Office of Technical Information — ?], the USSR VDNKh, and a number of departmental information institutes. This has made it possible to stay on top of all new items, promptly receive not only necessary information but also working drawings of progressive equipment and adaptations of interest to us.

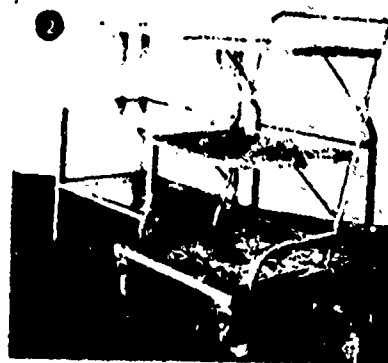
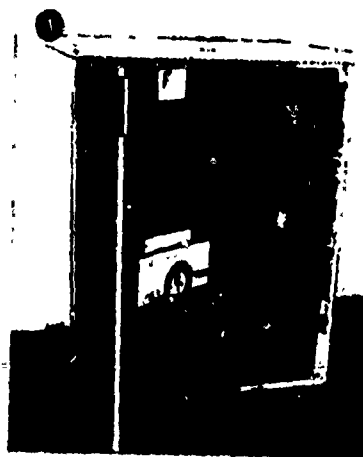
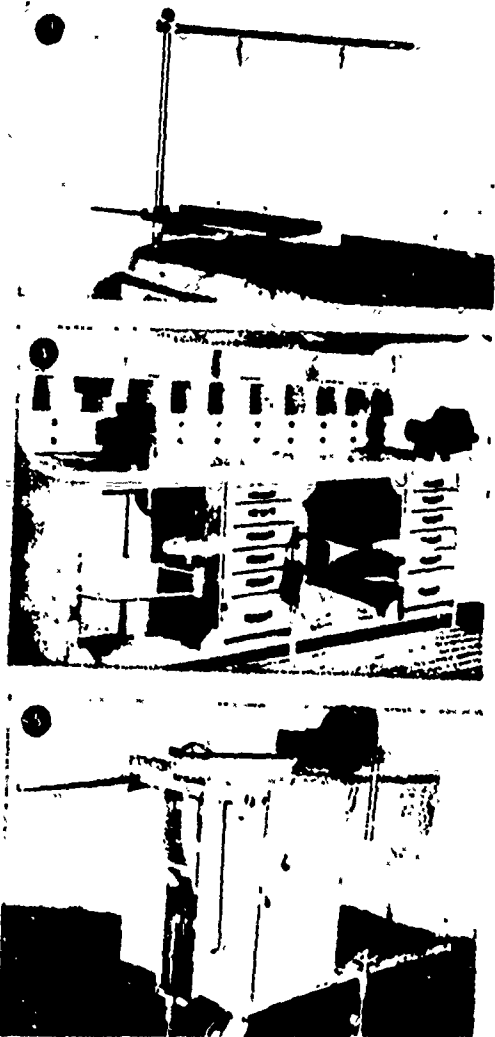
At the time we began designing the work places of machine tool operators, we already had in our possession working diagrams of the lathe operator and milling machine operator tool chests exhibited at the USSR VDNKh, as well as information, including technical documentation, from a number of industrial enterprises concerning individual types of machine tool operator work place gear which had already proven itself in practice.

However, the specifics of our enterprise is that it has a large and frequently changing list, numbering in the hundreds, of manufactured complex equipment. This demands that there be a large number of various tools and engineering gear at each work place which prevented us from accepting and introducing one of the existing "one for one."

Therefore, it was decided to develop that type of equipage for the work place of the lathe operators which would use practice-approved designs and which would respond to our conditions. Much work had to be done. It was first necessary to determine what gear and tools, and in what amounts, had to be available at the work place during a shift; we made up a list, and used models and test samples to determine the most feasible place of tool chest location. After final corrections had been made, projects were developed and samples made. In the final stage, we published an album on the organization of lathe operation and milling machine operator work places in which we placed the list and drawings of gear and tools kept at the work place and in the toolroom of the shop. The albums also contained reference materials: the plan of the work place, reference data on technical equipment, operating and instruction charts for different cutting stages, and tolerance and shrinkage charts. An active part in the development of the albums was taken by efficiency experts employed by the Soviet army M. Zobkov, Ye. Rogov, A. Gubanov, and V. Panyushkin, Soviet army employees I. Boykov, M. Zuyev, and many others.

We will describe some of the elements of equipping the work sites introduced at our enterprise.

The general-purpose lathe operator tool chest for two-shift operation (figure 1) is made from sheet steel. Its top is covered with plastic. Inside, it is divided into two sections by a vertical separator; each section has its own door and is intended for one worker.



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Each section of the tool chest has ten drawers and a pallet. The height of eight drawers is 45 mm, which excludes placement of tools in other than one row. The height of the upper and lower drawers is 100 mm. The upper drawer is used to store metering tools in appropriate cases and the lower drawer and pallet are for larger gear and auxiliary materials.

The replaceable separators in the drawers form compartments of various size. Each drawer and the pallet can hold 20 kg. They move out on rollers and have a stop device. The doors open 180 degrees and each has a separate bar lock. Each door also has places on its inner side in which to store auxiliary gear. There are also two pockets to hold various reference materials.

The receiving table, differing from that recommended by the competition, is fixed in place according to the shop's plan. Instead of wheels, it has adjustable screws so that it can be set at a convenient work height.

Billets and readied parts are transported by a special rack-cart with three racks; the height of each corresponds to the shelf height of the receiving table (figure 2). The upper shelves are hinged to facilitate placement of large-size items on the cart. At the milling machine operator work places, the lower shelf can be pulled out.

The stand to which layouts can be fastened at the lathe operator work place is also made differently (figure 3). It is brought out from the tool chest to the front headstock of the lathe. It is made in this way because, as experience shows, it is inconvenient for the worker to turn toward the tool chest each time he has to use the layout. The lower shelf of the stand to which the layout is fastened is used to store metering and auxiliary tools necessary for work. The author of this design is Engineer Major V. Loyko.

In addition to the equipment which is directly at each machine tool operator work place, group equipment has been made and introduced at the enterprise for each specialized sector. For example, the very simple beds welded from angle iron for large-size items (faceplates, chucks, stays) are very convenient. They substantially help to reduce preparatory and finishing time, improve work conditions, and raise labor productivity and standards. They were developed by Soviet army worker Yu. Gaydukov and Soviet army employee M. Zuyev.

At the suggestion of Soviet army employee V. Shekhovtsev, a test model of a special design roller conveyer was installed at the milling machine operator work place; it runs under machine tool jaws weighing up to 65 kilograms. The introduction of this suggestion significantly eased the effort of the worker and raised labor productivity by reducing preparatory-finishing time by 24 minutes per shift on the average.

All in all, the expenditures to remodel the machine tool operator work places and the introduction of progressive gear provides an economic effect of four rubles for each ruble spent.

Much work was also done in equipping metalworker work places. In particular, a work bench for two places (figure 4) was introduced at the enterprise for metalworker assemblers and a movable workbench (figure 5) for the metalworker-repairman; these were made according to competition recommendations.

For those metalworkers who are engaged in final assembly and use only wrenches of varying sizes, Engineer Major N. Puzyrev developed a convenient and compact workbench with movable (hinged) shelves for a complete assortment of wrenches. Special work places with boxes for tools were also made for the metalworker-electrical assemblers.

It would be desirable if this competition was but the beginning of creative efficiency expert thought directed toward introducing NOT elements not only to the work places of production workers, but also to improve auxiliary operations without which complex implementation of NOT at an enterprise is senseless. A broad field of activity opens up before the efficiency experts. For example, at our enterprise we have introduced clamp-carts to transport heavy billets, which was suggested by Soviet army worker V. Osyukhin; a device to measure the bending of crane booms as developed by Soviet army worker Yu. Gaydukov and Soviet army employee A. Mitrofanenko; "open book" racks for the tool shops, with the design borrowed from the Tashsel'mash plant; and so forth.

Problems still remain to be solved in the rationalization and mechanization of warehouse operations and finishing shops, warehouse and intershop containers, mechanization of the clean-up of premises and briquetting of metal shavings, washing of floors and windows in production shops, and many others.

## WORK PLACES

(pp 7-8)

Engineer Lieutenant Colonel M. Gamanilin

Taking part in the competition, our enterprise's collective, along with the introduction of more efficient equipping of work places for metalsmiths, radio repairmen, welders, lathe operators, and electrical assemblers is doing much work to create specialized work places, the introduction of which has made possible a savings of more than 10,000 rubles a year.

Following are descriptions of some of them.

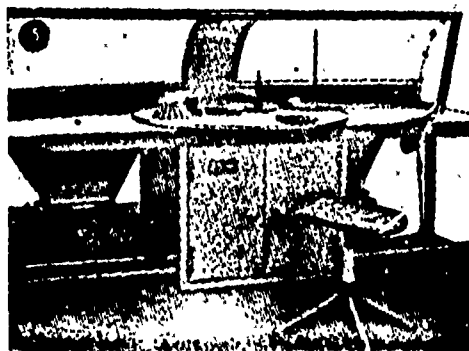
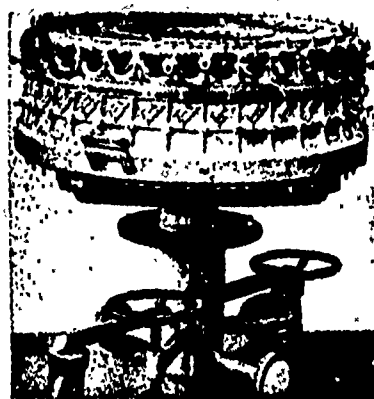
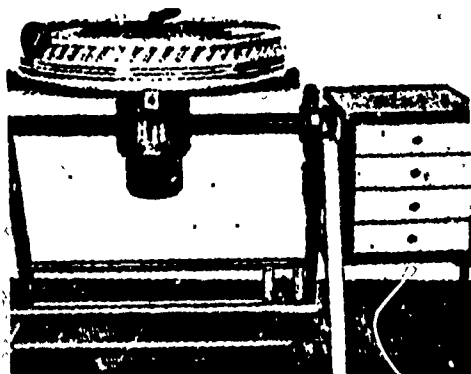
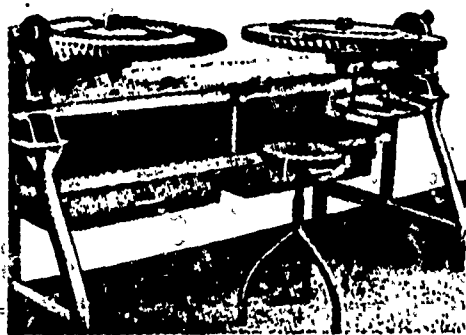
The workbench for the compressor rotor wheel repair metalsmith (figure 1) is welded together from steel pipes, channel iron, and angle iron. Two rotating-fixing devices are mounted on the table top lined with plastic. These devices select and fix the compressor wheel in a position most convenient for the repairman.

Repair and metering tools are kept in two drawers. For handling convenience, they are placed on rotating shelves fastened to the table top. Repair operations (depending on the nature of the work) can be carried out either standing or sitting. The workbench is designed for simultaneous use by two persons. Its dimensions are 2150 x 1250 x 970 mm.

The workbench of the compressor stator directional apparatus repair work (figure 2) consists of a frame welded together from steel pipes and angle iron. A rotating-fixing device with two degrees of freedom is mounted on it; it helps set the apparatus in the most convenient working position.

A small chest with four drawers for tools is fastened to the right side of the frame. Its upper part is faced with plastic. The workbench dimensions are 1600 x 1150 x 935 mm.

The workbench for the oil unit and drive repair metalsmith (figure 3) is designed for the simultaneous use by two individuals. It is welded together from steel angles and sheets. Its upper panel is



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made in the form of a palette (to collect oil) and covered over with a perforated sheet of rustproof steel. Two rotating-fixing devices are fastened to the frame; they ensure placement of the unit to be disassembled in the most convenient working position. The frame also has a set of adapters and tools necessary to disassemble elements of the units and drives. If the unit is disassembled in a position set out beyond the limits of the panel, then there are pivoting trays, kept under the frame, to collect the oil.

Tools are kept in two metal drawers installed in the central part of the frame. Large-size tools and devices are kept on two open panels of the lower tier. The dimensions of the workbench are 2250 x 1100 x 1200 mm.

The workbench of the oil unit metalsmith-assembler is similarly equipped. The only difference is that along the rear edge there are small cassettes made from organic glass with lids for the storage of assembled units.

The workbench for the compressor stator housing repair metalsmith (figure 4) is made from steel pipes and sheets. It is made in the form of a large socket set on a crosspiece to the ends of which are fastened wheels weight line. The upper part of this socket has a rotating support for the unit to be repaired and can be fixed to the necessary position by a foot pedal. The workbench is kept from moving across the floor by two set screws. Its dimensions are 1200 x 1020 x 680 mm.

The workbench of the paint method defectoscope operator (figure 5) consists of a welded frame and panel faced with plastic. A round table is mounted in the center of the panel and it also is faced with plastic. The exhaust ventilation receiver, made from organic glass on a tubular frame, is located to the rear; it ensures normal illumination of the workbench. A two-door chest with shelves on which to store production equipment and expendable materials is built into the center of the table. Two defectoscope operators can work at the workbench simultaneously. Its dimensions are 2200 x 1190 x 1000 mm.

## WITH A CONSIDERATION OF TECHNOLOGICAL FEATURES

(pp 8-9)

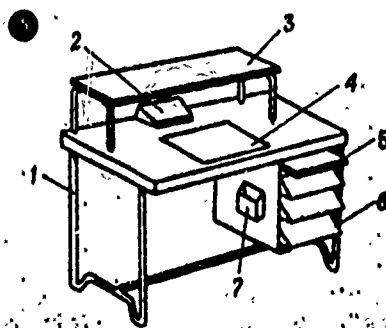
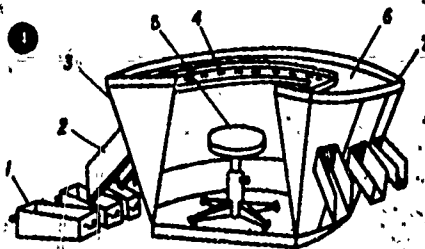
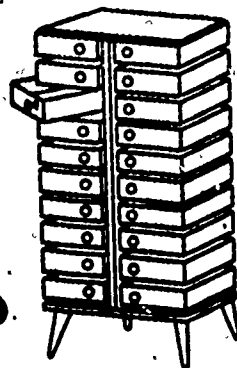
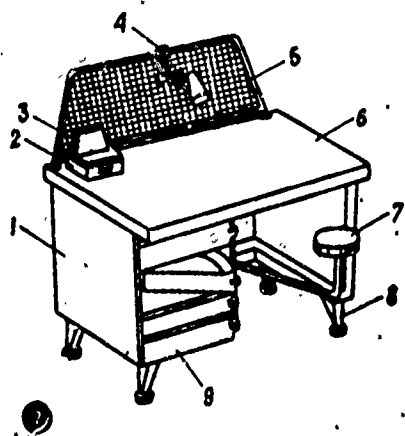
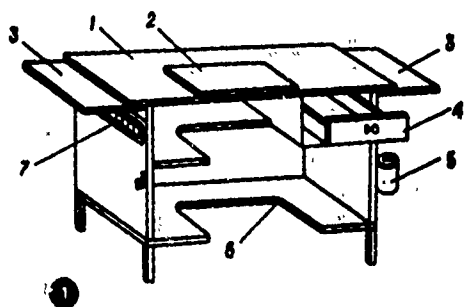
Lieutenant Colonel N. Tamanov

The repairmen of the Order of Lenin Leningrad Military District, taking part in the competition announced by the editors of the "Tekhnika i Vooruzheniye" magazine, the Department of Inventions of the USSR Ministry of Defense, the VOIR Central Council, and the management of the USSR VDNKh have introduced many convenient work places developed through the active participation of efficiency experts and with considerations of the features of repair technology. These workbenches are made according to requirements of scientific organization of labor and their design features, in our estimation, may be of interest to other repair plants and enterprises.

The workbench of the electrical unit repair metalsmith (figure 1) is a wooden table with legs made from metal shapes. The cover, 1, is faced with plastic. The item to be repaired is placed on a rubber mat, 2. Drawers, 4, for tools, fastenings, and small parts are located on the right-hand side of the table. The electric power supply and fuse panel, 7, is mounted on the side wall. A small can for technical waste is mounted on either the right or the left side. The table's shelves, 6, are cut out for leg space. Auxiliary equipment is placed on the side insert shelves, 3: devices to burn off insulation from leads, a place for industrial liquids, and others. This kind of workbench provides maximum convenience for work and the metalsmith does not have to make any unnecessary motions.

The metalsmith workbench is also simple and convenient for work (figure 2). Its frame is welded from steel angles. The side walls, 1, are made from sheet steel. The table top, 6, is faced with duraluminum. The screen, 5, is made from metal screening. A lamp, 4, is fastened to the screen's frame. There is a box, 2, on the left side of the table for auxiliary devices and it has a pocket, 3, in which technical documents are stored. The workbench is mounted on legs, 8, with metal tips. There is a console-type seat, 7, which can be moved and which also rotates. The tool boxes, 9, are completely pivotable.





A cabinet to store small parts and fastenings is shown in figure 3. Its frame is welded from pipes and steel angles. The drawers are made so they can rotate 180 degrees on a horizontal axis. Such a cabinet takes up but little space and is convenient to use.

A special work place has been equipped at one of the repair enterprises for checking and sorting standard parts and fastenings (figure 4). It consists of a horseshoe-shaped table, 3. The sideboards, 7, which are 30 mm high, form a tub, 6, in which the parts are placed. There are openings, 4, cut into the inner part of the table which lead into troughs, 2. A metal basket, 1, 500 x 250 x 180 mm in size, are placed under each trough.

2. 1. 3. 4. 5. 6. 7.

Work can be done while standing or seated on stool, 5. After parts and fastenings have been washed, they are delivered to the table and placed into the tub. After checking them, the sorter drops the items into the appropriate openings, the number of which are set according to the nature of production.

There has been a significant increase in productive labor and repair quality through the introduction of a workbench for the radio assembler repairing units (figure 5). It is a table consisting of a tubular frame, 1, with a shelf, 3, power distribution panel, 2, three drawers, 6, a movable shelf, 5, and a box, 7, for small waste. The table top is covered with laminated plastic. The item to be repaired is placed on a rubber mat, 4.

A set of tools is kept in the upper box, the center one has a bin for small parts and fastenings, and the lower one is used for various gear (testor, cords, unit covers, and so forth).

The workbench is provided with equipment necessary to repair mechanical elements of units, namely: a small-size portable drill stand for drilling openings from 0.3 to 5 mm, a device with a flexible shaft to drill small diameter holes in hard-to-reach places, a vise with movable textilite jaws to hold small parts for metalworking, a device for removing and installing pins into hinged parts, and a device with a set of clamps to work pinheads and to finish off the pins. All of this is kept on a shelf, 3. The set can be changed and added to depending on the type and designation of the unit to be repaired.

1. 2. 3. 4. 5. 6. 7.

## PRELIMINARY TOTALS

(p 9)

Engineer Lieutenant Colonel (Reserves) V. Prosekov

Preliminary competition totals on the introduction of rational equipping of work places have been drawn up at a number of enterprises engaged in the repair of motor tractor equipment.

Thus, at one of the enterprises, 24 work places have been equipped according to the requirements of scientific organization of labor for specialists of various professions. Labor productivity increased by 5-8 percent at those work areas where they have been introduced. At the present time, the creative work brigades are developing equipment and accessories for 34 more specialized work places, including those for the disassembly of transmissions and repair of the piston and connecting rod groups.

According to competition requirements, all workbenches of the electrical assemblers have been equipped at another enterprise, 80 percent of the lathe operator work places have been equipped, and the introduction of recommended equipment for the work places of metalsmiths and welders is under completion.

Efficiency experts are actively participating in the competition. For example, they have introduced a design to equip the welding area in the engine repair department, the work places along the gear box and universal joint assembly line, and a rebuilding of the spring assembly line.

The command element of one of the repair chasti included the work to introduce rational equipping of work places into the organizational-technical measures plan to provide for improved production efficiency for 1971. As of now, 68 percent of the equipment made according to competition recommendations has been introduced. It was also decided to develop individual projects applicable to the conditions of the chast' and to introduce equipment which would improve the working conditions for auxiliary workers.

## THE HEIRS OF COMBAT GLORY

(pp 10-11)

Lieutenant Colonel (Reserves) F. Levshin

In my files there is a photograph which shows the attack of T-34's of the Guards Kantemirov soyedineniye during battle at the Kursk arc. As photographer for the Krasnaya Zvezda, I also met with the men from this soyedineniye during the Stalingrad battles and in the final days of the war when they moved from the Dresden area to help the inhabitants of Prague who had taken up arms against the fascist invaders.

More than a quarter of a century has gone by since then. How the new generation of tank men are carrying out their duty to the homeland! Are they following the heroic traditions of the frontline personnel? A direct answer: with honor. I became convinced of this after recently visiting a famed division, particularly the company which is commanded by Guards Lieutenant M. Klishin. Inspired by the historic decisions of the 24th CPSU Congress, the men are persistently, with full stress of moral and physical strength, mastering the art of winning.

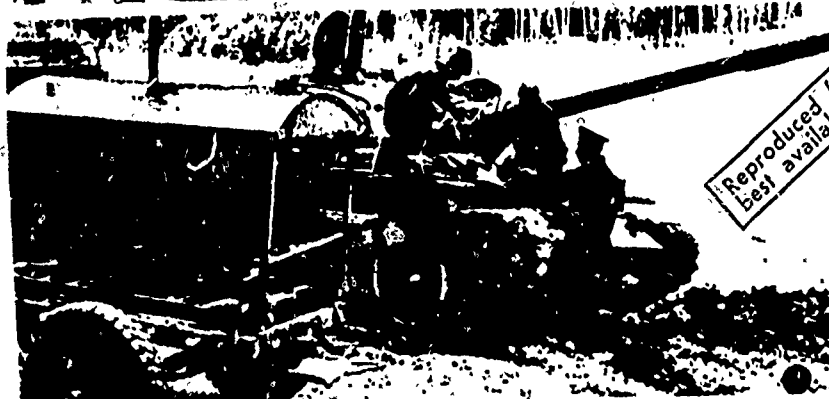
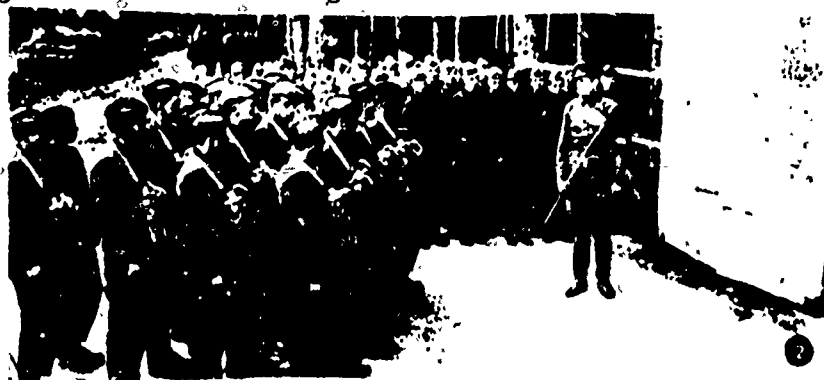
The combat vehicles speed ahead at top speed (1). The senior officer, in checking driving, commented "outstanding" with satisfaction. This word for the young tank men has a sound of respect for their successes.

Modern tanks are able to cross deep and wide rivers. Firm skills, acquired during training at the water proving grounds, are essential for this. In the photo (2), the crews receive instructions prior to the beginning of the exercise. The mobile shop (3) was set up nearby. The repairmen help the crews to ready the tanks for water driving. It has now become a tradition in the division to bring out the repair facilities for every field exercise in which the hardware is used. This is just one more example indicating how stubbornly the men of this soyedineniye are struggling for high field skills.

On the signal of the maneuver director, the first tank confidently moves into the water. Behind it come the second, the third... (4). A few minutes have gone by and the company, in full complement, has moved to the other shore.

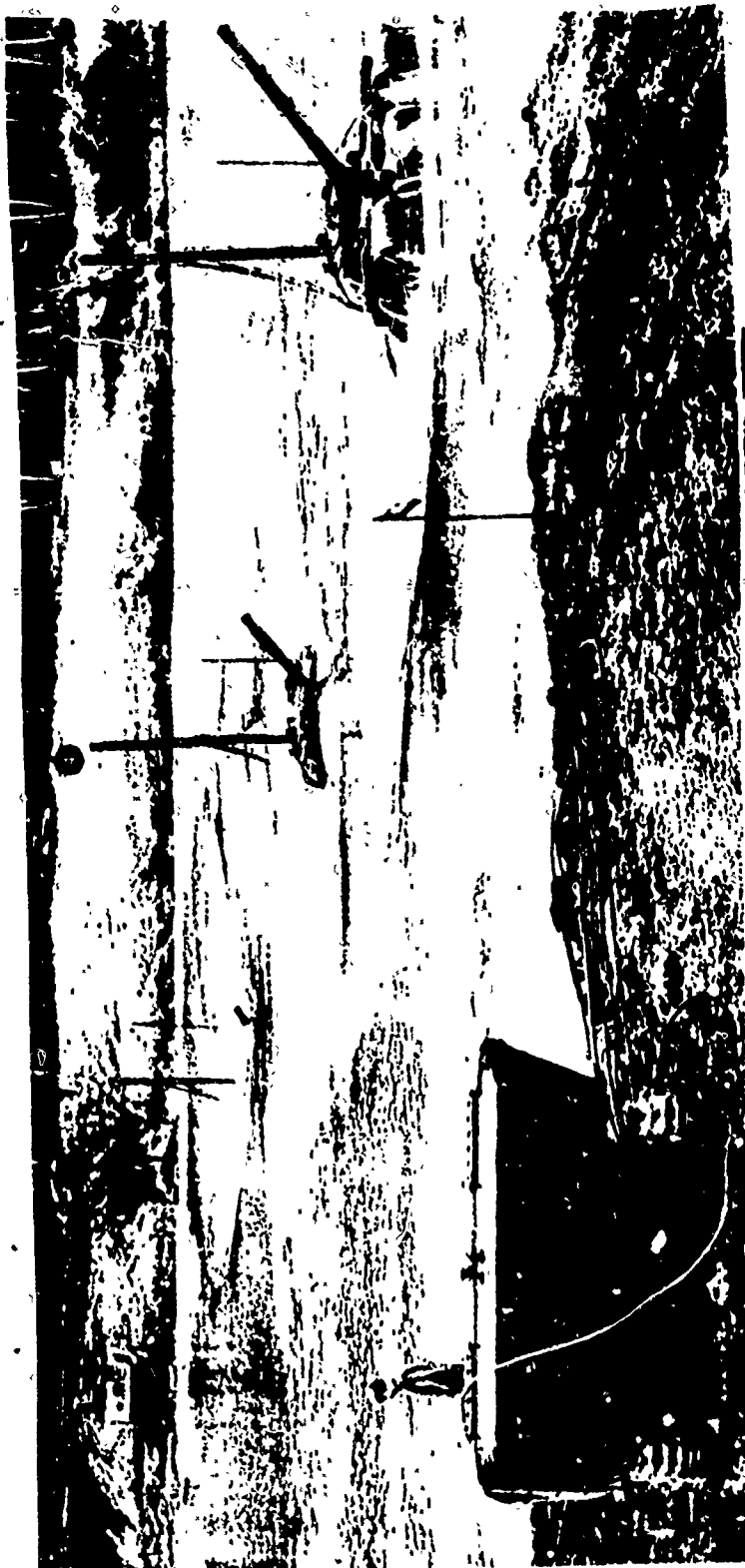
The great effort by the officers-instructors, party and Komsomol organizations, and of each soldier is finally crowned with success. The deputy company commander for technical matters, Guards Engineer Lieutenant A. Golik (5), puts quite a bit into the collective effort. This erudite specialist, he has served for just a little more than one year, is industrious, demanding to himself and his subordinates, and has earned deserved prestige. Just as required, he teaches the tank men to carry out complex exercises (6) and ably organizes the technical maintenance of armored equipment (7).

The field exercises are over. Company personnel return to the post. Now they have to prepare for political studies. They are studying the materials of the 24th CPSU Congress (8). The Kantemirov personnel are full of desire to implement the plans of the Lenin party to further strengthen the defensive might of the beloved homeland.

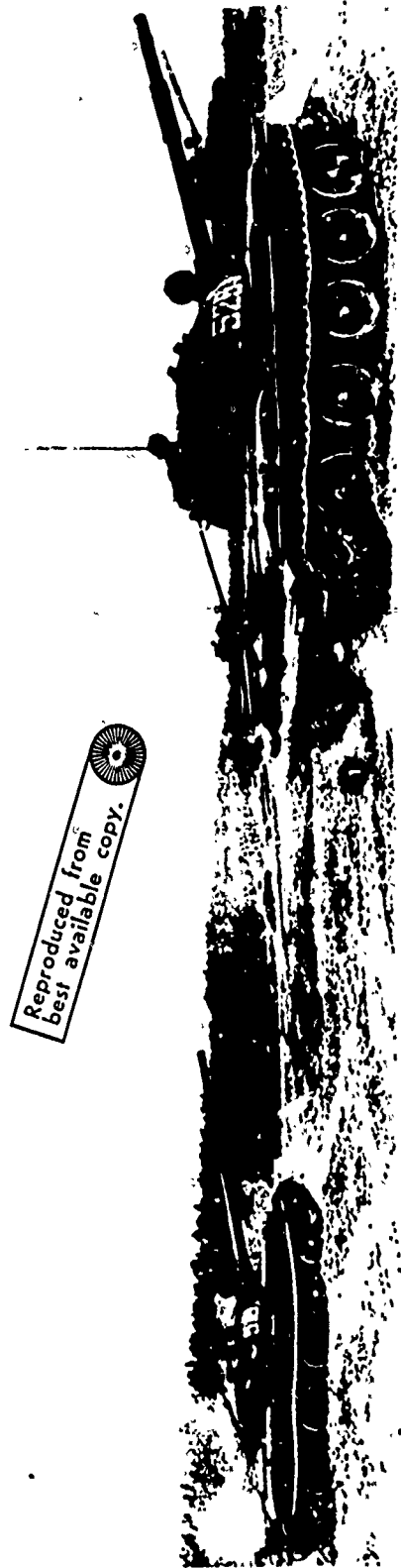


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## RADIOISOTOPIC GENERATORS

(pp 12-14)

D. Krivozub, professor, doctor of technical sciences

The discovery of radioactive substances has led to the wide use of natural and artificial isotopes in various branches of science and technology. In particular, they are used in electric energy generators in such branches as power engineering.

It is known that the disintegration of atomic nuclei is accompanied by the separation of kinetic energy possessing alpha-particles (positively charged nuclei of helium) or beta-particles (electrons) and by quanta of electromagnetic energy (gamma-rays). The simultaneous emission is possible of these particles with an overabundance of one of them. As they are absorbed in substances, there is a continuous emission of heat energy. However, not all of this can be utilized for direct conversion into electric energy. Only half of the gamma-ray energy is used, since hard gamma-quanta depart beyond the confines of even a massive generator. When beta-disintegration occurs, only one-third of the energy is carried off by these particles; the rest of these are neutrinos. The energy of alpha-disintegration is large (approximately 5-6 Mev for one disintegration) and these radioisotopes are usually the best fuel for radioisotopic electrogenerators (RIEG or RIG). Biological protection is quite simple since the run of the alpha-particles terminates inside the radioisotopic substance itself. Unfortunately, many of the alpha-radioisotopes have a small half-life  $T$  (the time during which one-half of the initial product disintegrates).

Radioisotopic materials for the RIG must possess high specific power, low cost, a sufficiently large half-life, must not react with the material of the ampule in which they are confined, with water or air, must not dissolve in it, must have heat, chemical, and radiation stability and high heat conductivity, must contain an insignificant amount of admixtures with hard radiation, and must have a very high mechanical sturdiness.

More than 1,000 radioactive isotopes are known. But only about 50 of them are characterized as practically applicable half-life (from 100



days to 10 years and more). Table 1 gives the characteristics for the more usable isotopes. It can be seen from this table that the first four radioisotopes — "short-lived" — have a rather high specific heat power  $R_t$ . The remaining three belong to the "long-life" and they have a much smaller  $R_t$ , but they are very effective for RIG intended for long-term operation without recharging.

Table 1

Parameters	Co-60	Ce-144	Po-210	Cm-242	Sr-90	Cs-137	Pu-238
Half-life $T$ , in years	5.27	0.78	0.378	0.45	27.1	29.7	36.4
Type of disintegration							
Specific heat power $P_t$ , watts/gram	17.5	26.7	141	120	0.94	0.41	0.58
Specific weight activity $P_a$ , curie/gram	1,130	3,180	4,500	3,310	142	87	17
Specific energetic activity $P_e$ , curie/watt	65	120	31.4	27.6	150	215	30.3
Type of bond	metal	CeO <sub>2</sub>	metal	Cm <sub>2</sub> O <sub>3</sub>	Sr TiO <sub>3</sub>	glass	PuO <sub>2</sub>

Note: One curie corresponds to  $3.7 \cdot 10^{10}$  disintegration in one second.  
This amount of disintegration gives one gram of radium.

Electric energy may be obtained in various ways with the use of radioisotopes — by direct charge (atomic batteries), thermoelectric, thermoion, and dynamic. In obtaining electric energy by the first method (figure 1a), the atomic battery uses a rod covered with a beta-emitter isolated in the center of a metal beaker. The departing electrons negatively charge the walls of the beaker, the rod receives a positive potential. In the developing process, the beta-particles have to move against the forces of the electrical field. Such elements have a high voltage, a current of several microamperes, and a power on the order of a milliwatt.

The thermoelectric electric method (figure 1b) to obtain electric energy with the use of isotopes is that the isotope is placed within a

metal ampule; hot welds of semiconductor convertors of heat into electric energy are pressed against the outside walls of the ampule. The cold welds make contact with the cooler or biological protection. Such RIG are quite efficient when it is necessary to obtain power from several watts to 0.5 kilowatts.

The thermoionic (thermoemission) method (figure 1c): one of the cylindrical tubes, tube 8 for example, is heated by an isotope placed in it to a temperature of 1700-2000° K while the temperature of the other is maintained 3-4 times lower. The inner tube (cathode) then emits electrons and acquires a higher potential than the outer one (anode). The vacuum gap between the tubes is 0.2-0.3 mm. Cesium vapors are fed into the space to neutralize the inevitable volumetric negative charge at the cathode. Generators of this type may develop a power of more than 0.5 kilowatts. However, they are inconvenient in that the narrow gap between the electrodes becomes impure rather rapidly.

In the dynamic (turbogenerator) cycle (figure 1d), the isotope placed in the heat unit 5 is heated by a heat conductor (nitrogen, helium, liquid sodium). It enters into a turbine which has an electrogenerator on its shaft. The heat conductor is subsequently cooled in a condenser and then fed to the heat exchanger by a compressor or pump. This principle may be used to build an RIG with a power of several kilowatts. However, they are more complex and less dependable since they contain rotating machine elements.

Primary attention is currently given to thermoelectric RIG which have an energy capacity of approximately two orders higher than the electrochemical sources. These are devices with internal heat sources, the number of which reduce as a result of disintegration of radioisotope nuclei. The temperature distribution within the device depends on the nature of heat transmission (heat conductivity or emission) and the method of heat exchange with the ambient medium (convection or contact bond). These RIG use thermoelements in the shape of rods, for example, 20 mm high and a cross-section of 5 x 5 mm possessing a holed (p) electron (n) conductivity. When one end is heated and the other end is cooled, there is a temperature drop  $\Delta T$  with the result that an electromotive force is stimulated  $E = x \cdot \Delta T$ , where  $x$  is the Zeebek coefficient. Low temperature thermoelements are differentiated (temperature of the hot weld  $T_r$  up to 300° C), intermediate temperature ( $T_r = 300 \div 700^\circ \text{C}$ ), and high temperature ( $T_r > 700^\circ \text{C}$ ). The first one is used most frequently and it is made on the basis of tri-alloys by means of cold pressing:  $\text{Bi}_2 \text{Te}_3 + \text{Sb}_2 \text{Te}_3$  for p-elements and  $\text{Bi}_2 \text{Te}_3 + \text{Bi}_2 \text{Se}_3$  for n-elements. They possess a resource of more than 50,000 hours. In addition to this, the thermoelement is characterized by good specific electrical conductivity  $\sigma$ , a specific heat conductivity  $\chi$ , a quality factor of 
$$Z = \frac{\alpha^2 \cdot \sigma}{\chi}.$$

These parameters change significantly when there is a change in  $T_r$  (figure 2) and, moreover, not identically for elements with different types of conductivity. The efficiency of such converters depends

substantially on the temperature drop and quality factor; in modern semiconductor thermoelements, it can reach 12-15 percent.

The type p and n rods are connected in sequence in order to obtain the necessary electromotive force and the subsequent windings are in parallel to develop the necessary current. So-called modules are formed which possess, unfortunately, a rather high internal electrical resistance. Another shortcoming of these converters lies in the sharp voltage drop as the load current (soft volt ampere characteristic) is increased which requires voltage stabilization or RIG operation in a rather limited regime.

The cylindrical isotopic block is located in the center of the radioisotopic thermoelectric generator (figure 3) and is fastened in the metal housing of the heat unit with a lid. The required directivity of the heat flow takes place with the use of insulating screens. The thermoelectric battery can be located on the lower or upper end or on the side surface of the heat unit (in this case, it represents a multifaceted prism). In order to compensate for temperature stresses and mechanical tolerances, the "hot" side of the thermal battery is placed against the surface of the heat unit by means of a flexible heat crossover, which also simultaneously serves as the electrical insulator. The battery must be insulated from the housing by biological protection. All of this creates additional heat resistance. In order to improve heat take-off and a reduction in  $T_x$  (temperature of the housing contacting the medium), the housing with its biological protection is provided with ribs. There are no ribs on generators of this type which are intended for use in water.

It is essential to note at this point that the most important part of the generator is the heat unit. It must be able to withstand the heaviest emergency situations, must have a very high mechanical sturdiness (vibration strength and vibration stability), as well as stability to high operating temperatures and powerful radiation fields.

The arrangement of one of the RIG, the "Angara" type, is shown in figure 4. The basic data characterizing some of the domestic RIG are given in Table 2.

Radioisotopic electrogenerators find their application in automatic weather and other tracking stations, in special non-serviced installations, in space vehicles, and so forth.

The RIG have a number of advantages over other autonomous sources of electric energy: high reliability, long operating life, and low operating costs.

If rules of radiation safety are observed, the operation of RIG is completely harmless to the operating personnel.

The relatively high specific weight of the RIG is compensated by their output of a large specific energy which is considerably higher than that of storage batteries.

Table 2

Characteristics	Beta-1	Beta-2	Beta-3	Beta-S	"Efir"	"Angara"
Isotopes	Ce-144	Sr-90	Sr-90	Sr-90	Sr-90	Sr-90
Activity A, curie	17,500	22,000	40,000	31,000	100,000	40,000
Heat power Pt, watts	135	148	260	200	690	260
Electrical power Pe, watts	5	7	12	10	30	12
Electromotive force E, volts	6.5	7.9	21.2	10.5	32/12	24.4
Voltage U, volts	3.5	4	12	6	21.4	12/6
Electrical capacity Q, kwt-h	--	--	880	880	1,000	1,050
Service life t, years	1	10	10	10	10	10
Weight G, kg	400/2100	130/500	250	150/500	250/ 10,000	120/600
Efficiency %	3.7	4.72	4.6	5	4.35	4.62

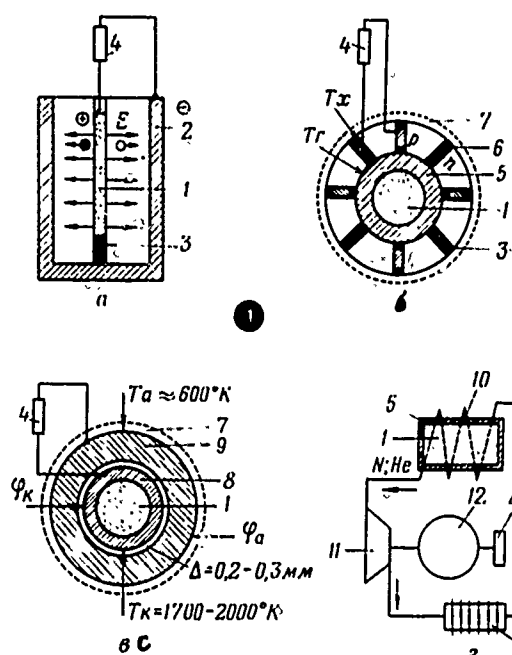


Рис. 1. Способы преобразования энергии радиоизотопов в электрическую энергию (а — непосредственный заряд, показан элемент атомной батареи; б — термоэлектрический; в — термоионный; г — динамический): 1 — радиоактивный изотоп; 2 — металлический ступан; 3 — электрическая изоляция; 4 —

электрическая нагрузка; 5 — тепловой блок; 6 — полупроводниковый преобразователь; 7 — охладитель или биологическая защита; 8 — внутренняя трубка (катод); 9 — наружная трубка (анод); 10 — змеевик (теплообменник); 11 — турбины; 12 — электрический генератор; 13 — конденсатор; 14 — компрессор (или насос).

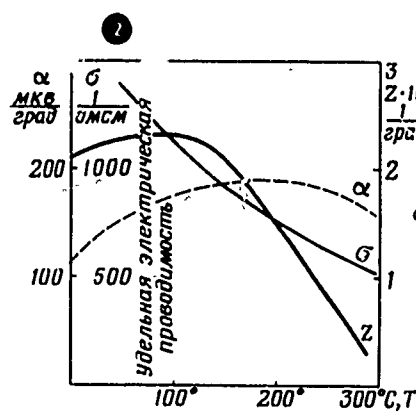


Рис. 2. Зависимость изменения коэффициента Зеебека  $\alpha$ , удельной электрической проводимости  $\sigma$  и добротности  $Z$  от температуры для Р — полупроводника.

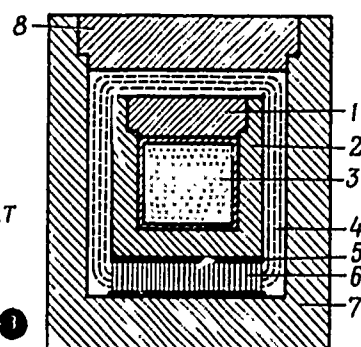


Рис. 3. Схема термоэлектрического генератора: 1 — крышка теплового блока; 2 — тепловой блок; 3 — изотопный блок; 4 — тепловая изоляция; 5 — тепловой гибкий переход с электрической изоляцией; 6 — термоэлектрическая батарея; 7 — корпус с биологической защитой; 8 — крышка генератора.

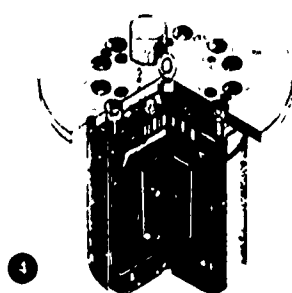


Рис. 4. Клинографический разрез радиоизотопного электрического генератора «Ангара».

Figure 1. Methods to convert the energy of radioisotopes into electrical energy (a — direct charge, the element of an atomic battery is shown; b — thermoelectric; c — thermoionic; d — dynamic): 1 — radioactive isotope; 2 — metal beaker; 3 — electrical insulation; 4 — electrical load; 5 — heat unit; 6 — semiconductor converter; 7 — cooler or biological protection; 8 — inner tube (cathode); 9 — outside tube (anode); 10 — coil (heat exchanger); 11 — turbine; 12 — electrical generator; 13 — condenser; 14 — compressor (or pump).

Figure 2. The relationship of change in the Zeebeck coefficient  $\alpha$ , the specific electrical conductivity  $\sigma$ , and quality factor  $Z$  to temperature for P of the semiconductor.

Figure 3. Diagram of a thermoelectric generator: 1 — lid of the heat unit; 2 — heat unit; 3 — isotopic unit; 4 — heat insulation; 5 — flexible heat cross-over with electrical insulation; 6 — thermoelectric battery; 7 — housing with biological protection; 8 — generator lid.

Figure 4. Clinographic cross-section of the "Angara" radioisotopic electrogenerator.

## POWER STEERING UNITS

(pp 14-15)

Engineer Lieutenant Colonel I. Chaykovskiy

As the weight of vehicles increases, there is also an increase in the effort necessary to turn the wheels, particularly when moving at low speeds or when there is lower air pressure in the tires. However, it is very difficult to turn the wheels of a parked vehicle even when there is a relatively high air pressure in the tires (2-2.5 kilograms per square centimeter). An effort of 70-80 and even more kilograms must be applied to the turning wheels. It would seem that all that is necessary to ease turning of the wheels would be to increase the gear ratio of the steering mechanism. However, this worsens maneuverability and the energetic expenditures for handling are not reduced.

It was possible to resolve this problem through the use of power steering which utilizes some of the engine power to turn the wheels. The driver only has to apply an effort of some 12-15 kilograms to the steering wheel. Additionally, the power steering unit substantially raises driving safety, particularly at high speeds and particularly when there is tire damage or a heavy impact by a wheel against an obstacle. These qualities are particularly important for wheeled military vehicles which often have to be operated over destroyed roads and broken terrain.

In driving a vehicle with power steering, the driver expends effort only to displace the slide valve inside the distribution housing. However, it is not desirable to overly reduce this effort because the driver no longer "feels" the road — feels the resistance of wheel turning. Therefore, the power unit is "hardened" — special elements are introduced by means of which the effort to be applied to the steering wheel becomes proportional to the angle of turn of the vehicle (to the amount of load on the power unit).

Hydraulic power units (figure 1) are the most widespread. Their operating principles are identical. But the design and placement of the main element — supply pump, distributor, operating device (cylinder), and steering wheel mechanism — depend on the type of vehicle.

The GAZ-66, ZIL-130, ZIL-131, URAL-375, and KAZ-608 vehicles use standardized vaned double-action pumps activated from the engine crankshaft by a V-belt drive. The pump's safety valve is computed for a limiting pressure of 65-70 kilograms per square centimeter. The passing valve limits fluid circulation in the system during engine operation at higher revolutions. Geared monotype pumps, driven from the intermediate shaft of the gearbox, are used on the BTR-60P and BRDM-2 transporters.

The hydraulic power pump operates only when the engine is on and its efficiency depends on the number of crankshaft revolutions. This is why vehicles which have power units should never have the engines turned off when under motion, for example, when coasting. Pump efficiency reduces at low revolutions of the crankshaft and the effort applied to the steering wheel increases. Therefore, when turning the vehicle's wheels in a parked position or when moving at a low speed, the number of engine revolutions must be increased. In addition, the gears cannot be put in neutral in the BTR-60P and BRDM-2 transporters, as this will disconnect the pump. Since the power unit in the BTR-60P and BRDM-2 is part of the general hydraulic system, it must be disconnected before the flap of the waterjet impeller is opened or the additional wheels are raised (lowered). Only after these operations have been completed can the control valve levers be placed in the "wheel" position.

The power distribution slide valves are made in a flow-through type. When the slide valve is in the neutral (middle) position, the pump is partially exhausted. The slide valve in the distributors of the GAZ-66, BTR-60P and BRDM-2 vehicles is fixed in a neutral position by means of so-called reactive chambers (see figures 1a, 1b). These chambers are connected by channels which have vaned slide valves at the ends to the appropriate cavities of the cylinder — A and B. As wheel-turning resistance force rises, there is an increase in the fluid pressure in the working cavity of the cylinder, let us assume in cavity A, and simultaneously in chamber a connected to it. The cavity of cylinder B and the chamber of distributor b are connected at this moment to the drain line. The fluid pressure difference in the distributor chambers creates a force which hinders slide valve displacement and is the one which the driver must overcome. The greater the resistance of turning, the more effort must be applied to the steering wheel. When the turn is completed, a pressure difference is created in chambers a and b, and the slide valve again assumes a neutral position.

The fluid is forced out of the cylinder through the distributor into the tank during a specific period of time with the result that the return of the wheels is slowed up somewhat. Since the volumes of cylinders A and B differ, there is a breakdown in the symmetry of the stabilization process. For the same reason, the equal forces of resistance to wheel turning cause unidentical effort to be applied to the steering wheel — somewhat higher when making a left turn. This should be particularly taken into consideration when driving a vehicle in mountainous terrain.

The steering mechanisms of the ZIL-131 and URAL-375 vehicles use distributions with reaction plungers and centering springs (figure 2). When turning the steering wheel, the steering mechanism screw moves into (out of) the piston rod and displaces the slide valve inside the distributor housing thrust bearing. The plungers compress the springs. The change in the drain slit size and in the pressure causes an increase in the fluid pressure in one of the cylinder blocks and on the reactive plungers. The piston begins to move and turns the Pittman arm, shaft, and wheel through the gear drive. The greater the force of wheel-turning resistance, the greater the fluid pressure on the reaction plungers. There is a corresponding increase in the effort applied to the steering wheel.

When operating vehicles which have power steering units, it is recommended that the wheels not be turned in place when the motor is working at low revolutions. The steering wheel should not be kept in the extreme position for too long because in this case the fluid pressure is very great. It overheats and can lead to a breakdown in the gaskets. In order to avoid increased wear on the elements of the hydraulic system, it is also undesirable to tow a vehicle with an inoperative pump for a prolonged period of time.

An assessment of the technical condition of the steering mechanism by the amount of steering wheel play can only be made after the engine has been started. The fact of the matter is that when the engine is not working the free play of the steering wheel can exceed the limit of 25 degrees because of slide valve displacement. During inspection of BRDM-2 and BTR-60PB vehicles, the control level must be kept in the "wheel" position and the clutch engaged.



Рис. 1. Схема привода рулевого управления с гидроусилителем (а, б — реактивные камеры; А, Б — полости цилиндра): 1 — корпус распределителя; 2 — золотник; 3 — сошки; 4 — насос; 5 — бак; 6 и 7 — перепускной и предохранительный клапаны; 8 — калиброванное отверстие; 9 — поршень цилиндра; 10 — перепускной (аварийный) клапан.

Рис. 2. Работа гидроусилителя ЗИЛ-131 (а — нейтральное положение, б — поворот вправо, в — поворот влево): 1 — цилиндр гидроусилителя; 2 — вал сошки; 3 — винт рулевого управления; 4 — золотник; 5 — реактивный плунжер; 6 — шариковый клапан; 7 — пружина; 8 — поршень рейки. Стрелками показано давление жидкости на поршень.

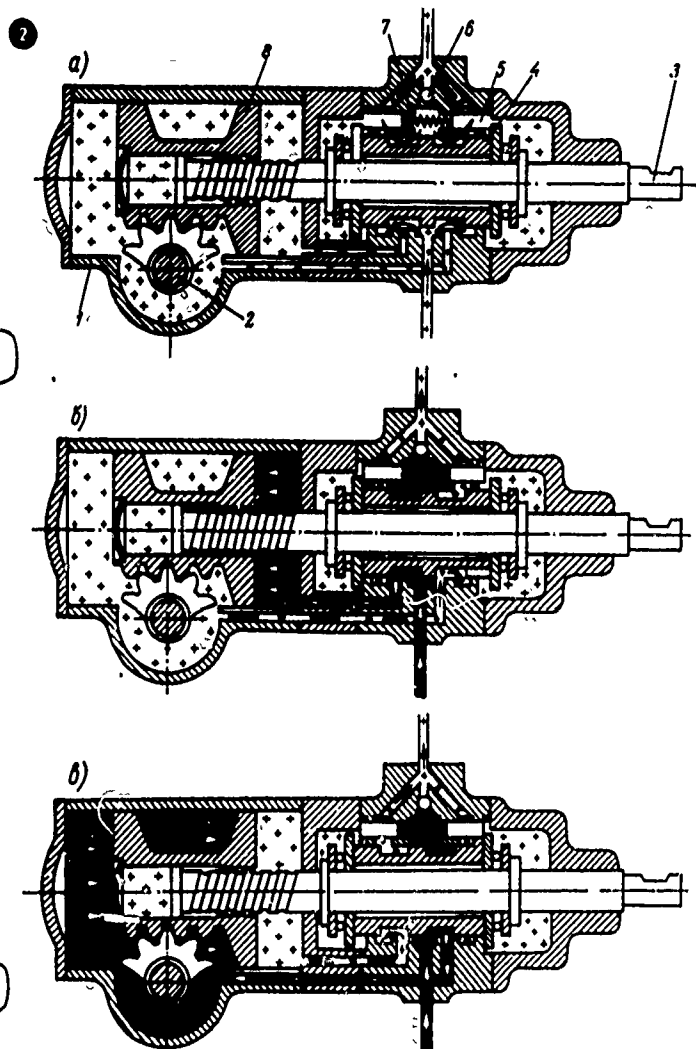
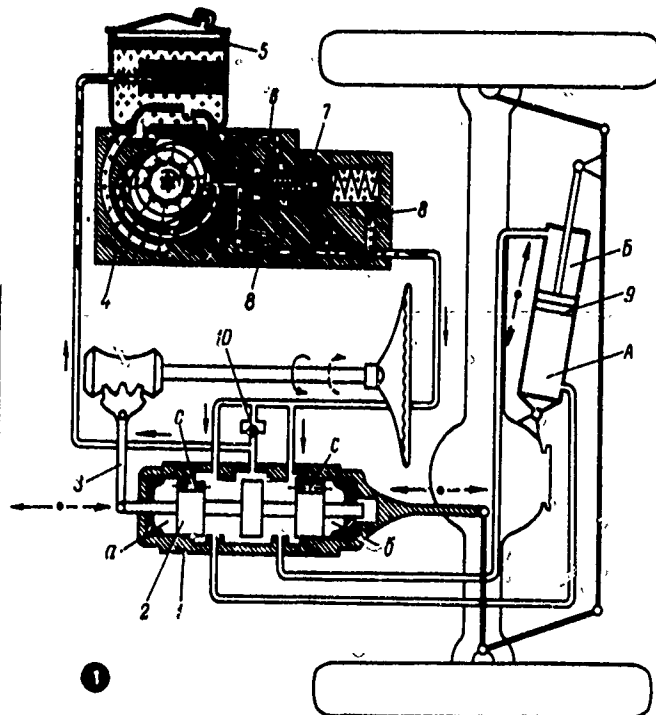


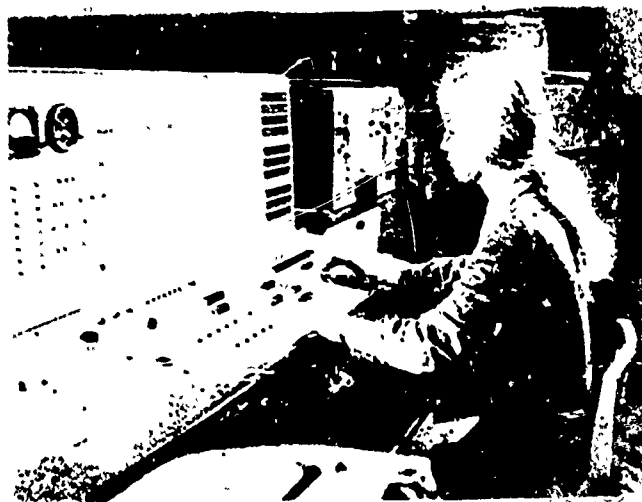
Figure 1. Diagram of the steering control drive with hydraulic power (a, b — reaction chambers; A, B — cylinder cavities): 1 — distributor housing; 2 — slide valve; 3 — Pittman; 4 — pump; 5 — tank; 6 and 7 — bypass and safety valves; 8 — calibrated opening; 9 — cylinder piston; 10 — bypass (emergency) valve.

Figure 2. Operation of the ZIL-131 hydraulic power system (a — neutral position, b — right turn, c — left turn): 1 — hydraulic power unit cylinder; 2 — Pittman shaft; 3 — steering control screw; 4 — slide valve; 5 — reaction plunger; 6 — ball valve; 7 — spring; 8 — piston rod. Fluid pressure on the piston is shown by arrows.

## ELECTRONICS IN THE SERVICE OF AEROFLOT

(p 16)

Engineer Colonel K. Leonidov



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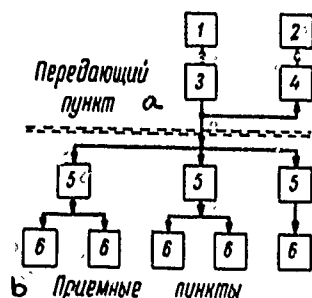
Soviet Aeroflot is currently the largest air transport enterprise in the world. In 1970, more than 70 million persons were carried along the main air lines (their extent exceeds 600,000 kilometers). These figures are indicative that aviation in the Soviet Union has truly become a mass form of transport.

The 24th CPSU Congress set newer and even more grandiose tasks before all workers engaged in passenger and freight traffic, as well as before the aviators. The Directives require that support be given to the further development of transport and to increase its capacity and maneuverability. It must promptly and uninterruptedly satisfy the needs of the national economy and the population in shipments. To do this, it is necessary to develop reserves in the transport's traffic capacities and traffic capabilities and to increase the freight turn-around of all of its forms by 32-35 percent.

The main means to help successfully carry out the assigned tasks are electronic computers which are receiving a wider and wider application in air transport. It is easy to believe this after viewing the exposition in the "USSR Transport" pavilion at the Exhibition of Achievements of the National Economy of the USSR where several automated systems are on display.

For example, interest is attracted by the "Aviaremont" system intended to control the productive activity of a major modern enterprise. Of particular interest is the fact that it is universal and can be used with out slight changes in the most varied of enterprises engaged in the manufacturing and repair of aircraft, vessels, motor vehicles, and so forth. The system consists of a Minsk-22 electronic digital computer, means of information transmission, intraplant telegraph communications systems, and information viewing stands. It can be used to model production processes using the critical path planning methods, calculate operational-calendar work plans for production sectors with a consideration for the current state of production and organize their implementation, perform operational control over production, and forecast its development for lengthy periods.

The "Aviaremont" has been successfully functioning since 1967 at plant No 400 of the Civil Aviation and since 1969 at the Minsk Aviation Repair Plant. Here is the result from the introduction of this automated system: the equal load distribution to production centers has been fully ensured, aircraft repair time has been reduced by 20 percent, labor productivity has increased by 15 percent, and the unit cost of repair has been reduced by 10 percent. In all, only one year was required to completely amortize the costs of introducing the "Aviaremont" system.



Block-schematic of the "Pogoda-1" meteorological information system intended for the remote transmission of weather summaries.

Key: a — transmitting point; b — receiving points.

An automated material-technical supply control system (ASUMS) is installed at the plant. It plans the requirements in aviation technical gear, controls its movement, maintains bookkeeping records of material.

goods, and calculates and supervises economic indexes. The economic effect from the introduction of the ASUMS was 400,000 rubles.

All types of training devices are widely used to train pilots of the Civil Air Fleet. One of them, the complex KTS-An-24 training unit, was demonstrated at the exhibition. It is intended to teach and train air crews under conditions close to the actual flight of an An-24 aircraft. The training device is based on electronic calculating devices which model the operation of aircraft systems. Moreover, the training unit also contains equipment to imitate ground visibility flights. It is a wide-screen television set which projects the terrain image onto the screen. The device consists of a cabin with screen and projector, instructor panels, ten cabinets with calculating devices, and a mock-up of the terrain. Preliminary training done in this training device has very perceptible advantages over direct training in aircraft. Efficiency is raised considerably because the flight personnel are trained under conditions of complete safety. Training costs are reduced and, finally, it is completely independent of weather conditions.

The "Pogoda-1" weather information system, intended for the remote transmission of weather summaries to the airport services, is also not without electronics. The following are installed at the transmitting station of the airfield meteorosynoptic group (see sketch): a control point 1, a control mimic panel 2, command-forming units 3, and a decoder 4. The receiving points have decoding units 5 and a weather information panel 6. The communications line is a multistrand cable over which nearly 20,000 commands are transmitted.

The following information is fed to the panel: the time of observation, the altitude and type of cloudiness, visibility, wind direction and speed, pressure, temperature, and humidity. In addition, a description is given of such weather elements as rain, fog, smoke, sheet ice, dust storms, snow, snow storms, bumpiness, hail, icing, and thunderstorms.

Dependable information transmission is ensured over a distance of up to 1,000 meters. The time to take each element of information does not exceed 3-4 seconds.

Electronic digital computers are also widely used in passenger service. Thus, there is an electronic digital computer in the central air travel office which operates as a ticket agent. Teletypes receive requests from all ends of the country -- passenger names, flight numbers, and number of seats. The teletype information is translated to a perforated tape which is then fed into the computing device. Finished results come out of the machine's output.

This electronic ticket agent instantaneously operates thousands of data and makes the necessary decision. Not only can it reply to 100 telegrams in seven minutes, but it can also calculate the number of

rejections for a particular flight. This helps to better compile timetables, select optimum versions of aircraft movement, and introduce new flights.

A system to reserve seats and to sell tickets, the "Sirena-1", has already been introduced at the Moscow air terminal. It stores in its memory all seats on aircraft flying out of Moscow over a 30-day period. In all, more than 1,100 flights can be programmed into the system. By using the "Sirena-1" system, each ticket agent will be able to sell 600-700 tickets in one shift whereas without this system, the best ticket agent could sell but 200 tickets.

## AUTOMATIC REGULATOR

(p 17)

Engineer Major L. Yanyushkin

The automatic pressure regulator (ARD) is used to maintain the necessary law of air pressure change (Figure 1) in the sealed cabin of an aircraft. For example, when using the ARD-54, a normal air pressure is maintained in the cabin up to an altitude of 2,000 meters. As the flight altitude increases, the pressure decreases (line a-b). In the altitude range of 2,000 to 7,100 meters, the regulator maintains a constant pressure (line b-c). With a further increase in altitude, a constant difference is automatically maintained between the pressure inside the cabin and the atmospheric pressure (line c-d).

The delivery of air into the sealed cabin is usually done from the engine's compressor. The ARD-54 regulator reacts to the amount of pressure in a cabin, regulates it according to the given law, and forces out part of the air through the passage of the air scouring valve. Let us review its operating principle (Figure 2). Up to an altitude of 2,000 meters, the inner cavity of the device is connected with the outside air through the three-position valve 7. As a result, the pressure in this cavity is less than the pressure in the sealed cabin only by the amount of loss, depending on the hydraulic resistance of the calibrated opening 3. Moreover, it is connected to the submembrane cavity of scouring valve 9 through which free ventilation of the sealed cabin takes place to an altitude of 2,000 meters. As the flight altitude increases and atmospheric pressure decreases, the force applied on bellows 8 is reduced, and upon reaching an altitude of 2,000 meters, valve 9 closes completely. In the altitude range of 2,000 to 7,100 meters, the pressure remains the same within the cavity of the command unit and the sealed cabin. It is equal to the atmosphere at an altitude of 2,000 meters, which corresponds to  $596 \pm 15$  millimeters mercury column.

At an altitude of 7,100 meters, when the pressure drop between the sealed cabin and the atmosphere reaches a given value, the excess pressure regulator 5 goes into operation and valve 4 opens. The force applied to the membrane of the scouring valve reaches a value at which a constant difference is maintained between the pressure in the sealed cabin and the atmospheric pressure; this is  $294 \pm 15$  millimeters mercury column.

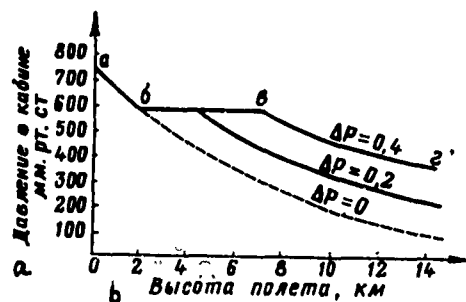


Figure 1. Graph showing pressure change in a sealed cabin maintained by an ARD-54 pressure regulator.

Key: a — cabin pressure in millimeters mercury column;  
b — flight altitude in kilometers.

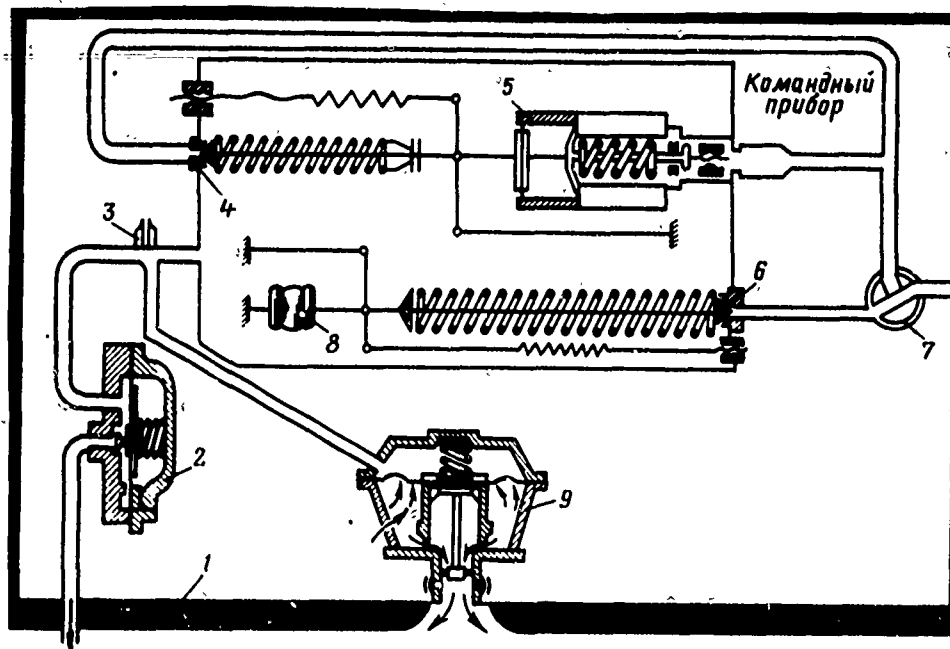


Figure 2. Basic schematic of the ARD-54 automatic pressure regulator: 1 — bottom plate of the airtight cabin; 2 — damper; 3 — calibrated opening; 4 — valve; 5 — excess pressure regulator; 6 — valve; 7 — three-position valve; 8 — bellows; 9 — cabin air scouring valve.

The ARD-54 operates in a normal as well as striking pressure state. The transition is done to prevent sharp air shocks and destruction of the skin in the event of a sharp breakdown in cabin sealing. This is done by an advance retuning of the regulator's excess pressure element. The retuning is done by using a switch which has two positions: one of which ("0.4") corresponds to the normal state and the other ("0.2") corresponds to the striking state.

When cabin pressure is checked on the ground, the lever of this valve is set to the center position. The air tightness of the cabin is checked when the lever is in the "disconnect" position (extreme counter-clockwise position). This is done in the following manner. The hose is hooked up from the ground unit to ensure the delivery of the necessary amount of air to the cabin connecting pipe and control over the blow-in of the sealed cabin; the hose is also connected from the air cylinder to the connecting pipe of the sealed entry hatches and the cabin is made airtight. Then, after opening the valve of the unit which blows air into the cabin, a control instrument is used to ensure that the rate of pressure rise in the cabin does not exceed the prescribed rise. A pressure of  $0.2 \text{ kg-f/cm}^2$  is developed in the cabin and maintained constant; a careful inspection is then made of the cabin (hatches, windows, seams, and the tightness of sealed elements and control lines).

Air pressure in the cabin is raised to  $0.4 \text{ kg-f/cm}^2$ , after which air delivery is stopped and the valve closed. The time is measured during which the cabin air pressure drops from  $0.4$  to  $0.1 \text{ kg-f/cm}^2$ . The cabin is considered to be airtight if this time is not less than the permissible time. If the cabin pressure drops very rapidly, the point of leakage is determined by ear and then made more precise with the use of a soapy foam.

During the time that the automatic pressure regulator is in operation, its proper functioning should be carefully checked, a periodic inspection made of the fastenings, the valve seats and the protection screen of the calibrated opening should be washed out, and dust and moisture should be removed from the surface of the unit. No adjustment or oiling should be performed.

In the event the ARD-54 is inoperative, it is possible to maintain air pressure in the cabin manually by using the combination pressure valve in a range of  $0.1$  to  $0.4 \pm 0.02 \text{ kg-f/cm}^2$ . In the working position, the small fly wheel in this valve should be turned as far as it will go. As the fly wheel is turned, the pressure in the cabin will decrease. This valve also performs a safety function by automatically disconnecting when the pressure difference between that in the cabin and the outside air exceeds  $0.43 \pm 0.02 \text{ kg-f/cm}^2$ . In order to prevent rarefaction in the cabin during a sharp altitude drop in the aircraft flight, a reverse drop valve is mounted in the bottom of the sealed cabin which opens when the air pressure in the cabin is less than that of the outside air pressure.



## NEW MEGAOHMMETERS

(pp 18-19)

Engineer Captain V. Lisukov

The dependable operation of electrical units depends greatly on the condition of the insulation of their electrical circuits. If the insulation is broken, the danger arises of injury to people by electrical current and the unit itself can become inoperative. Therefore, primary attention must be given to preventative control during the operating process. At the present time, the condition of insulation is determined by measuring its resistance with a special instrument — the megaohmmeter. The M1101M inductance megaohmmeters with a nominal freerunning voltage of 100 volts (a measuring limit of 100 Megohm), 500 volts (500 Megohm), and 1,000 volts (1,000 Megohm), and the MS-05 and MS-06 2,500-volt megaohmmeters are the most widespread portable instruments used to measure insulation resistance of electrical equipment and circuits which are in a de-energized state. A manually-driven direct current generator is used as the source of current. To use it, it is necessary to turn the manual drive handle at a rate close to the nominal — 120 rpm. Herein lies their only shortcoming.

The series production has now begun of the BM-1 and BM-2 (Figure 1) noninductance megaohmmeters. The use of transistors, diodes, and condensers in these meters has obviated the use of manually-driven direct current generators. This has considerably raised instrument reliability and has simplified measurements.

These new instruments may also be used to assess the dampness of insulation and to check (measure) high-ohmic radiotechnical resistors. They can operate normally at temperatures in the ambient medium of  $-40^{\circ}$  to  $+50^{\circ}$  C and at a relative humidity of up to  $95 \pm 3$  percent. The basic technical data of the BM-1 instrument are given in the table. A considerable operating convenience is provided by the supply source which consists of three series connected 1.6-FMTs-U-3.2 dry cells (the "Saturn" type battery). In this case, the instrument generates a test voltage of 100 and 500 volts.

Type of Parameter	Unit of Measurement	Nominal Data
Voltage at the open megaohmmeter probes	Volts	100, 500
Upper measuring limit:		
a) at a voltage of 500 volts	Mohm	500
b) at a voltage of 100 volts	Mohm	100
Basic error to the operating length of the scale	Percent	1.5
Supply voltage	Volts	4.5
Consumed power (not more than)	Watt	0.5
Number of measurements by one set of new batteries	Times	2,000
Overall dimensions	Millimeters	209 by 142 by 140
Weight (not more than)	Kilograms	2.3

In addition to the autonomous direct current source, the instrument also has a direct current converter into alternating current (multi-vibrator and a noncontact switching device), a step-up transformer, voltage booster, and a measuring device. For a more economic use of the electrical batteries and for work convenience, one of the megaohmmeter probes has a start button, KnP, by means of which the circuit is switched on only at the moment the measurements are made.

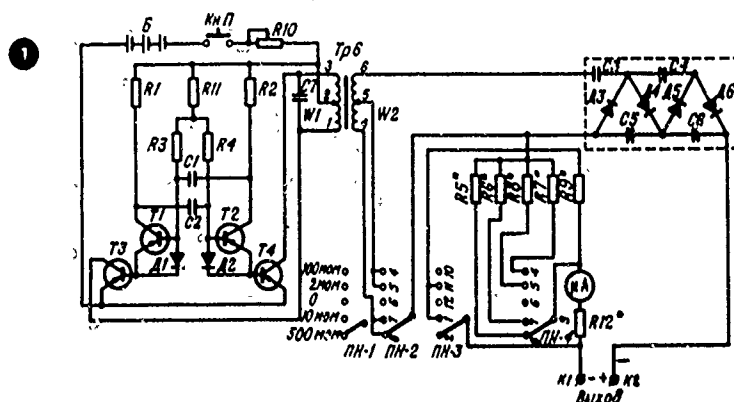


Figure 1. Basic circuit of the BM-1 megaohmmeter.

The KnP closes the supply circuit of the multivibrator which is made up from transistors T1 and T2, resistors R1, R2, R3, R4, and R11, diodes D1 and D2, and condensers C1 and C2. The multivibrator begins to generate rectangular impulses which are fed to transistors T3 and T4. These resistors perform the function of low voltage noncontact current interrupters in the preliminary winding W<sub>1</sub> of the step-up transformer TR. A pulsating current flows along the winding and the polarity of the pulses in each half of the winding is different. The secondary winding W<sub>2</sub> is connected to the voltage booster (it is also the rectifier) made up from diodes D3, D4, D5, and D6 and condensers C3, C4, C5, and C6. A constant voltage is thusly applied to the megaohmmeter probes, and when they are closed around any resistance, a direct current begins to flow through the microammeter  $\mu$  A (the microammeter scale is graduated in megohms). The voltage switch is used to switch the measured voltage and the measuring limits of the megaohmmeter.

The operating efficiency of the megaohmmeter must be checked before any measurements are performed. This is done by closing the probes, setting the voltage switch to the 100 or 500 volt position, and the button is depressed so that the instrument's needle can be set to the zero mark of potentiometer R10. With the probes separated, the needle should position itself at the mark when the KnP is depressed.

When measuring insulation resistance, the PN must be set to the required voltage. At 100 volts, resistance can be measured from 0 to 3 Mohm and from 2 to 100 Mohm; at 500 volts, from 0 to 20 Mohm and from 10 to 500 Mohm. If the measured resistance is not known, the switch is set to the largest measuring limit. The instrument's needle is then set by the corrector to the  $\infty$  mark. The output probes are closed, the KnP is depressed, and the needle is set to the zero mark by the "UST 0" regulator. Following this, one of the probes is connected to the housing, the other is placed against the circuit to be checked, the button (microswitch) is depressed, and the reading taken from the appropriate scale. When measuring is completed, the voltage booster switch is set to the zero mark. The BM-2 megaohmmeter has a similar circuitry and design but can develop a voltage of 1,000 volts.

Insulation resistance is nonlinear and depends on the amplitude of the applied voltage (Figure 2). Therefore, the measuring voltage must be not less than the nominal voltage of the electrical device. Thus, it is suggested that the GOST 11828-66 electrical machines have the insulation resistance of the windings measured at a nominal voltage of up to 500 volts by a 500-volt megaohmmeter and windings with a nominal voltage of more than 500 volts be measured by a 1,000-volt megaohmmeter.

If the electrical circuit of the machine contains other items designed for lower test voltages, then these must be disconnected during insulation resistance measurements and checked by standard or technical

documents pertaining to them. It is better to use a megaohmmeter with a much higher voltage because during insulation resistance measurements, this will help to detect any possible defects. But in all cases, the nominal voltage must be less than the test voltage of the unit, otherwise a break in the insulation will occur.

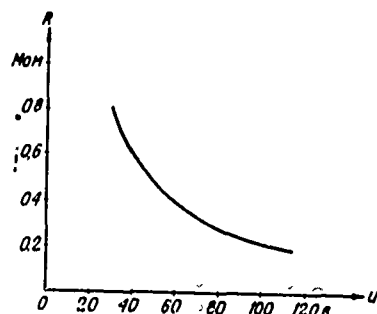


Figure 2. Ratio of insulation resistance to applied voltage.

It has become practice to make visual readings of the insulation resistance values on the megaohmmeter scale every 60 seconds after application of the voltage (from the moment that the generator handle is turned for megaohmmeters with built-in direct current generators). This must be done because at the moment that the voltage is applied, when there is still a significant current because of capacitance charging (Figure 3), the insulation resistance read from the megaohmmeter will be very low. As the capacitance current attenuates, the readings will gradually grow and after a certain time will indicate the established insulation resistance reading. In testing items with a low capacitance (short sectors of a cable net) with absorptional currents, the reading is made 15 seconds after the voltage has been applied.

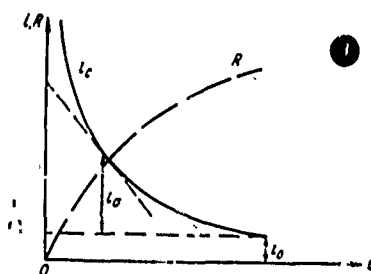


Figure 3. Ratio of insulation resistance and currents to time of applied voltage:  $I_c$  — capacitance current,  $I_a$  — absorption current,  $I_0$  — through conducting current,  $R$  — insulation resistance.

Upon concluding the measuring process, it is necessary to discharge every independent electrical circuit through the grounded case

of the electrical unit. If this is not done, the charges retained in the insulation capacitance pose a danger to individuals. According to GOST 11828-66, each winding after its insulation resistance has been measured is connected to the casing for not less than 15 seconds if the power is up to 1,000 kilowatts (or 1,000 kilovolt amperes) and for not less than 60 seconds for higher power. During repeat measurements, the discharge time must not be less than the charging time (it is desirable that it be several times larger), otherwise the insulation resistance reading will be higher.

If measurements are performed after insulation has been tested by a rectified voltage, then the discharge time must be considerably greater (dozens of minutes) because, much higher voltages are used than in the megaoammeter and the voltage rise is made in stages; the total time of voltage application is quite large.

It should be remembered that in the event of different polarities of the megaoammeter and of the rectifier which is used to perform the measurements, there is a reduction in the measured resistances.

How should the results of measuring insulation resistance be properly assessed? According to the requirements of GOST 183-66, the insulation resistance of a winding during the operating temperature of the machine must not be less than the value obtained from the formula

$$R = \frac{U}{1,000 + 0.01 \cdot P}$$
 (but not less than 0.5 Mohm), where U is the nominal voltage of the given winding expressed in volts; P is the nominal power of the machine in kilovolt amperes (in kilowatts for direct current machines).

It is known that insulation resistance depends on the temperature: it quickly drops as temperature increases. In most instances, it is impossible to measure it during the working temperature of a machine, even immediately after it has been stopped, because even in this short period of time the temperature drops noticeably. Therefore, the given formula, which takes into account certain nominal data of the machine, cannot be used to properly determine the insulation resistance in a cold state.

At low temperatures, a reference calculation can be made by a double formula computation of values for every 20° C (full or partial) of difference between the winding's operating temperature and that temperature at which the measurements are made. For example, the three-phase current generator GSF-200 of 200 kilowatts or 250 kilovolt ampere power, at  $\cos \varphi = 0.8$ , has a nominal linear voltage on the stator winding of  $U_n = 400$  volts. The problem is to determine the least permissible value of stator winding insulation resistance if measurements are made at a temperature of +20° C.

At first, let us determine the least permissible stator winding insulation resistance at the operating temperature:

But this value is less than the indicated minimum (0.5 Mohm); therefore, the following recalculation has to be made. According to technical conditions, the operating temperature of the generator winding is  $+125^{\circ}\text{C}$ . The difference between this temperature and the one at which the measurement is made is  $105^{\circ}\text{C}$ , which is five times greater than  $20^{\circ}\text{C}$ . Consequently, the measured value of insulation resistance must not be less than  $0.5 \cdot 2^5 = 0.5 \cdot 32 = 16 \text{ Mohm}$ .

Since the machine's insulation resistance is not suitable for calculation, then it is difficult to judge its state only by its measured absolute value. The low resistance value indicates not only a break or defect in the insulation, but also that there is a conducting channel in the defective place. This is why during the machine operating process the basic method to judge the state of insulation by measuring its resistance is the comparative method. A comparison is made of the derived insulation resistance values against the data of previous measurements. Any significant deviation in insulation resistance values of different phases not noticed before usually indicates some kind of substantial defect in the insulation. At the same time, a decrease in the insulation resistance of all three phases of the winding, as a rule, is caused by a change in the overall condition of its surface: dirtiness (dust, oil vapors, fresh paint) or moisturization.

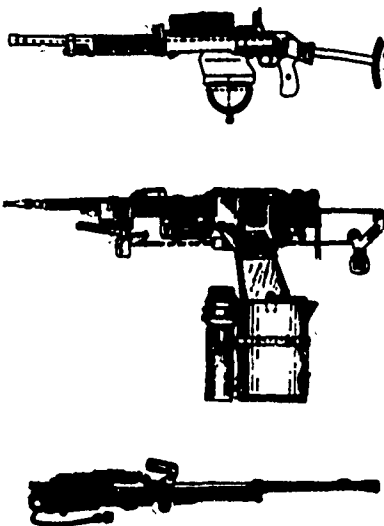
Specific safety measures have to be followed when working with megaohmmeters. Before connecting up the probes of the BM-1 or BM-2 to the unit to be measured, a temporary safety barrier must be set up and warning signs placed to keep the workers from making contact with current-carrying elements which are under voltage.

All voltage is removed from the unit and measures taken to prevent any possibility of voltage delivery to the item being tested. If there is a deviation in the megaohmmeter needle at the time that it is being connected, this is indicative of the presence of voltage. In this case, it must be discharged from the capacitance current. During measuring, all protective groundings of the device are disconnected.

Measurements must not be made during a thunderstorm or threat of thunderstorm. Megaohmmeter measurement of insulation resistance in units which have a voltage of more than 1,000 volts or distributor devices of up to 1,000 volts must be performed by two individuals in accordance with the rules of technical electrical safety.

## TANK MACHINE GUNS

(p 20)



From top to bottom: the 7.62-mm DT tank machine gun; the SGMT target machine gun; the PKT Kalashnikov tank machine gun.

The mounting of a machine gun was provided for on the world's first tank designed by A. A. Porokhovshchikov. In subsequent years, automatic small arms were still the main type of armament for wheeled and tracked armored vehicles. They were still used even when tanks were equipped with cannons.

Ordinary heavy machine guns were used at first. However, the limited space in the battle compartments and the difficulties to cool and replace barrels brought about the need to develop special tank machine guns. A multitude of problems arose before the designers. For example, it was necessary to determine whether or not to develop special cooling devices or to make use of a heavier barrel, to increase the fire unit or to reduce the firing rate in order to reduce consumption of ammunition in a unit of time without concurrently reducing the efficiency of target destruction.

The designing of the first Soviet tank machine gun was based on the model 1927 Degtyarev aviation system. In order that it would take up less space in the battle compartment, design engineer V. A. Degtyarev provided a special removable metal stock, the length of which could be adjusted depending on the individual characteristics of the person handling it. To mount the machine gun in the tank, G. S. Shpagin designed a special roller bearing mount consisting of a bearing socket fastened to the tank's armor and a ball which held the body of the machine gun. As distinguished from infantry and aviation machine guns, the tank machine gun had an open sight which, depending on the firing range, was set at 400, 600, 800, and 1,000 meters.

The 7.62-mm DT tank machine gun was accepted by the Red Army in 1929. It successfully combined the specific requirements levied on tank armament and was successfully used during the Great Patriotic War. The acceptance of the DT completed the development of a family of standard machine guns for infantry, aviation, and tanks with a single automatic system and common main assemblies and parts.

The DT did not have sufficient power to combat air targets and the 1938 model 12.7-mm large caliber machine gun was accepted as the anti-aircraft tank machine gun. It was mounted on the tank's turret on a special mount.

Individual design shortcomings of the DT were found during the war years and it was modernized in 1944. The recoil spring was moved from under the barrel to the trigger guard assembly because the heat would cause it to shrink and it would lose elasticity. A change was made in the design of the piston guide tube, with the result that it was possible to disassemble the machine gun without removing it from its mount and without leaving the tank. A number of parts were now stamped, which reduced processing time.

The combat use experience of the 7.62-mm Goryunov system heavy machine gun (SG-43 and SGM) and its remarkable battle qualities attracted the attention of tank weapons designers. The decision was made to use it in the armament of armored troops as a target machine gun and in pair with the cannon; it was also mounted on armored personnel carriers.

The SGM machine gun, paired with the cannon on medium tanks was mounted to the cradle bracket. Target pointing was made from a scale applied to the grid of the weapon's optical sight. It was remote controlled by an electrical trigger.

The SGM target machine gun was mounted in the control compartment and was fired by the tank's driver. An extension to remove powder gasses was used instead of the flash hider on the muzzle.

The SGMB machine gun was mounted on armored personnel carriers on a special mount.



In the post-war period, in connection with the standardization of small arms based on the Kalashnikov submachine gun, the PKT Kalashnikov machine gun replaced the Goryunov system tank machine gun. As opposed to the PK, it had a more massive barrel (1.2 kilograms heavier).

During firing, the cartridges were fed to the receiver from a metal belt placed in a box. The belt has a capacity of 250 rounds. The greatest fire effectiveness from the PKT against ground targets is attained at a distance of up to 1,000 meters. The firing rate is 250 rounds per minute.

Heavy caliber machine guns were also used on tanks in addition to the 7.62-mm machine guns. The 12.7-mm DShKT machine gun, mounted on a special mount on the tank's turret, is used against air targets. The 14.5-mm Vladimirov system machine gun (KPV) paired with the cannon is a powerful means to destroy personnel and antitank means.

Despite the fact that artillery pieces play the primary role in tank armament, the tank machine guns still remain a powerful and effective weapon to combat lightly-armored enemy targets and personnel.

## FUEL PUMP-REGULATOR

(pp 20-21)

Engineer Lieutenant Colonel V. Anyushkin

The TNR-3RM fuel pump-regulator is intended to deliver a specific amount of fuel to the combustion chamber of the S-300M turbostarter and oil to the hydraulic clutch coupling between the starter and the turbojet aviation engine when starting the engine. It also ensures acceleration of the turbostarter to operating revolutions (31,000-35,000 rpm) and stable operation at these revolutions with sufficient power to turn the engine.

The primary elements of the TNR-3RM are the geared pump 1, the screened filter 2, starting screw 3, starting valve 4, reduction valve 6, and the centrifugal regulator. The pendulum fork 18 of the centrifugal regulator is activated by means of a conical gear 20 set in the grooves of the pump's drive pinion shaft 19.

The screen filter 2, set in the high pressure channel directly behind the rocker assembly, keeps the starting and operating jets from becoming dirty and the plunger of the centrifugal regulator against sticking.

The starter valve 4 develops the necessary pressure drop for normal operation. It provides for the dependable firing of the combustion chamber to provide good atomization of the fuel to the starting jets. Regulated to a pressure of 0.9-1 kg-f/cm<sup>2</sup>, it hinders fuel leakage at the beginning of the starting cycle when the fuel pump productivity is still low. During subsequent work of the turbostarter, the open valve operates as a jet tube for fuel drainage. The opening of this jet tube is changed by turning starter screw 3 to set the necessary turbostarter pickup time. If the ambient temperature rises, the acceleration time to the working revolutions increases and can go beyond the permissible limits. Therefore, the turbostarter is regulated to obtain the normal parameters of engine starting. This is done by turning the starter screw and checking at the same time that the temperature of the gas would not exceed 800° C. Checks are made for every 1/8th turn of the screw. Consideration in this process is also given to the fact that the time of

repeat starting and also the starting of a preliminary heated turbo-starter is increased somewhat.

It is necessary to remember that the pickup assembly is so designed that it does not ensure a sufficient accuracy in delivering fuel at any moment of turbostarter acceleration. The amount of delivered fuel is close to the required only at the beginning and completion of the acceleration process and that at average revolutions (in the range from 6,000 to 7,000 rpm) it is greater than the required, with the result that there is the possibility of increased gas temperature. There is a special device in the pump's centrifugal regulator to reduce it.

A single-stage centrifugal regulator determines the operating revolutions of the turbostarter and the revolutions for oil delivery to the hydraulic clutch (29,000-31,000 rpm).

The regulator has two openings 15 in the upper part of the plunger 16. Spring 13 works on the plunger with a force of 0.13 kg-f, ensuring its immobility to 6,000-7,000 rpm. If the turbostarter begins to develop a greater number of revolutions, the plunger displaces upwards until lodged against collar 8 in bearing 12, located in plate 9. The plate is pressed by spring 10 whose tension determines the operating revolutions of the turbostarter. When opening 15 is opposite window 14, there is an additional delivery of fuel in bushing 17 (up to 26,000 rpm), with the result that the normal starting temperature of the turbostarter is ensured.

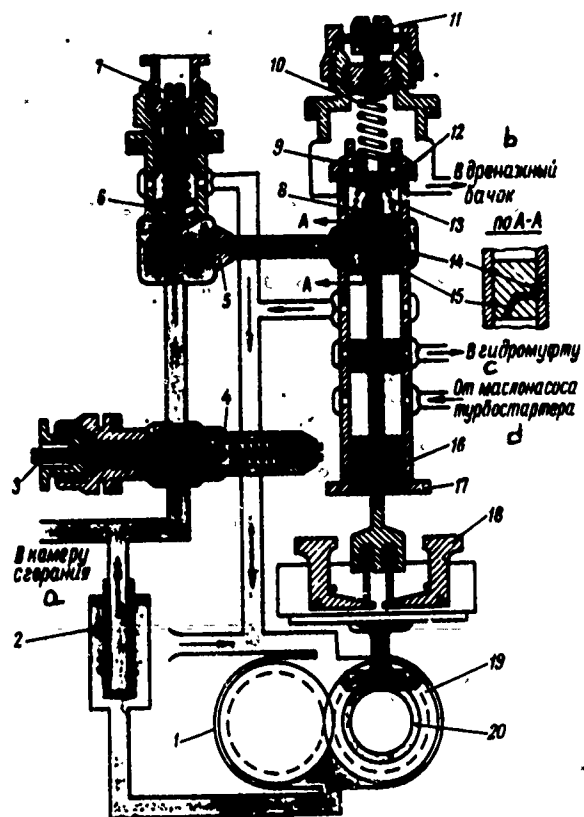
Fuel drain ceases in the range from 26,000 to 28,000 rpm because spring 10 begins to compress and the opening passes beyond the upper edge of the bushing's window. The turbostarter is accelerated to the operating revolutions. The moment at which oil is delivered to the clutch and excess fuel is drained depends on the degree of compression of spring 10 regulated by screw 11. The design of the plunger is such that oil is delivered to the hydraulic clutch somewhat earlier than the fuel drains. For example, if the working revolutions of the turbostarter are 32,500 per minute, the oil begins to enter the hydraulic clutch when it is operating at 30,000 rpm. The fuel drain through the centrifugal regulator begins at 33,000 rpm.

The amount of fuel drained at the operating revolutions is determined by the position of bushing 17 and plunger 16. When window 14 is completely open, fuel drain is not determined by the centrifugal regulator but by jet tube 5, which is so constructed that the necessary amount of fuel would be delivered to the combustion chamber to restore operating revolutions (68-73 kg-f/hr). A short-term increase in the number of turbostarter revolutions is permissible. In all cases, however, it should not exceed 35,000. If the number of revolutions exceeds 33,500 per minute, then regulating screw 11 should be loosened. Each time it is turned 1/16th of a turn, the results should be checked by starting the engine. If the number of revolutions drops below 31,000 per minute, regulating screw 11 must be tightened.

There must be a specific fuel consumption (85-100 kg-f/hr) which must correspond to the working revolutions. Turbostarter power depends on fuel consumption and, consequently, so does the normal course of engine starting. Its working revolutions must conform to the permissible gas temperature, which should not exceed 680° C at an ambient temperature of up to +15° C and 700° C if it exceeds +15° C. Turbostarter power may be reduced considerably as a result of filter pollution, worn pump gears, atmospheric changes, and other conditions. Thus, the drop can be so great at high ambient temperatures that the engine simply cannot be started. Turbostarter power is increased by raising the fuel pressure in front of the nozzles. The required fuel operating pressure is ensured by reduction valve 6. It maintains a pressure of 18 kg-f/cm<sup>2</sup> in front of the operating nozzles. Fuel consumption in this case is 95-96 kg-f/hr and the working revolutions are 32,500 per minute. There is 95-100 horsepower at the turbostarter's output shaft.

Turbostarter power is usually rated by the time the engine develops 400 rpm during its cold turning process. This time should not exceed 45 seconds. If it is greater, it may be assumed that there has been a decrease in fuel delivery to the combustion chamber and in turbostarter power. Therefore, screw 7 should be tightened by two turns, after which the results are checked by cold cranking of the engine. If the starting time cannot be substantially reduced, it means that too much fuel is pouring through the starting screw. After tightening it by 1/8th of a revolution, the results should again be checked. If there is an increase in fuel consumption at working revolutions, the gas temperature at the turbostarter outlet may exceed the permissible value. In this case, screw 7 should be loosened by one turn, after which the results are checked by cold cranking of the engine.

The use experience with the TNR-3RM fuel pump indicates that its proper adjustment, as well as its prompt inspection and cleaning of the filter, ensures its sufficient reliability within the limits of the established service life.



The TNR-3RM fuel pump-regulator.

Key:

- |                               |                                     |
|-------------------------------|-------------------------------------|
| 1 — geared pump               | 11 — adjusting screw                |
| 2 — screen filter             | 12 — bearing                        |
| 3 — starting screw            | 13 — spring                         |
| 4 — starting valve            | 14 — window                         |
| 5 — jet tube                  | 15 — opening                        |
| 6 — reducing valve            | 16 — plunger                        |
| 7 — screw                     | 17 — bushing                        |
| 8 — collar                    | 18 — pendulum fork                  |
| 9 — plate                     | 19, 20 — conical gears              |
| 10 — spring                   |                                     |
| a — to the combustion chamber | c — to the hydraulic clutch         |
| b — to the drain tank         | d — from the turbostarter oil pump. |

## CONTEMPORARY TEACHING MEANS

(pp 22-24)

Engineer Colonel A. Balandash  
Engineer Lieutenant Colonel V. Khomich

Training highly qualified officer cadres is a most important task of the higher military training institutions. Along with such widely used technical means of education as films, strip films, and tape recordings, a large role is also played by electronic computers, television, and video recordings.

Unfortunately, some instructors limit themselves to the use of chalk, blackboard, and posters, even though it is widely known that the use of technical means of training expedites, improves, and lessens the cost of the training process. Thus, according to data from the Military Engineer Academy imeni Dzerzhinskiy, the use of such means raises the lecture rate by 10 percent, and, consequently, makes it possible to considerably increase the volume of information. It also helps to better hold the attention of the students, since after 20-25 minutes there is a weakening in attention to a monotype lecture.

Some of the devices which currently are penetrating deeper and deeper into the training process are the LETI-60 strip film projector, the "Proton" slide projector, the "Ukraina-4" film projector, the table model portable EDI-454 projector, and the EPD-452 epidioscope-filmstrip projector.

The use of experience of technical means at the Military Academy of Armored Troops imeni Malinovskiy makes possible the recommendation of a number of methods for their use. Strip films demonstrated during lectures should consist of a small number of frames (5-12). A larger number of frames is permissible only in showing different types of vehicles and machinery in the descriptive part of the lecture. It is important that each frame would fulfill a specific methods task upon which it is necessary to concentrate students' attention. Good results are obtained from the use of strip films combined with posters: numerical data and graphs are given on posters, while descriptive matter (the overall view of an assembly, the dynamics of a process) is shown with strip films.

Some frames may repeat diagrams and graphs given in textbooks, and it is necessary to refer to the sources during the showings, as this will help the student during his independent study. Scenarios in which the goal and content of each frame are given play a great role in the development of strip films.

The greatest usefulness is obtained from strip films when studying such courses as tank operation and rehabilitation, production technology, and tank electrical equipment. For example, during studies and lectures on tank operation, it is expedient to use strip films to demonstrate to the students the different types of wear, forms of corrosive destruction, and various means of servicing the vehicles in the motor pool and under field conditions.

The EDI-454 projectors open great potentials for the instructors. They help to demonstrate during lectures all graphic materials, recordings, and use of formulas. The fact that the records were made ahead of time has a positive effect on the quality of the material demonstrated. If recording on transparent tape is done during the lecture, the lecturer always faces the auditorium. When the EDI-454 is used in studies on tactics, the dynamics of battle can always be quickly and accurately reproduced by repeat buildup of diagrams, previously made on film, as overlays to the initial situation.

There is a constant improvement in the technical means of information transmission. An apparatus for remote control of projectors by radio has already been developed and their light-technical parameters are being improved. Slide projectors will have a much greater capacity, up to 200 slides, in the near future. Their reliability is improving and their dimensions decreasing. Daytime film apparatus is under intensive development. Unfortunately, the problem of wide production of film necessary for the training process is still to be resolved.

The use of television probably has the greatest prospects. The latest technical achievements in this field are forcing a new review of its possibilities in the training process. At the present time, it is used with very limited methods goals. Thus, the Military Academy imeni Frunze uses a closed television circuit to translate films to a large number of auditoriums, demonstrate exercises on large-scale sandboxes, and transmit interesting lectures and communiques.

The expansion of videotape techniques and the development of small-size and inexpensive television projectors makes it possible to more fully and with lesser material expenditures to use such advantages of television in education as demonstrations without the need to close the lights, to show the dynamics of processes in a slowed tempo, and many others.

One of the basic directions in improving the educational process of engineer training is that of widely using technical means of control

and programmed study. It was mentioned by Marshal of the Soviet Union M. V. Zakharov at the All-Army Scientific-Methods Conference in 1967 that scientific studies in military training institutions and at the troop level indicate that there are still many potentials to further improve the quality of specialist training.

The technical means of supervision by degree of satisfying the basic didactic requirements and, consequently, by complexity of arrangement may be divided into three groups: simple, automatic, and control devices based on the use of electronic digital computers (ETsVM).

The simplest control means ensure supervision and self-supervision during the independent study process with programmed training material and control programs. They use the selective answering method.

Matrices or perforated cassettes are the most widespread. They are successfully used in the training process of a number of military academies. Their arrangement is quite uncomplicated (Figure 1): 1 — the matrix base, 4 — insert, 6 — upper cover, 2 — stopper, and 7 — peg. Control is exercised by a control blank 5 and a coded blank 3 placed on the matrix; the coded blank has squares, corresponding to the correct answers, in a bright red color. Blank 3 is placed on the bottom of the base with an opaque insert with openings in it, a control blank, and a transparent upper cover with openings all placed on top. The assembled matrix is held together by a stopper which is stamped by the instructor. During the control process, the students punch an opening in each row corresponding to the code of their selected answer. Answer correctness is checked by the color of the code blank square visible through the punched-out opening.

The simple control devices also include special control blanks, plotting boards, and perforated cassettes which make use of standard perforated cards, perforated envelopes, and perforated slides.

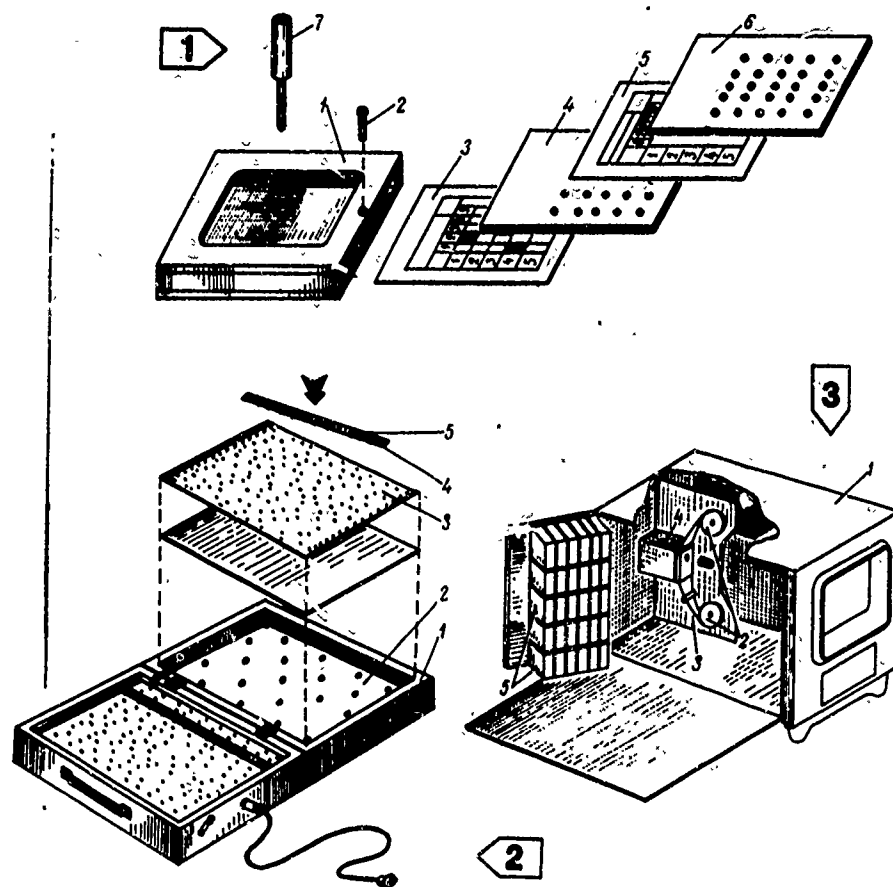
The control devices would be even simpler if the self-checking function was removed from them. In this case, the function of external reverse communications — checking answer correctness — must be done by the instructor. The simplest form of this group of control devices is the group control unit (Figure 2). It consists of a case 1, a source of light 2, code plates 3 with openings, and control scales 4 with movable slides 5. For general control purposes, the students are issued scales with individual control programs. According to the code of the selected answers, they move the slides covering the openings in the control scale. The instructor rates the number of wrong answers by the number of visible openings on the code tables.

The simple control devices can be linked to a device to evaluate correctness of answers. At the present time, two types of such complexes are in existence: the lecture auditorium equipped with a feedback device and auditoriums with automatic control. The feedback devices help the



instructor to exercise control by simultaneous questioning of all students. This raises the activity of the trainees, forces them to constantly follow the materials being given, and the instructor obtains efficient information on the degree to which the students master the questions.

Such devices represent a series of buttons, keys, and switches, permitting simple responses to be made to the instructor's questions ("yes"; "no"; "don't know"), and the instructor's panel which summarizes or documents the answers to posed questions.



The automatic control auditorium is distinguished by the great number of possible answers. Thus, in some of them the student's panel — a well with five sockets for a double plug — takes off voltage from any of five points on a potentiometer. The correctness of the answer is checked by a coded matrix mounted on the instructor's panel and the results of answers to the first question are printed on a standard electrical machine.

The K-54 information-control device is an automatic means of control (Figure 3). This is a controlled filmstrip projector which emits information in the form of text or graphic representation preliminarily placed on a strip of film. It is handled by the trainee with the use of a control unit according to a directed program also imprinted on film. The K-54 has a logic element which can assess selected answers to 15 questions. This device consists of a case 1, which has a film-running mechanism 3 with cassettes 2, an optical projection system 4, and an automation unit 5. The front panel has a semi-transparent screen, five numbered answer buttons, a button to turn the machine on and off, a light panel to assess one answer, and a panel to assess a series of answers.

Control is exercised in the following manner. The program frame appears on the screen after the machine is switched on. The answer is made by depressing one of the buttons. The panel indicates the correctness of the answer and the program frame is changed.

The KISI-5 ("Lastochka") device expands the instructor's capabilities to check the knowledge of the trainees. Moreover, the students can use it for self-checking, independent study, and training. This device can be supplied with a static accumulator which fixes all operations performed by the student during the machine's operation in a control state and also the time expended for each operation.

Control machines provide a great usefulness but, unfortunately, they do have a number of shortcomings. First of all, this lies in the limitation of their memory which makes feedback very rigid and formalized. Secondly, they pin down the initiative of the students to a certain degree. Thirdly, they cannot differentiate among the students as to their degree of preparedness. All of these shortcomings can be completely eliminated if electronic digital computers are used which would perform all control functions during the teaching process: information retention, its presentation in a convenient form and at the necessary speed, an assessment of the student's knowledge, and the selection of appropriate portions of the training material according to the student's knowledge.

It should be remembered that the ETsVM also helped to more fully resolve the tasks of programmed training. Possessing a huge memory and rapid action, the electronic digital computer is the foundation in training complexes and has the potentials for better adaptation to the knowledge level and capabilities of the students.

It is essential to have a large amount of data concerning the student, his thinking, and his memory to provide a more thorough individualization of training. The modern ETsVM make it possible to store not only a significant volume of training material, but also the work history for a large group of students which can be counted in hundreds and even thousands of persons.

The wide use of electronic digital computers is economically justified only when a large number of students are simultaneously served. Under mass training conditions, the ETsVM becomes the foundation of the training complex's automated system which also includes student panels, linking devices, communications lines, and many other elements. For example, a training complex of this type was established in the Military Air Engineer Academy imeni Zhukovskiy. It is used to conduct group exercises employing the programmed method, group practical exercises to develop and strengthen different skills and ability, and group control to perform work of an accounting nature using the electronic digital computer as a multipaneled computer.

The complex consists of student panels, linking devices, and the BESM-2M series digital computer. The circuit of this computer has certain small additions which have no effect on the machine's normal operating state. The student panels have keyboards to introduce symbols and commands into the ETsVM, a drum to change the register designations of the keyboards, a digital light panel, and two signal lamps ("correct" and "ETsVM occupied"). The panel helps introduce information in a freely constructed form into the ETsVM. The linking device includes a clock, commutator, local control system, and elements to coordinate the communications channels with the ETsVM.

The analogue computer (AVM) has a particular place in training highly qualified military engineers. These machines not only help to model the processes taking place in automatic systems, but also visually demonstrate their dynamics, perform investigations on the effect of individual elements on the work of the systems as a whole. For example, the EMU-8, MN-7 and IPT-5 analogue computers are widely used in the training process of the Military Academy of Armored Troops imeni Malinovskiy in the department of electrical equipment and automation. During lectures, practical studies, and laboratory studies, the students learn how to make good use of the AVM to solve engineering problems. They subsequently use this knowledge in doing course and diploma projects and during independent scientific research activities. The AVM gives the best results when calculating stabilizers, in determining the characteristics of transient processes, and the characteristics of speed and mechanical parameters.

Various training devices are used to inculcate the students with practical skills. These adaptive training devices significantly raise the efficiency of the training process.

In order to intensify the process of skill acquisition, the training devices must not only ensure training, but also the registration of qualitative criteria of progress assessment in a form which could be used to analyze the actions of the trainee and compare them with those of the instructor who works under identical conditions. It is precisely these possibilities which you find in the TT-3 training device developed in the Military Academy of Armored Troops imeni Malinovskiy.

It is intended for the initial training of officer candidates in training tank chasti and in military training institutions on how to drive tanks under conditions extremely close to actual. This is done through the use of a special computer unit in which all logical operations of tank driving and the dynamic properties of the engine, suspension, and transmission are modeled with sufficient accuracy. The combination oscillation which is generated by the drive is close to that which an actual tank would do when moving under identical conditions.

The training device's control panel helps the study director to follow the actions of the students and to give them instructions over the tank intercom. Special counters make it possible, immediately after training with the device, to objectively evaluate the preparedness level of the student, as well as the qualitative and quantitative indexes of his work. The use of acquired data, along with the standard graph, can also be used to determine when the skills acquired by the trainees are such that the training device no longer has to be used and work shifted over to driving actual vehicles.

It should be mentioned in conclusion that by using the technical means of training in the educational process of training military engineers, there is a substantial increase in study level and a fuller realization of the basic didactic principles. The work of the professorial and instructorial staff is eased considerably, methods are improved, and there is an increase in the efficiency of independent study by the future engineers. The education cost is also significantly reduced.

## THE TANK PROVING GROUND COMMAND POST

(pp 24-26)

Engineer Colonel A. Rymarenko  
Engineer Colonel V. Chernenko

The latest technical means and automated systems with which the tank proving ground command post are equipped help to raise the training quality of tank crews. For example, an automated panel was developed in the Military Academy of Armored Troops imeni Malinovskiy to ease the training effort and to provide an objective evaluation of student knowledge level. By using this device, commands are sent by the selector to the training sites, indication symbols of tanks positioned along the jump-off line can be lit up, the study director can have radio communications with the tank crews, the readiness of the vehicles to move out can be noted, and the moments fixed automatically when the tanks leave the jump-off line and when they return.

Moreover, the lights on the panel as they light up make it possible to follow the movement of a vehicle along a route sector of any length and its entry into a prescribed area, to automatically record the time to perform exercises number 3 and number 5 by each trainee and podrazdeleniye as a whole, to switch on the movement time counter in the event the tank stops, to fix the length of time it stands, and also to determine the distance between vehicles when moving in a column.

The panel has a tank radio set, a GU-20 selector, a tank clock, and and a VSA-5 rectifier. A model of the tank proving ground (on a scale of 1:2,000) is portrayed on the sloping panel (Figure 1). The control instruments are located on the vertical panel, while the control switches are on the horizontal panel. There is also a telephone.

Elements of the electrical circuit, the VSA-5 rectifier, and the radio are located in the inner compartments of the control panel. Two tank storage batteries may also be installed there to be used in emergency cases.

In addition to the control panel, the control system also includes electrical circuits to illuminate the points where the vehicles are located at the jump-off line at night.

Before the exercise begins, the PK switch (Figure 2) is set to the position corresponding to the number of vehicles in the column. Switch P1 is changed to the number corresponding to 90 percent of the vehicles in the column and the switch K<sub>obshch</sub> is connected. At this moment, the step selector ShI must be in the position shown in the sketch. The exercise director then uses the selector to give the command to inspect the vehicles, enter into communications, and report on readiness to move. Receiving a radio reply from the crews (in any sequence), he depresses keys K1-K10 corresponding to the vehicle numbers and lights light up on the panel, indicating the readiness of the tanks to move. For example, if key K1 is depressed, the current passes through the winding of relay R1, contacts R1-1 and R1-2 which block it as they close, and switch on lamp LG1. The other lights come on in the same way. After receiving the reports from all crews as to readiness to move, the exercise director disconnects K<sub>obshch</sub> and all RSM-1 relays are discharged. K<sub>obshch</sub> is then switched on again.

As a tank moves, its antenna closes two suspended leads above the jump-off line, which are insulated from each other, with the result that the start counter (Figure 3) is activated and current flows through the closed R4-1 contact and the winding of relay R1. Contacts R1-1 close and block relay winding R2. The step selector ShI is activated when contacts R2-1 are closed. At a specific position, contacts ShI-1 close and relay R3 is activated — its contacts R3- are opened and the R3-2 are closed. Condenser C, which had been charged up to this point, is discharged through the resistance and winding of relay R4. The latter immediately activates and in a period of 3-6 seconds (until such time as condenser C is discharged) keeps contacts R4-1 open and R4-2 closed. Because there is no current in the winding of relay R1 and contacts R1-1 and R2-2 are open, no voltage will be applied to the windings of relay R2 and to ShI with the result that there is no overheating of the low-ohmic winding of the ShI.

Contacts R4-1 close after 3-5 seconds and the input unit will again be ready to receive signals from the next vehicle. The circuitry of the start counter and the finish counter may also be made with a single insulated lead. In this case, an airtight microswitch is mounted on one of the supports holding the suspended lead. The reviewed schematic of the input unit eliminates the delivery of two or several signals from one vehicle because after activation, it does not react to antenna vibration for 3-5 seconds.

When the step switch is moved from position 0-13 to position 1-14 (see Figure 2), the SD-60 time counter and the three MES-54 impulse counters are switched on. One of these registers the movement time of the first vehicle, the second measures the movement time of 90 percent of the column vehicles, and the third measures the movement time of the entire column. In order to provide autonomous work of the counters, the armature design of the second ShI field was changed so that the switching-on of the contacts of the next impulse counter after the start of the

second vehicle would take place without switching-off the preceding counter.

If the first vehicle stops along the route, then its corresponding MES-54 counter can be temporarily disconnected by switch K-1. In this case, lamp LVI will begin to blink. This blinking will continue until the exercise director receives a radio signal from the tank commander that movement has been restarted.

Other time movement counters are switched-off in a similar way. When the first vehicle returns to the jump-off line, the finish counter disconnects only its MES-54 counter while the time counter for the movement of 90 percent of the vehicles in the column and that for the entire column continue to operate. We will demonstrate this by an example. Let us assume that the column consists of seven vehicles. Then switch PK (see Figure 2) must be in position 7, P1-6. After the sixth vehicle has started, the movable contact of the stop selector must be in position 6-19. Relay R6 is activated, contacts R6-1 are open, and contacts R6-2 are closed; the time counter for the sixth vehicle continues to mark off the time.

As soon as the movable contact passes position 6-19, the circuit of relay winding R6 is disconnected and the time counter for the movement of 90 percent of the vehicles in the column stops. This takes place because the back part "a" of the SHI armature slides off segment 6-19 and disconnects the mass.

As the tanks return to the jump-off line, the finish counter is activated and the movable contact of the SHI's second field disconnects the MES-54 counters in the appropriate sequence and the movement time of each tank is fixed.

The automatic shifting of the step selector armature from the position when all impulse counters are in operation to the position ensuring the consecutive switching-off of the impulse counters by the finish counter is done with three fields of the step selector (not depicted in the schematic). It returns the SHI to the initial position after all vehicles have returned.

As the last vehicle leaves the start, the movable contact of the step selector automatically shifts to position 1-14. Now, as the vehicles pass the finish line, the finish counter is activated and the back part of the SHI consecutively disconnects the electrical circuits leading to the MES-54 impulse counters. The counting of the travel time ceases.

As soon as the movable counter reaches the 23rd segment, the circuit of the third SHI field is closed and the armature automatically returns to the initial position. The fourth field of the step selector automatically switches-on the SD-60 time counter when the first tank

crosses the starting line and disconnects it when the last vehicle returns to the jump-off line after having passed the finish line.

The circuit provides for the positions of the vehicles at the jump-off line to be fixed by lights on the control panel. If a vehicle leaves, the light corresponding to its number automatically switches off. This takes place in the following manner. As soon as the start counter is switched on, the movable contact of the first ShI field moves from position 1 to position 2 (see Figure 3). The rear part "a" of the second field's movable counter disconnects contact 1 as it moves from position 1 to position 2 and lamp LI-1 turns off. Simultaneously, the MES-54 impulse time counter of the first vehicle's movement is switched on.

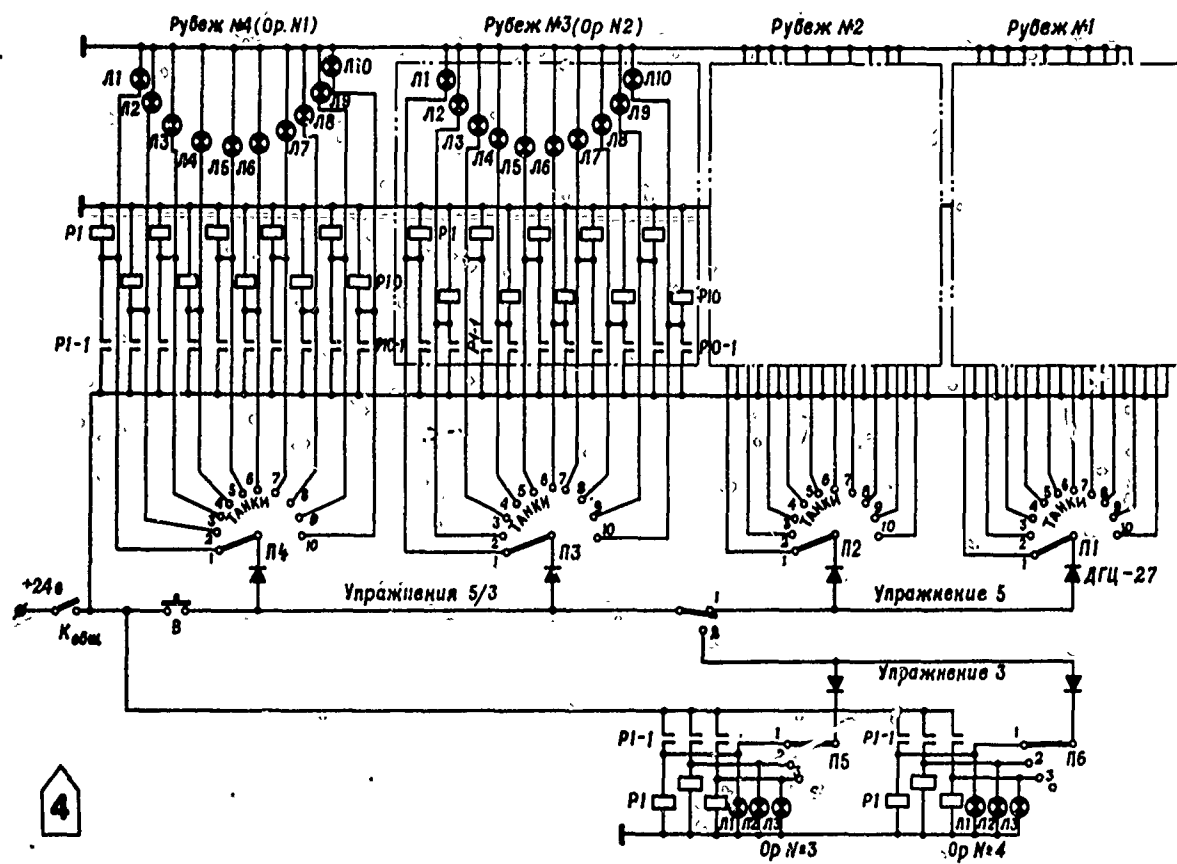
At the moment the vehicles return to the finish line, the impulse counters stop, the circuit of side "b" of the ShI armature closes, and lamps LI-1 to LI-10 once again light up, showing the number of the returning vehicle.

The equipment of the control panel is such that the passage of each vehicle across the jump-off line can be controlled. For this purpose, there are ten lamps at the periphery of each line to indicate each vehicle's number. The radioman-operator turns them on manually after the radio report made by the vehicle commander that the appropriate line has been passed. For example, when the first vehicle crosses line number 4 (Figure 4), switch P4 is placed in the first position, switch Kobshch is turned off, and button "V" is depressed. The current passes through lamp L1 and relay winding R1. Its contacts R1-1 are closed and the relay blocks itself. If switch P4 is placed in the second position, lamp L1 will burn because the current now passes through the closed contacts R1-1. If for some reason the tank crossed a line and a report was not made, the operator does not switch on the lamp signalling crossing of the line. To ensure independent switching-on of the control lamps, each line's circuit has a DGTs-27 diode.

In this way, the position of each vehicle along the route is fixed and the proper radio exchange by the trainees is checked. In addition, it is possible for the exercise director during the time intervals between the reports to make preliminary estimates of the distances between the vehicles as they move in the column. The time intervals are measured by switching on the free MES-54 counters. However, the exercise director first asks the column chief by radio as to the average speed of movement. The approximate distance in meters is calculated by a translation table.



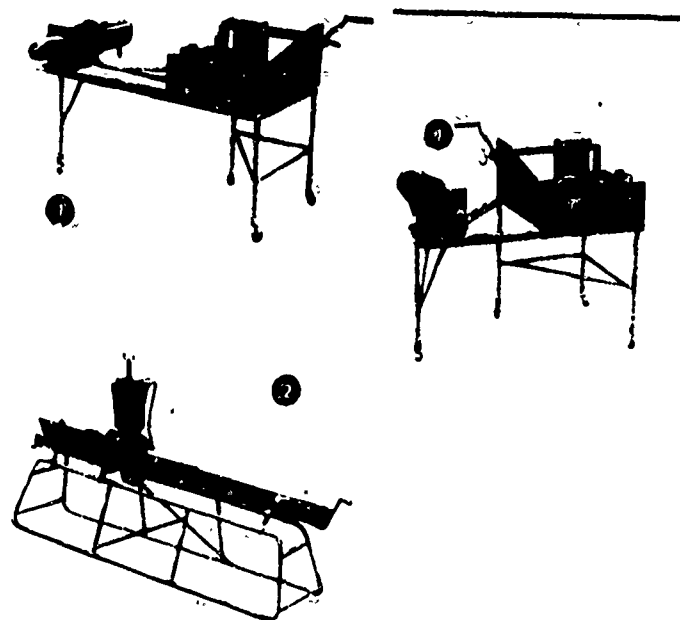




TO THOSE STUDYING THE TRACKED SELF-PROPELLED FERRY

(p 27)

Engineer Lieutenant Colonel G. Voronov  
Engineer K. Yudin



The training device of the joining mechanism and operating model of the ramp expansion mechanism of a tracked self-propelled ferry (GSP) helps in the training of personnel and to demonstrate the joining and unjoining processes of the GSP semiferries.

The training device (Figure 1) is made from series assemblies of a GSP mounted on special tables. The table legs, made from pipes, have springs and rollers. The rollers provide free movement for the table carrying the joining mechanisms in any direction, while the springs provide the oscillating movement to imitate actual conditions of joining semiferries into ferries when there is a slight tide or wave.

During the training process, the left and right parts of the training device are set at a distance of 0.5-1 meters from each other. The end pieces of the joining mechanism winches are placed into the jaw slits of both parts and the ratchets and pawls are lowered. The parts are drawn together by turning the handle. As soon as they approach each other and the supports of the crossramp units make contact, the work phase is changed by the switch handle — the locking mechanism is switched on in each winch. The movement of the connecting pieces in and out of the jaw openings indicates that the operation has been completed.

The model of the expanding mechanism (Figure 2) consists of two hydraulic cylinders (medium and small), an assembled screw and nut, and sectional assemblies of the decking elements — the traffic part of the semiferry. It is mounted on a frame welded from 30-mm diameter steel pipes.

In order to follow the work of all assemblies of the ramp-expanding mechanism during opening (closing), it is necessary to place the piston of the medium cylinder to its extreme position by turning the handle. At the same time, the screw will move to the right and enter the nut. This corresponds to a completely opened ramp.

In order to demonstrate the process of locking the ramp, the piston of the small hydraulic cylinder is lowered to its extreme position flush against the cylinder lid. As soon as the nut is firmly caught by the threads of the screw, the process of locking the ramp is completed and the hydraulic system is unloaded. The demonstration of closing (folding) the ramp is performed with the model in the reverse sequence.

## BIRTH OF THE GUARDS

(p 27)



### The Soviet Guards...

When we pronounce these words, we see in our mind's eye the initial period of the Great Patriotic War — the severest in its history. Possessing superiority in men and equipment along the axes of his main thrusts and discounting his losses, the enemy advanced toward the vitally important areas of the country.

The Communist Party called upon the Soviet people to fight to the last drop of blood, to defend each pound of native soil. And like steel, passing through a furnace, they tempered themselves in battles which reached extreme degrees of ferocity. The ranks of the bold among the bold and the brave among the brave continued to grow. The blitzkrieg doctrine on which Hitlerite strategy was based fell through.

In September 1941, the news flashed around the front: Four rifle divisions — the 100th, 127th, 153rd, and 161st — by demonstrating exemplary bravery, courage, discipline, and organization were renamed into Guards. "In the difficult situations of battle," it was stated in the order of the USSR People's Commissar of Defense, "these divisions often inflicted losses to the German-Fascist troops, routed them, and filled them with terror."

The Soviet Guards are the flesh and blood of the people. Its ideological birthplace emanates from the revolutionary past of our country. For example, it is known that the platform from which

V. I. Lenin spoke in the square of the Finnish Station upon returning from his emigration in 16 April 1917 was a piece of armor which was part of the first armored Red Guard detachment. The Guards tank regiment had its inception at this time.

Victories on the fields of battle inevitably accompanied the Soviet Guards as its remarkable valor was multiplied at a high military art. The Guards chast and soyedineniye were a true school of combat experience. The soldiers of all branches of arms attentively studied this experience, tried to inculcate it, and achieved this honorable title for their chast and soyedineniye in fierce battles with the enemy.

By the spring of 1943, the army and navy had more than 300 Guards chasti, ships, soyedineniya, and ob"yedineniya. In all during the Great Patriotic War, the Guards title was awarded to 11 combined-arms and six tank armies, 39 rifle, seven cavalry, 12 tank, nine mechanized, and 13 aviation corps, and to many divisions, regiments, and ships.

The Soviet Guards carried their banners with the portrait of the great Lenin and those burning words "For our Soviet Homeland" from the walls of Moscow and Stalingrad to Berlin, Prague, Vienna, and the shores of the Pacific Ocean. They gained immortal glory for themselves along this road.

The Guards, which was used as the example for all armed forces, even now is in the vanguard of combat and political training. It is the one which set the slogan of "The year of the 24th CPSU Congress, a year of outstanding training and service." Under this slogan, all Soviet fighting men are enthusiastically carrying out the responsible tasks assigned them by our Lenin party.

DETERMINING THE ECONOMIC EFFICIENCY OF  
SCIENTIFIC ORGANIZATION OF LABOR

(pp 28-29)

Engineer Colonel Ya. Shmakov  
Engineer Lieutenant Colonel I. Makarenko

The Directives of the 24th CPSU Congress for the Five-Year Plan to develop the USSR national economy during 1971-1975 provides that the industrial base of the socialist economy be expanded and improved, the technical level and effectiveness of production be raised, and that the quality of manufactured products be fundamentally improved. The wide introduction of scientific organization of labor (NOT) and production control assumes great significance in solving these tasks. Only in this way is it possible to ensure unwavering growth in productive labor and an efficient use in material and labor resources.

With the changeover by the enterprises to the new system of planning and economic incentive, the NOT plans have become an inherent part of the technical industrial finance plans. A mandatory statistical accounting on a scientific organization of labor basis has also been introduced which helps the higher organizations to coordinate enterprise activity, implement control, and summarize and disseminate leading know-how. The annual and long-range NOT work planning on a branch level is also of significance to raise production efficiency. The proper planning and implementation of NOT plans bring perceptible results. For example, in 1970 this gave more than one-sixth of the total productive labor increment for the repair enterprises of the USSR Ministry of Defense as a whole.

However, serious shortcomings have also been encountered in the planning and introduction of NOT measures. Many enterprises did not know how to properly base productive expediency and economic efficiency of the planned measures. At times there was an absence of technical and economic calculations based on norms and indexes reached in the fields of technology, economics, physiology, and psychology of labor. As a result, measures were frequently included in the NOT plans which had no relationship to the scientific organization of labor.

In order to eliminate such shortcomings on the country national economy level, the Scientific Research Institute of Labor developed a methodology for determining the economic effectiveness of NOT measures. This methodology was approved by the State Committee of the USSR Council of Ministers on matters of labor and wages.

It is usually difficult for enterprise workers engaged in work planning according to NOT to separate from all of the measures planned for implementation the ones which are most expedient from an economic point of view, that is, those whose introduction could have a significant effect on the technical and economic work indexes of the sector, the shop, or the enterprise. At the planning stage, the new methodology helps to determine the calculated and, after introduction, the actual economic effectiveness of each measure.

The basic indexes of the economic effectiveness of NOT measures determining the feasibility of their implementation are the annual economic effect and the growth of productive labor.

The annual economic effect is determined by the formula:  
$$E_g = (S_1 - S_2) \cdot V_g - Y_{en} Z_{ed}$$
where  $E_g$  is the annual economic effect in rubles;  $S_1$  and  $S_2$  are the production costs for a unit of product (work) before and after the introduction of measures, in rubles;  $V_g$  is the annual product (work) volume after the introduction of the measures, in norm-hours, units;  $Y_{en}$  is the normative comparative factor of economic effectiveness (the amount in reverse to the normative period of cost amortization);  $Z_{ed}$  are the one-time expenditures associated with the development and introduction of measures, in rubles.

The economic effectiveness to the end of the planned period is usually calculated as the actual economic effective, as is the effectiveness in computations made for the year. The first has a direct effect on the effectiveness of enterprise (shop, sector) work indexes during the current year, while the second is to the end of the period for the obtained effect.

The amortization time of measures planned for introduction should not exceed 1.5-2 years, otherwise the effective action of introduced measures will not permit an amortization of means expended on them. The most suitable period for the introduction of work place type projects, replanning of production sectors according to NOT requirements, and other measures requiring capital expenditures is taken at 6.7 years.

The second basic index of economic effectiveness — the growth in productive labor — is determined by product output for each worker, by reducing the number of workers, by reducing labor-intensiveness, and by increasing the duration of the stable work efficiency phase.

The annual economic effect must be very carefully determined. In practice, it is sometimes calculated relative to product (work) volume



set for the current year. This leads to an artificial increase in the expected magnitude of effectiveness. To make proper calculations, it is necessary to take product (work) volume provided for in the plan for the year following introduction. Only in this case will the calculated magnitude of economy, given by the introduction of one NOT measure or another, correspond to the actual. It is also necessary to take into consideration the duration of the effect so that the magnitude of the annual economic effect would fully characterize the economic significance of the planned NOT measure.

While developing the measures, primary attention should be given to those which encompass a large amount of work types (listings) and in which specialists of higher qualifications are engaged. These are the measures which will derive maximum effect in the current and in subsequent periods.

This method will also help to determine the more optimum sequence in the development of NOT plans and in the measures provided for them; that is, the specific periods to start and complete work depending on the magnitude of the anticipated economy. It has been established that the average values of expected economy from the introduction of measures during the first quarter are 0.917 of the calculated magnitude of annual economy, 0.667 in the second, 0.417 in the third, and 0.167 in the fourth. As we can see, the actual economy obtained by the enterprise as a result of introducing measures in the fourth quarter is nearly 5.5 times less in comparison with the one if these measures had been introduced in the first quarter.

The new method makes it possible to optimize the distribution of money allocated for NOT introduction between different enterprises and elements of a single enterprise. It will also help to more objectively resolve matters of material stimulation of work on NOT. Up to now, the prize sum was most often proportional to the magnitude of the annual economy in money obtained as a result of introducing NOT measures. Now it is calculated and distributed among those engaged in production proportional to their individual contributions.

How should the economic effectiveness of NOT measures be calculated? The method recommends that this work be started by determining the basic data necessary to perform the entire complex of calculations. Depending on the nature and content of the measures, as well as their final results, these data may include the labor-intensity of the annual program, the execution of output norms, the average annual wage of the workers, the number of workers, the loss in work time, the wage fund deducted for social security, and so forth.

Supplementary calculations are then made to reduce labor-intensiveness pertinent to reducing the number of workers, the economy in wages, and a reduction in work time loss. Only after this is the economic effectiveness computed by formulas recommended by the method.

Let us review this on the example of performing such calculations. At the armored vehicle assembly sector, there was an increase in the productive labor of the primary workers, whose average rated number was 46 persons, from the introduction of unit and subunit delivery of items performed by two auxiliary workers. The average monthly work time loss prior to the introduction of the measure was 66 minutes or 14 percent, after introduction it was 33 minutes or seven percent. The average annual wage for one worker was 1,620 rubles. Deductions for social security was 6.6 percent. The work time fund for the year was 230 days. The average monthly wage for an assistant worker was 100 rubles.

We perform the auxiliary calculations using these initial data. The reduction in work time loss in the year will be  $\frac{66-33}{60} \cdot 46 \cdot 230 = 5,819$  man-hours, while the wages for two additional assistant workers will be  $100 \cdot 2 \cdot 12 = 2,400$  rubles. Deductions for social security will be  $2,400 \cdot 0.066 = 158.4$  rubles; the relative economy in numbers of workers will be  $\frac{14-7}{100-7} \cdot 46 = 3.4$  persons, the economy in wages for the year will be  $3.4 \cdot 1,620 - 2,400 = 3,108$  rubles, and the economy in deductions for social security will be  $3,108 \cdot 0.066 = 158.4 = 46.7$  rubles. This is followed by the computation of the increment in productive labor which will be equal to  $P = \frac{3.4 \cdot 100}{46-3.4} = 8$  percent and the annual economic effect is  $E_g = 3,108 + 46.7 = 3,154.7$  rubles.

Here is another example to determine the savings obtained by reducing product production cost by reducing cadre turnover which during the year can be reduced by 4-6 percent as a result of establishing favorable working conditions, stimulating the growth of productivity, and by inculcating a communist attitude toward labor and other NOT measures.

The method recommends that these calculations be made by the formula:

$$\Delta_c = \sum_{i=1}^4 \bar{P}_{T1} \left( 1 - \frac{K_{T2}}{K_{T1}} \right),$$

where  $K_{T1}$  and  $K_{T2}$  are the cadre turnover factors before and after implementation of a complex of measures;  $\bar{P}_{T1}$  is the average annual loss expressed in money caused by cadre turnover (the economy in money obtained by the enterprise as a result of reducing cadre turnover).

Let us assume that prior to implementation of the measures, the cadre turnover factor was 13.2 percent and 18.1 percent afterwards. In the expression  $\sum_{i=1}^4 \bar{P}_{T1}$  primarily includes a reduction in

product output over a two-week period by workers who decided to quit. Some sources recommend that this reduction be taken as 20 percent. If, as an example, one worker produces 250 rubles worth of product in two

weeks and the number of workers quitting for personal reasons during the computed year is 60 persons less than in the past year, then the economy expressed in money will be  $\frac{250 \cdot 20}{100} \cdot 60 = 3,000$  rubles.

The second index is the loss suffered by the lack of products received during the course of two months from specialists newly hired and as a result of their nonfulfillment of the norm. According to data of the Scientific Research Institute of Labor, this loss is 10 percent per month. If we take 1,125 rubles as the two-month product output by one worker and take into consideration that newly-hired workers during the current year is 40 men less than in the previous year, then the savings will be  $\frac{1,125 \cdot 10}{100} \cdot 40 = 4,500$  rubles.

The third index is the expenses associated with teaching newly-hired workers. According to the Scientific Research Institute of Labor, the costs are 100 rubles per person. By this factor, the enterprises save  $100 \cdot 40 = 4,000$  rubles.

And the fourth factor is the supplementary expenditures associated with administrative work in hiring and firing workers by their own volition, which can be taken as five rubles per person. In this case, the savings in money is  $(60 + 40) \cdot 5 = 500$  rubles.

In this manner, the total amount of savings which the enterprise obtained by reducing the cadre turnover factor from 13.2 percent to 8.1 percent is  $E_s = (3,000 + 4,500 + 4,000 + 500) \cdot (1 - \frac{8.1}{13.2}) = 4,636$  rubles.

This sum will be even larger if we take into consideration, as an example, a factor such as the loss applied to the enterprise by newly-hired workers who cause spoilage during the time they assimilate the new work.

## THE CHAST' ACQUIRES A VEHICLE

(pp 30-31)

Engineer Colonel V. Ivanov

Running-in is the first and very important period of new vehicle operation during which the surfaces of parts are worked-in and packing and gaskets shrink. The operating life of the vehicle, its reliability, and its economic and dynamic indexes depend on how fully the requirements of the manufacturing plants and the rules of running-in are carried out.

The running-in period for new vehicles is three months and six months for those to be placed into prolonged storage; during this time they must cover 1,000 kilometers with strict adherence to prescribed operating states.

The organization of running-in of new vehicles greatly depends on the correct distribution of vehicles to podrazdeleniya. They should be assigned strictly according to tables of organization and with a consideration of the tasks facing the podrazdeleniye, an analysis of the number of vehicles assigned to the chast', and their technical state.

This can be done in different ways. Occasionally, so that there would be no hard feelings, 1-2 vehicles are assigned to each podrazdeleniye. This significantly complicates storage, use and maintenance, and the organization of studies to learn the new equipment. Moreover, the increased number of vehicle types in each podrazdeleniye hinders operation and maintenance of the vehicles in combat readiness. Also, it is not easy for the commanders and their deputies for technical matters to completely assimilate vehicles of different types. Therefore, the podrazdeleniye should be provided with vehicles according to tables of organization, but gradually, one podrazdeleniye after the other, with preference given to the combat podrazdeleniye. This also facilitates the organization of running-in the new vehicles.

A no less important task is that of retraining drivers to whom the running-in will be assigned. Obviously, they must be selected from among the most experienced and best disciplined soldiers. This is quite

understandable. If the running-in rules are not observed, then little use is gained from the fact that the vehicle is handled by an experienced driver. During the retraining process, it is expedient not only to clarify the features of running-in of the received vehicles to the drivers, but also to convince them of the need to strictly observe the operating rules and conditions. We will note that the maintenance of revolutions limits of the ZIL-131, Ural-375, and GAZ-66 engines, which have no limiting nut under the carburetor, wholly depends on the conscientiousness and discipline of the driver.

No matter how experienced the drivers, they must thoroughly learn the requirements of vehicle running-in instructions as well as the running-in rules and conditions prescribed by the manufacturing plants for the vehicles of a given type and to pass a test. Taking into consideration that vehicles being run-in must not be loaded by more than 75 percent of the nominal cargo capacity and that their speed should not exceed 60 percent of the maximum, it is useful to explain to the drivers the tonnage that this represents for a given vehicle and the amount of specific cargo that this covers. It is also useful to determine the speed limits along the routes and individual sectors where the running-in will take place.

The use of only prescribed grades of fuel, oil, and lubricants for the new vehicles is a mandatory condition for successful running-in. Therefore, the necessary supplies of these materials should be established prior to receiving new vehicles. Care should be taken in advance to ready the number signs without which running-in of new vehicles is not permitted.

Actually, running-in begins at the time that the chest' representative receives the new vehicles. Right then, be it at the motor tractor depot of the higher element, at the railroad station, at the port, or at the industrial plant, he is obligated to perform a control inspection and to organize the necessary technical maintenance. Occasionally, some of the technical maintenance (TO) operations are carried out only after the received vehicles have been taken to the chest'. This practice is not permissible.

During the control inspection, it is recommended that primary attention be given to the state of all external fastenings and that any loosenings be tightened, to the presence of oil and lubricant in all assemblies and their quality. All lubrication points, provided for in TO No. 1, are greased, and the remainder checked and greased as necessary. The oil is drained from the lubrication system, filtered, and only then put back into the system. This must be done because particles may be left in the oil which were torn from the metal surfaces during test stand engine running-in or which accidentally entered during assembly. As we know, they increase the abrasive wear of item surfaces.

In order that the vehicles be readied for their first run properly, it is expedient to assign specialists-repairmen to the

drivers and instruct them to correct any malfunctions, adjust ignition, the fuel system devices, electrical equipment, and other jobs requiring special skills. It is recommended that prior to engine starting, after the requirements of the manufacturing plant set forth in the operating instructions have been followed, of vehicles which have been parked for a prolonged time at depots or were transported by railroad or water transport, the cylinders of internal combustion engines be filled with 20-25 grams of oil through the sparkplugs openings and the cylinders of diesel engines filled with 75-100 grams through the air intake system.

When adjusting carburetors, some drivers try to ensure that the engine would operate stably at low revolutions. This should not be done because increased wear in non-worked parts is inevitable in a new engine. It is useful to warn drivers against this practice.

Of all assemblies of a vehicle, the greatest attention during running-in is required by an engine whose frictioning parts require particularly careful work-up. Therefore, it is necessary to warn all drivers that during running-in, especially when starting and warming up an engine, high crankshaft revolutions must be avoided and movement should be started only after an engine has been heated by gradually increasing the load. Prompt shifting to lower gears should be done in order to avoid overloading the engine of a vehicle being run-in. Engine braking must not be done as its nonworked-up coupling parts are not ready for higher loads.

The appropriate travel route during running-in is required to carry out these requirements. Whenever possible, the road should be level, without steep upgrades or downslopes, with a hard and dry soil so that the engine would not be subjected to large loads, the work state should not be changed frequently or sharply and the need for engine braking be excluded.

Control-measuring instruments are dependable assistants to the driver in determining the state of the basic systems and mechanisms. Constant attention should be given to the instruments and the slightest deviation from the norm should be taken as a command to immediately stop the vehicle and engine to clarify and eliminate the cause of malfunction.

During a prolonged run (for a period of one day) it is useful to perform control inspections while enroute — check the state of packings and gaskets in assemblies and systems, the degree of heating of assemblies and units, and the tightness of all fastenings. In the event oil leakage is detected, it is recommended that not only an inspection of the gaskets be made, but also that the breather pipes of the assemblies are clean and not polluted with dirt or foreign objects and that the amount of lubricant is within the prescribed limits.

The deputy commander for technical matters and the chief of the motor tractor service are the immediate organizers and supervisors of

new vehicle running-in. They are the ones who must ensure strict adherence to established running-in rules. Immediately after distribution of vehicles and their assignment by chas't orders to drivers who will perform the running-in, vehicle operation is planned. If there is a large number of vehicles, the operation plan (run schedule) is best formulated by stages, that is, in such a way that the vehicles would acquire the necessary kilometrage and would not enter into regular service simultaneously. This will provide a greater usefulness in using the run-in vehicles and their better maintenance at technical maintenance points by the specialist-repairmen. But, we will mention once again, that the running-in time should not be extended. It must be performed within three months. We will emphasize that individual vehicles should not be sent over a great distance from the location of the chas't. This will hinder control over their operation and in providing necessary assistance to the driver. He will not always be able to correct a malfunction in a new type vehicle. In that case, it will be necessary to send out specialists or a tractor for towing.

The instructions provide for the expenditure of motor resources during the running-in period of combat and line group vehicles, as a rule, only for training purposes. Such requirements seem extremely strict to us and its execution only extends the running-in time. Additionally, exercises on combat training are associated with movement over roadless terrain which is harmful to the vehicles being run-in. It would be more correct to permit the new vehicles to be used for administrative-technical and other needs during this period with an obvious adherence to established operating states, load norms, and running-in rules.

The running-in of different types of vehicles should not be performed in one way. The recommendations should always be followed which are set forth in the plant instructions. Thus, for the ZIL-131 vehicles, it is necessary prior to running-in, to check and tighten the stud nuts of the cylinder blockheads and the intake and exhaust manifolds for a cold engine and then after the first 100-120 kilometers. This is done to prevent a burn-through of the gaskets and a breakdown in engine operation.

It is not recommended to "coast" during the running-in of a ZIL-131 as this does not provide any fuel savings but only increases wear on engine parts and transmission. During "coasting" the engine temperature drops and, consequently, the formation of sludge increases in the lubrication system. There is a breakdown in the normal process of working fluid preparation which, in this engine, is warmed by the cooling liquid. A frequent change in work states characteristic during "coasting" also has a negative effect on the engine.

There is also a feature on how to use the throttle valve pedal. The great power reserve of the engine installed in the ZIL-131 and its good pickup does not require that the pedal be depressed to its limit

in the event of a one-time increase in engine resistance, as this is done for the ZIL-157 and ZIL-151 vehicles. There should be no hurry to engage the drop-down gear when moving onto a worse road. It must be mentioned that it is generally not recommended to drive a ZIL-131 for an extended time with the throttle valves open so that unnecessary detonations in the cylinders would be avoided.

The chief of the technical control point (KTP) has a rather important role in proper running-in. It may seem to some that new vehicles only undergo a perfunctory check at the KTP. This belief is quite erroneous. It is necessary for the chief to carefully inspect each vehicle to be run-in before it leaves the motor pool and upon its return; particular attention must be given to the adjustment of the control mechanisms, the gaskets, and whether or not the driver knows the basic rules of running-in. It is recommended that posters with technical data on running-in and a diagram of the route be used.

Prompt and good quality control inspections and technical maintenance performed during the running-in period and upon its completion are just as important as observing rules and conditions. This is best done at the technical maintenance points through which all vehicles to be run-in are passed at established times according to the running-in schedule.

Tightening operations occupy a great volume in the maintenance of new vehicles. Dislodged connections, gaskets, and extraction of bolts during running-in leads to a weakening of assembly fastenings, especially of the engine, the distributor box, cardon shaft flanges, reducers, and drive shafts. It is important to tightly fasten all fastenings, adhering to established torque pressures.

In conclusion, we would like to mention that even before running-in, the personnel must be made acquainted with the guarantees of the manufacturing plant and the method in which claims are submitted. In addition, it is expedient to direct the drivers' attention to the fact that the plant's guarantee is effective only when the instructions applicable to the vehicle are carefully followed. The guarantees do not cover damages occurring as a result of poor or late maintenance, improper operation, malusage, and storage of vehicles under conditions which do not conform to the instructions. However, if damages occur even though all rules of operation are observed, a claim must be immediately submitted to the manufacturing plant in the prescribed order without disassembling the malfunctioning unit or assembly. It is necessary to be firmly aware of these tenets and no attempt made to independently correct the malfunction by disassembling the unit, otherwise the claim right may be lost.



### Longest in the World

In 1934-1935 the world's longest telegraph-telephone line was set up between Moscow and Khabarovsk (8,715 kilometers). This was done by building 2,534 kilometers of new and rebuilding 6,181 kilometers of old overhead lines which carried a total of 34,860 kilometers of copper wires (two twin-lead circuits). One line used imported high frequency equipment and the other used domestic equipment; moreover, our equipment successfully withstood competition.

The right-of-way crossed 18 krais and oblasts and provided telegraph-telephone communications for hundreds of industrial centers. This main line differed not only in its scale, but also in new principles of line suspension. New rules for transposing copper and bimetallic telephone circuits were developed and used for the first time in its design and construction; this ensured their multiplexing in a broad frequency band (up to 150,000 hertz).

### Wire Broadcasting

In April 1921, the Kazan radio formation base developed an amplifier which, by using a horn with a telephone from a military forepost set, provided voice loudspeaking. This loudspeaking device was soon brought to Moscow and successfully tested with the horn mounted on the balcony of the Moscow Soviet. As a result, the Soviet of Labor and Defense issued a decree on 3 June 1921 to organize the loudspeaker broadcasting of news in six squares of Moscow. Thus, the foundation of wire broadcasting was laid.

### Generator Tube

In 1923, the outstanding Soviet radio engineer M. A. Bench-Bruyevich, while improving the technology and methods to produce and

pump out the first domestic generators, tested a new tube providing 25 kilowatts of power, an item which the West was even unable to dream of at that time. A year later the Nizhnygorod laboratory which he directed assembled and tested a model 100-kilowatt tube.

#### First Heat Direction Finder

The possibilities to detect ships by their heat emission was studied in the USSR long before the Great Patriotic War. Even in 1934 a group of staff members of the All-Union Electrotechnical Institute, under the supervision of Professor V. Granovskiy, developed a test model of a shore and ship heat direction finder.

The shore heat direction finder using a one-and-a-half meter mirror could detect, for example, a destroyer at a distance of 16-22 kilometers and a cargo ship at a distance of 8-9 kilometers. Target direction (finding) was done with very high accuracy — 1.0-1.5 degrees.

Series-produced heat direction finders, subsequently developed on the base of these initial models, were used during the Great Patriotic War aboard Soviet navy vessels.

#### First Changeable Sight

The changeable sight for height was first developed by Tula gunsmiths in 1770 for the 12.7-mm Cossack rifle. This sight, with one permanent and two changeable pieces of different height in combination with the good ballistics of the rifle, ensured its good accuracy and range of fire. The previously used sight, a front sight and rear sight of a permanent size, permitted aimed fire to be conducted only at short ranges.

#### Base Striker Fuse

The first base striker fuse was developed and placed into the general issue of the Russian army in 1883.

As the shell encountered an obstacle, the striker moved forward and heated the primer with its pin. The explosive charge was ignited through an opening in the adapter and the explosion took place. This fuse was safe to handle, dependable, and did not require any preliminary operations prior to firing.

#### Rifle With Polygonal Riflings

Striving to make the loading of rifled weapons easier, the Tula gunsmith, Tsyganov, was the first to use polygonal riflings in 1783

in the barrel of a Cossack rifle, of approximately 10 millimeters caliber, which he had developed. Its cross-sectional form was that of an equilateral triangle. These riflings provided the projectile with a high velocity and there was no failure during firing and accuracy was better.

In the West, polygonal riflings came into being only in 1791 in German rifles which had rectangular cross-sectional rifling.

## STORAGE PREPARATIONS

(pp 32-33)

Engineer Colonel A. Abramov, candidate of technical sciences

All armored vehicles which have not been used for more than a month, depending on the proposed duration of operating break, are placed into short-term or long-term storage.

The sequence of technological operations carried out during the vehicle preparation period depends in any case on the storage period and technical state. Thus, in readying a vehicle for short-term storage, it must be serviced according to the scope of technical maintenance (TO) No 1. If the vehicles are to be used two or three times during the year, then the individual operations of this form of technical maintenance (lubrication, checking the adjustment of mechanisms) need only be carried out once a year. Experience shows that it is best to do this following the second time the vehicle leaves the motor pool.

Vehicles placed in long-term storage are divided into two groups by scope of preparatory work: those which have been used and new vehicles. Both groups, regardless of their kilometrage (from the moment of the previous regular technical maintenance) undergo TO No 2. In addition to the work provided for in TO No 1 and TO No 2, a series of additional work is performed to all vehicles in preparing them for storage. This supplementary work will be discussed in this article.

Technological charts are made for each vehicle before beginning to ready it. The chart is used to note the volume of work according to the type of technical maintenance, data on vehicle condition, and instructions on preparations for storage. The sequence in which to perform technical maintenance of assemblies and units is based on the possibilities of utilizing existing means of mechanization and the number of specialists-repairmen called in to perform complicated tasks.

The personnel are then instructed and reminded of the more important operations and on the requirements of technical safety. Only after all of these matters have been understood are the crews permitted to begin work.

There is no need to examine in detail the scope and order of work performance as it is set forth with sufficient clarity in the appropriate instructions. Consequently, we will dwell only on those operations which require more careful attention.

Storage batteries which have been put into an operating state are placed into position and connected to the low current charging net after careful inspection. In individual cases, the batteries are placed in specially equipped boxes placed alongside the vehicles and are also connected (with the exception of the dry charge) to the low current charging net.

The engine systems require careful handling during the preparatory period. A careful check must be made of all hose connections, devices to exhaust air from the fuel system tanks, the fuel distribution valve, the tightness of the drain cocks and valves, and other assemblies in order to prevent leakage of fuel, oil, and coolant. In no case may the fuel tanks be overfilled. The durite hoses can only be made from cold resistant rubber.

We will comment that all types of fuel filters, except the TF-1 (TFK-3), of short-term storage vehicles are washed out once a year while the TF-1 (TFK-3) filters are washed out according to the Regulations on materiel and vehicle operation but not less than once every three years. Oil and lubricant in the power train assemblies is replaced if it has worked the prescribed period.

This work is done every time a long-term storage vehicle which has been in operation passes through preparatory work. At the same time, the filters are removed from the fuel tank funnels, the dirt removed, wrapped in parchment paper (preliminarily greased for non-mothballed vehicles), and placed in the vehicle. Oil in the lubrication system is replaced each time the vehicle is prepared for storage. The amount of oil used must conform strictly to the norm.

If the sealing of the cooling system was never checked during vehicle operation, then it is recommended that this be done after five years of storage for new vehicles being readied for storage and after three years for those vehicles which have gone through major repair. It is recommended that the system be washed out ahead of time to remove any scale.

The most arduous operation is that of disassembling mechanisms which is done to check the condition of parts and for the replacement of consistent lubricants. This is done only to vehicles which have gone through the guaranteed run.

The changing of running gear parts of short-term storage vehicles is done gradually.

When the lubricant in the power train assemblies of medium tanks is changed, there is no need to wash out these assemblies. The lubricant is changed in the planetary gear rotation mechanism of medium tanks and prime movers mounted on their chassis only during repairs. The friction coupling mechanism bearings are lubricated once a year for short-term storage vehicles and during each preparatory period for long-term storage vehicles and this must be followed immediately by cleaning out the lubricant delivery pipes to the bearings.

When readying vehicles for long-term storage, the insulation of electric leads and cables must be checked. This is done by disconnecting the lead (cable lead) from the power source and the consumer and the megaohmmeter connected to the lead wire and vehicle chassis is used to measure insulation resistance. If it is less than 0.5 megohm, the old cable terminals are removed and the insulation resistance measured again. If it is again less than the indicated value, then the lead (cable) is completely replaced; but if it reads more than 0.5 megohm, then only a new terminal must be added. This is done by winding the bare lead and insulation with a polyvinyl chloride tape. A polyvinyl chloride tube is then placed on the end of the lead and terminal, wrapped in tape, and the place of tube placement is first covered with shellac or a bakelite lacquer. The terminal may be bent to ease seating of the tube.

This can be done in another way. The bare lead and insulation are wound with a rubberized electrical insulation tape which is then covered with a band made of cotton threads (No 00) and saturated with shellac or bakelite lacquer. Both methods may also be used to replace damaged terminals on leads whose insulation resistance is more than 0.5 megohm at the first checking.

The greasy and corroded metal winding of electrical leads is cleaned off with dry rags. The leads, rubber tips, and caps, as well as brushes and contact panels, may not be cleaned with gasoline or other solvents.

A few words about the features of readying wheeled vehicles for storage. A very complex and responsible operation is that of their suspension, which is done to take the load from the tires, springs, and other elements of the running gear. It is recommended that this be done only to those vehicles which are to be stored for more than six months. This is done by placing supports under the springs of such a height that the wheels would not touch the ground. A preliminary operation to unload the springs is by placing spreaders between the springs and the body which are of a size 20-30 percent greater than the distance between the spring and body. Wheeled vehicles with balanced suspensions are suspended in such a manner that the wheels would not touch the ground and the lower supports of the balancers would be unloaded. The supports on which the vehicles are suspended are made from strong material and placed on a hard and solid ground or on horizontally placed runners.

In servicing a vehicle, its organic equipment and spare parts and tools are checked and replenished to the norm, after which they are put in place and secured.

Upon completing all preparatory work, it is necessary to check on how well the work was performed, the assemblies and aggregates plumbed, and the vehicle made available for inspection by the receiving commission. The vehicle can then be mothballed after this.

## LAYING COMMUNICATIONS LINES

(p 33)

Engineer Ya. Marchevskiy

As shown by practice, a reduction in the time to lay and remove field communications cable lines is facilitated by making full use of the technical potentials of cable laying vehicles and by a well-planned work organization.

For example, when laying cables, the duties among the team members are distributed in the following manner. The first and second operators, who are in the vehicle, place the next cable drum in the duty stand and ready it for work by freeing the upper coupling half and carefully checking the condition of the outer windings.

Prior to installation, when the last row of cable comes off the drum, the first operator gives the command "Attention" over the intercom. The driver-mechanic repeats the command and reduces speed to 3-4 kph. The command "Stop" is given when there are 3-4 windings left. After stopping, the third operator goes to the back of the vehicle and pulling on the cable, quickly unwinds the rest of it. He then connects the lower free coupling half with the upper coupling half ready on the duty stand and gives the command "Forward" to the driver-mechanic. The second operator moves the cable manually in the vehicle's body.

In this case, the maximum time taken from the moment the vehicle stops until it begins moving again is not more than 35-40 seconds. The initial speed of the vehicle should not exceed 3-4 kph so that the coupling halves would not be damaged when passing over the laying blade. At this speed it is easy to disconnect and join the coupling halves during checking and line alignment and it also avoids breaking the contacts in the coupling half.

Communications are established more quickly by those podrazdeleniya which, making use of all available means, first lay the cable on the surface of the ground and then after checking, bury it. It is easy to lay cable along the ground surface by using high-side trucks. In doing it this way, the symmetrical, soldered, insulated, and interconnected



construction length cables (10-15 kilometers) are manually placed in the vehicle body winding to winding so that the windings would not be broken when dropped from the vehicle.

The cable is picked up by a team of three men. The vehicle's speed is changed within limits of 3-5 kph. The order of work execution may be the following: the cable is passed under the vehicle moving along the line. It is picked up by the first operator who is in the center of the truck body, who passes it to the second operator, who places the cable winding to winding in the forward part of the body. Then, as cable accumulates, the second operator hands it over to the third. He rolls the cable into a ring at the back end of the truck body. The operators should change places during work because the one who is in the middle of the body has the hardest job.

The work of removing buried communications cable is significantly expedited and the work of the first operator eased by a manual towing stand with individual hydraulic drives from the wheels. The installation of this device takes not more than 35-40 minutes for any truck. The rate of cable laying along the ground surface increases.

Also worthy of attention is the experience in removing buried cable communications lines. However, as practice has shown, the established norms may be covered if the proper hoisting height is selected for the digging knife under the cable and that it be exactly oriented above the right-of-way in a horizontal plane.

The position of the removed cable upon leaving the cassette is the reference for setting the digging knife. If the knife moves precisely along the path, then the cable moves out of the truck body along the center without touching the sides. Movement of the blade to the right or left is determined by the cable position toward one of the truck body sides. The third operator, who rides the trailer plow during line removal, corrects the blade position by giving directional hand signals to the first operator. The latter, using the tumbler switches on the vehicle's instrument panel, shifts the trailer plow in the necessary direction.

The optimum depth of burying is also determined by the position of the cable upon its exit from the cassette. If the cable is unevenly jerked out of the cassette, then burying should be deeper. When the cable is smoothly unwound, and is pressed against the lower steel roller without gripping, this indicates that the proper burying depth has been selected. The latest modifications of cable vehicles additionally have a portable control panel so that the third operator could move the trailer plow and regulate the burying depth by himself.

An important item to consider during cable laying is the differences in soil, its moisture content, density, and stickiness. The protective layer may be too thick in solid soils, which hampers cable

removal. If the sector of solid soil is small, then the protective zone setting is not changed but assistance is given to manually stretch the cable at the point where it leaves the cassette behind the upper large roller. The protective layer setting is changed when the sector with changing soil structure is of considerable length.

## SHARPENING ELECTRIC TOOLS

(pp 34-35)

Engineer Lieutenant Colonel V. Belikov

The productivity of electrical tools is greatly dependent on how well they are made ready for work. However, this is often believed to be nothing more than a lubrication and adjustment of all mechanisms and the main item is forgotten -- the need to carefully grind and finish cutting surfaces and to properly place the working elements. But it is the state of the planing blades, cutting discs, drills, and milling cutters that determines not only the productivity of the tool but also the quality of the operation performed. Moreover, if the working element is not properly readied, then the tool's service life is reduced. Strange as it may seem, there is but little said on this matter in technical literature. Therefore, in our estimation, it is useful to bring up the basic rules which are most widely used in making electrical tools ready.

We will mention first off that grinding quality greatly depends on the proper selection of the grinding wheel by hardness and graininess. Large-grain wheels do not provide the necessary cleanliness for the processed surface while wheels with too small grains become glazed. As a result, the cutting edges are overheated and their surface becomes bluish in color. It is recommended that the preliminary grinding of a (wood) cutting tool be done with a grinding wheel with a 40-22 graininess and final grinding at a graininess of 25-16. It is best to use the SM-1 and SM-2 soft wheels or, if unavoidable, average hardness wheels ST and ST-1. It must be remembered that the harder the tool to be sharpened, the softer must be the wheel.

The grinding wheel must be checked before it is used and if necessary, it should be adjusted by angling or rounding its faces (figure 1). Any radial or side wobbling must be corrected. Trimming is also done to restore the cutting capabilities of the abrasive. This is done with a diamond pencil. If this is not available, an abrasive wheel or a silicon carbide file with ceramic binding of the grain which is one or two sizes larger than the grain on the wheel to be trimmed may be used. We will mention that the tool to be used to trim the wheels must be fastened to a special holder.

The tool to be sharpened must be fed smoothly and evenly. One should not force the grinding, increase the lateral feed, or press the blades sharply against the wheel. This will lead to a burning of the blades and can ruin the tool. The cutting edges of the sharpened tool must be sharp, without any temper colors, nicks, and scratches, and must have the correct geometrical form.

As a rule, the planing blades of electric planers are sharpened only along the rear face of the cup-shaped wheel to an angle of 15 degrees or rounded. Delivery rate at the end of sharpening, when the blades are formed, must be one-half that of the initial passes. Finishing is added to the blades to eliminate any sharpening defects, to make the blades sharper and, at the same time, of sufficient strength. This is easiest done manually by using a whetstone of white electrocarborandum on a ceramic base with a grain size of 6-10 and a hardness of SM2-SM1. The whetstone must be lubricated. The blade must be so held that its back edge would be at an angle of 2-3 degrees to the whetstone surface (figure 2). The pressure is gradually reduced on the blade and it is rubbed over the whetstone in a circular motion until a face of not more than 0.5 mm is formed on the blade edge. Any nicks or scratches are removed by moving the whetstone, without pressure, first over the front edge and then over the back edge. This increases tool sturdiness by 2-3 times.

It is very important that the cutting knives be properly installed on the drum (rotor) of the planer. All the blades should be at the same distance from the center. If this is not done, only one blade will work; it will quickly dull, and the surface of the processed item will be wavy. The working edges of the knives are set at the same level as the fixed rear skid and strictly in parallel to it. If this is not followed, work quality is poor (a staggered profile is formed) and productivity is reduced. All of the knives must be evenly weighted to prevent drum vibration. They should be weighed together with the fastening strips. The permissible difference in the weight of two pairs of knives of up to 100 mm in length should not exceed one gram. If necessary, the weight of one of the blades is reduced by grinding down the edge opposite to the cutting edge. Metal should not be removed from the side edges.

The cutting knives are set in the drum with the use of a template-scale which is laid against the rear skid. The cutting knife which is in the extreme upper position must lay against the template with its cutting edge along the entire length (figure 3). A properly adjusted cutting knife is lightly tightened with screws and then again checked against the template. The side screws and then the inside screws are tightened and the same sequence followed for the second cutting knife.

The teeth of saw blades are sharpened on an IE9704 lathe with a consideration of the work for which the saw blades are intended. Ripping of wood is done with saw blades with teeth sharpened at a right angle to the side surface. For crosscutting, the saw blades should have teeth sharpened at a sharp angle. At oblique sharpening, it should be remembered

that the sharper the blades, the less stable is their cutting edges. Optimum sharpening of the front edge is at an angle of 50-55 degrees.

All the teeth of a properly sharpened saw blade have an identical pitch, height, and angle with the spaces between them smoothly rounded. In order to reduce tooth friction against the wood, every other one is bent to a different direction. The amount depends on the nature and wetness of the wood (Table 1). In all cases, it should not exceed (to one side) one-half the thickness of the saw blade. The maximum permissible angling of the teeth to one side for the saw blades of the IE5101 (I-153) and IE5102 (S-456) electric saws is 0.8 mm.

Table 1

Type of Wood Processed	Absolute Humidity of the Wood, in %	Amount of Deviation of Saw Blades (to One Side), in mm
Soft (pine, fir)	Up to 30	0.50-0.60
	Over 30	0.60-0.70
Hard (oak, beech)	Up to 30	0.40-0.45
	Over 30	0.50-0.55

The teeth are worn unevenly during the work process and their deviation breaks down. Tool productivity drops and sawing quality worsens. In order to avoid this, a so-called joining is done to the periphery and side surfaces after two or three sharpenings or after tooth deviation. This is done on grinding lathes. The teeth are first straightened by height. The back edges of the teeth are brought up to a rotating polishing wheel. The disc and wheel planes must be mutually perpendicular. As the protruding teeth are ground down, the feed is smoothly increased. Side joining is then done — the protruding edges of individual teeth are ground down. The saw blade is fed to the polishing wheel in such a fashion that their planes would be parallel. It is not permitted to grind down a layer of material thicker than 0.2 mm because this can form flat areas on the edges which sharply increase saw blade friction during work.

This work may also be done manually without removing the saw blade from the electric saw. Safety rules must be strictly followed when this work is done. The safety cover must be in place and the file held in a holder. The work is done at low revolutions (the electric saw is turned on and immediately turned off). The amount of prejoining surface on a tooth should not exceed 0.3 mm. After placing the saw blade into the saw, a check must be made to see that its plane is exactly perpendicular to the axis of rotation and that the latter is identical with the axis of spindle rotation.

Chain saws are filed after 3-4 hours of work. They must be preliminarily wiped and washed in kerosene. It is very important that tooth geometry be retained (figure 4, table 2). It is recommended that PTs-15M chain saws be sharpened in this sequence: first the cutting and undercutting teeth on one side, then the ones on the other side, and finally, the plunging teeth. The front edge of the cutting teeth are sharpened at an angle of 60 degrees, the undercutting teeth at 70 degrees, and the plunging teeth at 90 degrees. The back edges of the teeth should not be processed because this causes a quick reduction in initial deviation. Joining of a chain saw is done by first straightening out the teeth on one side and then on the other. It is usually enough to reduce the height of 10-15 of the more protruding teeth.

Table 2

Angle Designation	Size of Sharpening Angle, in Degrees, for Teeth		
	Cutting	Undercutting	Plunging
Back	9-10	9-10	9-10
Front	0-5	0-5	10-15
Front Edge E	55-65	55-65	90
Back Edge E <sub>1</sub>	54	80	90

The height of the plunging blades in a chain saw ready for work must be 0.6-0.9 mm less than that of the cutting teeth and that of the undercutting teeth by 0.4-0.5 mm. After checking and sharpening, the chain saw should be washed in kerosene and dipped for several minutes into melted solidol and then wiped and the excess grease removed.

A properly tightened chain saw should be easily moved by hand and when tightened with a small force (on the order of one kilogram) should move by 2-3 mm. The chain should move for a short time after the motor has turned off.

The plunger chain should be sharpened along the forward edge. The required leading angle (20 degrees) is done on a sharpening lathe. The blade and chain are set in such a way that its center would be 0.34 of the greatest radius of the blade from the side surface of the grinding wheel. All teeth should have an identical height and angle of incidence of the front edges while the cutting edges should be equidistant from each other. It should be kept in mind that tightness has a particular effect

on the work of the plunging chain. An extremely tightened chain quickly wears out, which leads to an overheating of the guide rollers and motor. An insufficient tightness causes vibration, with the result that accuracy and quality of performed work drop. Chain tightness is checked by pulling it from the ribs of the guide roller with a force of five kilograms. The deflection should be 6-8 mm.

Both the saw and plunger chains which have not been used, initially stretch out during work. This is why new chains must be run at idle speed for 5-10 minutes and then several test sawings performed. Chain tightness is then adjusted again.

Twist (auger) drill bits used for drilling wood against the grain (figure 5) first have the cutting blades sharpened along the back edges, then the undercutting edges, and finally the drill center. The sharpening angle of the cutting edge is 45 degrees. The undercutting edges are sharpened only on the inner side. The cutting edges of a drill must be exactly perpendicular to the longitudinal axis and at the same level; the undercutting edges must have a rounded form and identical height; and the directing center is situated exactly along the drill axis. The height of the undercutting edges is 1-1.5 mm and that of the guiding center is 3-4 mm. Drill bits used to drill openings in wood along the fiber do not have any undercutting edges. The peaks are sharpened at an angle of 60 degrees or 120 degrees.

Selection of the metal drill bit angle of sharpening depends on the material to be processed. Thus, it is 116-118 degrees for steel, cast iron, and hard bronze (figure 5b). The drill bits are sharpened on sharpening lathes provided with special adapters. The drill bits are set at an angle of 58-60 degrees to the side surface of the grinding wheel and rubbed without removing them from the wheel and without changing the angle of incidence so that an even back edge would be obtained. Both cutting edges of a finished tool must have an identical length and must be at the same angle to the drill bit axis; the center of the lateral edge must coincide with the axis of rotation and be at an angle of 55 degrees to one of the cutting edges and 125 degrees to the other.

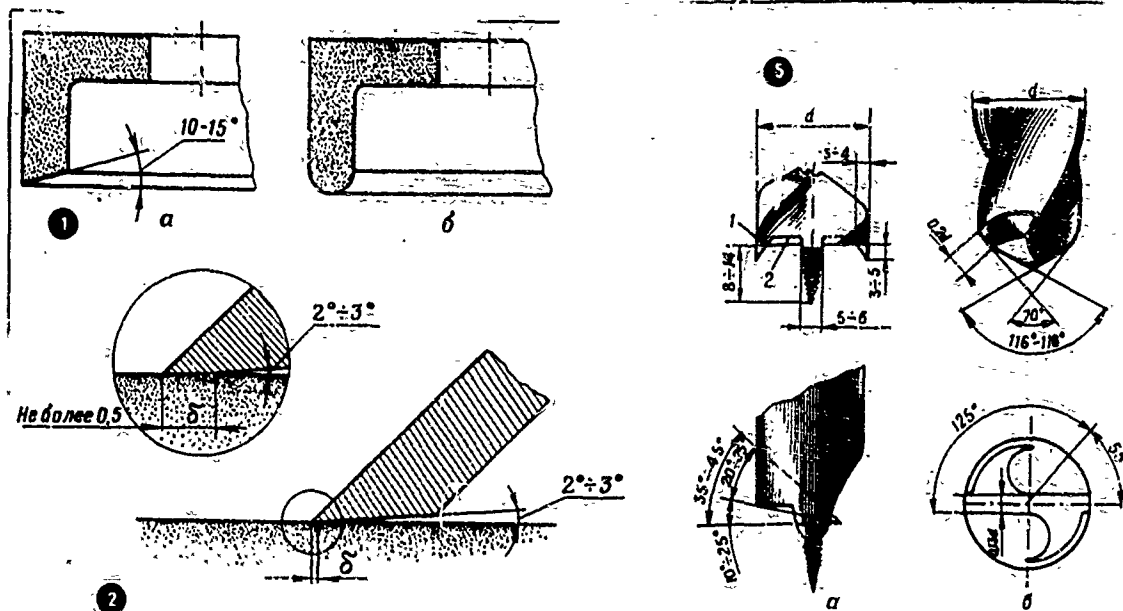


Figure 1. Grinding wheels fixed for undercutting (a) and with a rounded face (b).

Figure 2. Finishing a cutting blade on a whetstone.

Figure 3. Mounting cutting blades on the rotor of a electric saw: 1, 3 - front and rear skids; 2 - template-scale; 4 - tightening screw; 5 - blade; 6 - rotor

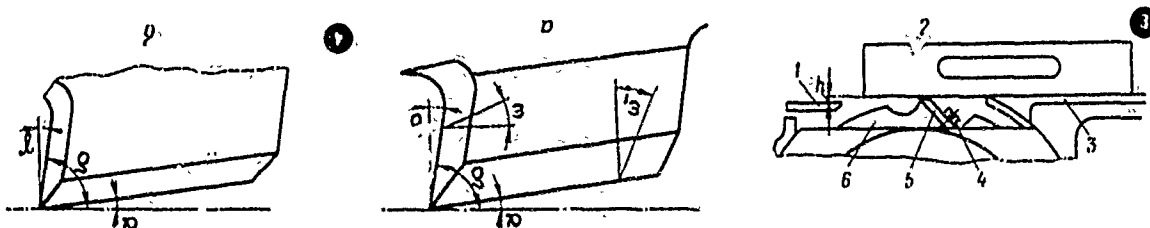


Figure 4. Geometry of cutting (a) and plunging (b) teeth of a chain saw: - rear angle; - front angle; - angle of rear edge honing; - angle of front edge honing.

Figure 5. Drill bit honing angles: a - woodworking auger; b - metalworking twist drill bits.



## HUNGARIAN TANK PERSONNEL

(p 36)

Engineer Colonel Ye. Kosyrev

The military post which we visited on the invitation of our Hungarian friends is named after Janos Hunyadi, one of the wonderful heroes during the struggle against Turkish overlordship. Tank personnel live and train here.

We were met by the deputy regimental commander for political matters, Lieutenant Colonel Jozsef Pot. Naturally, our conversation entered into the training and education of personnel. The lieutenant colonel stated that just as all soldiers of the Hungarian People's Army, the tankmen are persistently mastering knowledge and skills to be a firm link in the defensive organization of the Warsaw Pact.

We were convinced of their successes after having visited the driving exercises. There are many outstanding drivers. An example is Komsomol member Private First Class Istvan Durko. He is a mechanic-driver and has won the title of "Outstanding Hungarian Serviceman" twice. This day, just as always, he brilliantly overcame rather complex obstacles.

We should mention that the regiment has a good material-training base. The tank proving ground and the firing range are automated. All elements are available necessary for fruitful combat training. Underwater driving classes are in a separate building.

We enter the training building. There is a large signal light panel on the wall in the entrance. After giving the signal to begin the next exercise, the duty officer switches the appropriate tumbler switches and, looking at the panel, can see which classes are occupied and which are free.

The classes have standard furniture — light metal frame chairs and tables placed along the wall in the shape of the letter "U". Sectional assemblies and units are set on carts so that they can be moved to the center of the class. Here also are posters, diagrams, electrified stands,

and charts. Some of them are permanently fixed. The others can be removed when there is a need to do so.

There is a film training device in the driving class which they had made themselves. According to the deputy regimental commander for technical matters, Engineer Major Laslo Leanfalvi, the soldiers work with great satisfaction in this class: they are attracted by the training process. There is no doubt as to the usefulness of such training devices. Comrade Leanfalvi was convinced of this through his own experience while studying at the Higher Academy of Armored Troops imeni Malinovskiy. Today, in his own work, he fully utilizes the knowledge acquired during his years of training in the Soviet Union and strives to introduce much of what he learned in the academy into the technical training and vehicle operation practice.

Particular mention should be made that the constant exchange of know-how with tank personnel of the fraternal armies is a long tradition in the regiment. The deputy commander, Major Ferenc Kantor, pointed this out by saying that in their training, the tank personnel constantly feel the friendly elbows of their neighbors to the right and left. To the left lies the Soviet tank regiment which is part of the Southern Group of Forces. To the right, immediately across the border, stands the tank regiment of the Czechoslovak People's Army. The comrades-in-arms enrich their experience and discuss and solve combat training problems during joint exercises, demonstrative exercises, conferences, and in friendly meetings.

The regimental command and the party organization, which is headed by Major Denes Oborni, feel it their primary duty to further strengthen the fraternal ties and the combat readiness of the socialist armies. Our Hungarian comrades base their work on the expressions of the First Secretary of the Central Committee of the Hungarian Socialist Workers Party, János Kadar, who stated that the imperialists "even today have not turned away from their intent to reverse the wheels of history and to unseat, through open force or by subversive activity, the rule of the working people in socialist countries. However, the Soviet Union and the socialist countries have sufficient power to properly repel the efforts of any aggressor to conquer them. Hungary deems it necessary to strengthen the organization of the Warsaw Pact which is a mighty and reliable shield for all socialist countries and for all humanity."

We parted from our comrades-in-arms at the peak of the training day. In the name of the regiment's personnel, Lieutenant Colonel Jozsef Pot asked us to transmit warm greetings to the Soviet tank personnel in conjunction with the traditional holiday — Tank Day — and to assure them that the Hungarian tank personnel, just as the entire Hungarian army, are always ready to carry out their military duty.



One of the best methodologists in the chas', company commander Captain Bela Chibro gives much attention to training driver-mechanics.



Private First Class Ondras Tonay and Private Ervin Feldi have much to learn from the experienced repairman, Senior Sergeant Laos Zok.



Tank driver-mechanic, Private First Class Istvan Durko, carried out his exercise with an "outstanding" rating.

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best available copy.

Colonel M. Sekirin, docent candidate of historical sciences

The expanded net of radio and wire communications is often compared to the nerves of a living organism. Just as a disruption to the physiological continuity of nerve fibers results in human ailments, so any breakdown in communications has its effect on troop control. This concept is found throughout the book by Marshal of the Signal Troops I. T. Peresyphkin.\* Its author traversed the rough road from an enlisted political soldier and signal battalion commander in the Red Cossack division to USSR Peoples Commissar of Communications, chief of the Main Signal Directorate of the Red Army, and Deputy Peoples Commissar of Defense. The establishment and development of the Soviet signal troops took place before his eyes and with his active participation. The technical rearming of the Red Army on the eve of the war required huge resources. In the event that war erupted, it was planned to make wide use of peripheral centers and general state communications lines. Even more so because considerable results had already been achieved in the development of the country's telephone system and radiofication. The first large groups of shortwave and ultrashortwave radios and field radio centers were made available prior to the war to the national economy and to the troops. Postal and other means of communication worked well. But there were those difficulties which had to be eradicated after the war started.

The complete lack of cable lines at the beginning of the war had a negative effect on the stability of wire communications. Because all of the communications lines were overhead lines and were suspended along railroads and highways, they were frequently made inoperative by enemy aviation and diversionary groups. This resulted in the loss of communications at the army-front-center level and communications were also disrupted at the troop level.

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\* I. Peresyphkin. "... And Even More Important In Battle." Moscow, Sovetskaya Rossiya Publishing House, 1970, 253 pages with illustrations, cost 87 kopecks.

Many commanders and headquarters relied on telephone (wire) communications with which they were accustomed. But since it was often broken, it was felt that communications were lost. Not all knew how to make use of radios. Some simply underestimated the role of radio communications or else were afraid that enemy radio intelligence would fix the position of the command post (headquarters) so that they sent the radios as far as possible from their dispositions. The book's author referred to this radio fear as "a child's disease in the initial period of the war."

Considering the experiences of the initial engagements, the General Staff and the Supreme Field Headquarters of the Supreme Commander in Chief made a judgment of this so-called radio fear and its concurrent underestimation of the means of radio communication. The decisive introduction of radio into troop control became irrevocable. Personal radios were introduced for commanders and commanding generals, which followed them in all situations. "Radio communications with the use of personal radio sets," comments the book, "were so organized that the commander would have the possibility to tie into the senior officer, with subordinate troops, and with his staff. The introduction of personal radios was a very important measure and played a great role to improve troop control."

The book also describes the material-technical prerequisites which make possible the establishment of stable communications at the troop level. A new radio plant was established during the first months of the year which began the mass production of portable shortwave and ultrashortwave 13-R and A-7 radios. Nearly 70,000 of these sets were made available to armored troops and artillery chasti during the war.

Even earlier in Moscow, a telephone and telegraph equipment plant was set up in the buildings of evacuated enterprises. Machine tools from the Krasnaya zarya and Kinap plants were delivered to it by aircraft and across the Road of Life from blockaded Leningrad. Specialists called back from the front, together with the workers and their families, set up in an unbelievably short time the manufacturing and delivery of telephone equipment, field telephone switchboards and stations to the front.

It is only regrettable that in the recollections of I. T. Peresypkin, little is said on how the development and assimilation of many new models, the modernization of existing equipment including telephone and telegraph sets, switchboards, and low frequency amplifiers, and the modernization of field telephone and telegraph cables took place during the war years. The author could have acquainted the readers with the scientists and designers who provided the front with such remarkable portable radio sets as the RB, RBM, RSB, the Partizanka and Sever, the RAF and RSVF vehicular radios, the RUK-5 radio centers, and the Karbid attachment which, in combination with the RAF-KV-4 and RAF-KV-5 radios, provided letter printing communications by August 1944.

The book's contents were determined to a certain degree by the author's personal experience and service. He examines in considerable detail the communications support for the battles at Moscow, Stalingrad, and Kursk and the operations conducted at Voronezh, in the Donbass, on the Dnepr, beyond the Dnepr, in Belorussia, Poland, and Germany.

The reader is acquainted with certain changes which took place in the organization of communications. For example, front-level radio groups with three or five radios were used in the Right Bank Ukraine and the first mobile telegraph-telephone center installed in the bodies of 12 vehicles was used in Belorussia. This center had Bodo and ST-35 equipment, telephone switchboards, and high frequency telephone equipment. As practical experience shows, the mobile centers fully justified themselves as they were able to maneuver and promptly establish communications during the shifting of front and army headquarters. Two-way radio communications and communications by elements of the operational rear over independent networks were implemented for the first time.

The clear descriptions of the deeds of the signalmen is one of the merits of the book. It is known that more than 260 signalmen were awarded the title of Hero of the Soviet Union and tens of thousands were awarded battle orders. Many warm words are spoken about the signalmen-girls who demonstrated bravery and loyalty to the homeland on the fronts of the Great Patriotic War.

The author did not avoid inaccuracies of a factual nature. Thus, pages 149, 151, 152, and 153 describe his visits to the control elements of allegedly the 38th army. But since it describes his meeting with K. S. Moskalenko and his cohorts, then reference is obviously being made to his visit in early 1943 to the 40th army, which was operating on the Voronezh Front. General K. Moskalenko commanded the 38th army up to July 1942 and then again beginning in October 1943.

In recalling the offensive in Eastern Prussia, the author erroneously feels that our troops captured the city of Gumbinnen in October 1944 (page 231), whereas this actually took place on 21 January 1945.

Obviously, the listed errors do not reduce the overall worthiness and rich concepts of the book.

## SERVICING CHEMICAL EQUIPMENT

(pp 38-39)

Lieutenant Colonel M. Shnir

Each chemical-reconnaissance man is well aware that the operation of chemical reconnaissance equipment at low temperatures is characterized by a reduced sensitivity of the indicator tubes to toxic agents because the reaction speed is reduced.

In order to avoid this, some indicator tubes have to be warmed up in winter in a special heater which is part of the set. Care must be taken in doing this. The tube with the red ring and dot must be placed in the side socket (test and control tube) before using when the temperatures are negative. When the ampules thaw out, the tubes must be immediately removed and one placed in the rack and the other in the pump opening. If this is not done, the reagents may overheat and lose their properties. As soon as air is sucked in through the test tube, both tubes must be warmed up for one minute and then the lower ampules may be opened. A longer holding time (in determining toxic agents in harmless concentrations) also should not exceed the prescribed time.

For example, the sensitivity of the indicator tube with the single yellow ring noticeably decreases not only at negative temperatures but also at positive temperatures which do not exceed 10-15 degrees Centigrade. The most favorable conditions for interreaction of the reagents with the toxic agents occur if the tube is warmed up for several minutes after air intake. A change in the color of filler element can then be noticed.

A reliable tube which gives true readings in winter and summer is the one with three green rings. However, in the case of dubious readings, it also should be placed for a time in the heating unit. After this, then, is when the coloration of the filler element should be determined.

The work of the automatic gas signalling unit depends on the temperature. When cold air is drawn through the indicator tape which has been soaked with a liquid reagent, it becomes wetter than at positive temperatures. As a result, there is an increase in the

aerodynamic resistance of the main gas line. Increased dampness of the indicator tape may also be caused by larger reagent drops falling on the tape when the instrument's work cycle is changed. If this time period increases by even a portion of a second, the size of the drops increases by 10-15 percent. This can take place as the chemical scout tunes the instrument in a warm building but works with it in the open air. The tape drawing mechanism will naturally undergo strong loads. Movement will be slowed down and the time-cycle shift will increase.

It must be remembered that such changes reduce the efficiency of the pump drawing the air to be checked through the main gas line. This is why it is necessary to make sure that a normal voltage (not more than six volts) would be applied to the electrical motor and that the sizes of the drops would be properly adjusted.

During the winter, the condition of the reagents in the drain tank should be checked more frequently, every four hours of operation, and promptly removed. Otherwise, the absorption filter may become polluted. It is also important to make more frequent checks than usual of the supply voltage in all circuits because the capacity of a storage battery sharply drops in very cold weather. This requirement pertains to all machines and instruments in which storage batteries are used.

Thus, the water system of the TMS-65 must be warmed up (blown through) by the exhaust gasses from the vehicle engine before starting. This operation is performed until warm gas escapes from the drain cocks and valves. If the outside air temperature is below  $-30^{\circ}\text{C}$ , then the same must also be done with the oil in the hydraulic system. This is done by switching the hydraulic system oil pumps to the "idle" state or else warm the oil tank with warm air or exhaust gasses. The oil must be drained from the system upon work completion.

In readying a machine to operate in cold  $30-40^{\circ}\text{C}$  weather, the water system pipelines, the 2.5 VS-3a pump, and the slide valves and drain cocks must be warmed. The pump is warmed by a blowtorch until such time as the external shaft can be turned by hand. After the engine is started, the water system should be filled with hot water from special containers (if the vehicle is moving, the water in the containers can be heated by the exhaust gasses). In very cold weather, the inner walls of the water system lines and sleeves become covered with ice; it must be removed every so often. Upon completion of work, water is pumped out of the system by means of the 2.5 VS-3a and the drain cocks and plugs left open.

Solar oil is usually used to start the AGV-3 power unit for a steam boiler. During winter, a mixture of solar oil and gasoline is used in a 1:1 ratio (by volume). This mixture is made ahead of time and stored in a small compartment of the fuel container. Before activating the mechanical pumps and fan, the Moskvich engine must be warmed with



the radiator closed. The pumps are turned on consecutively. First, the oil pump, and then the water pump. The oil pump is manually turned to prevent breakage (the water pump must be disconnected — the belt removed from the pulley wheel). Between these two operations, the steam boiler should be filled with water and when hot water appears in the system, both pumps and walls of the fuel container are warmed. The fuel must be warmed to prevent any interruptions in the work of the jet nozzle. If this is not done, the fuel filters may ice up at the intake pipe.

The jet nozzles must be turned on at intervals of 5-10 minutes before switching on the water pump, the steam collector heated with a blowtorch, and the steam hose, one end of which is lowered into the tank with water, is connected to its middle opening. The water pump shaft is turned manually and the gearshift disconnected when the belt is placed on the pulley wheel. The steam hose is used to warm the water lines.

Only warm water should enter the boiler. Both valves in its drain line should be so adjusted that the water would flow in a thin stream from the system, otherwise the system may freeze up.

In stopping power machinery during winter, it is also necessary to take certain of its features into consideration. For example, when fuel delivery to the fire box ceases, the valves on the steam collector must be closed and the valves and cocks on the boiler and steam lines opened. The latter actions are necessary so that steam would not condense in the steam lines. The water pump must be placed into a neutral position and the water completely removed from the liquid-carrying utility lines.

The condensate must be promptly removed from compartment machinery and if necessary, steam hoses should be used to heat all of its utility lines. Valves and cocks should be opened upon completion of work.

When operating the ARS-12 and DKV machines during winter, an effort should be made to prevent freezing of the deactivating solutions in the utility lines, tanks, and instruments. Prior to starting, the ARS-12 mechanical pump must be heated with hot water and the same done to the power box housing. Then, after manually turning the pump's drive shaft, the pump should be made to operate at low revolutions. After work is over, all fluid should be removed from the utility lines and units. The PR-4 pistol grip and hose nozzle must be kept dry and constantly rubbed. The hoses and sleeves must not be sharply overheated because rubber becomes brittle at low temperatures and cracks at the bends.

In order for the TDA machine to work without interruption during the winter, the power take-off box, the gears, and the assembly drives must be warmed up with a blowtorch following which the machine is "cold started" and the jet nozzles in the combustion chamber are fired up. Gasoline will sometimes not ignite so it is necessary to open the

butterfly valve of the air line. If this does not help, then it is recommended that the casing of the combustion chamber be warmed with a blowtorch. The temperature in the chamber is brought up to  $900^{\circ}\text{C}$  and the smoke-forming substance in the tank is heated to  $15-20^{\circ}\text{C}$ .

The operation of degassing units also has its own features in cold weather. Thus, when the temperature is  $-10^{\circ}\text{C}$  and lower, the DK-4 gas-fluid sleeve can be straightened out only after it has been heated for two minutes with a gas-liquid stream.

It was not by mere chance that we dwelt on some features of equipment operation under winter conditions as by not knowing them, it is impossible to establish accident-free work of the equipment.

## HELICOPTERS IN THE FALL

(pp 38-39)

Engineer Colonel I. Kurmaz, candidate of technical sciences  
Engineer Lieutenant Colonel N. Mikhaylychev

The operation of helicopters during the spring and fall, in the so-called transitional periods characterized by sharp temperature variations and profusive rains — is associated with certain difficulties.

During the readying of equipment to operate at this time of year, particular attention should be given, along with other jobs, to the fitting and repair of covers, silencers, airtight covers and hatches, and to fuel tank caps. The prompt checking of the proper functioning and cleanliness of fuselage drainage compartments and the tail beams is of great significance. If the drains are clogged, then at low temperatures the water which has accumulated in the compartments freezes, a matter not permissible for those areas where such important elements are placed as rotor reducer, hydraulic boosters, and the control system actuating arms.

Icing of the helicopter's rotor or tail rotors can lead to dangerous consequences during the starting process or at the moment the transmission is engaged. Experience shows that ice forms essentially at the ends of the blades, particularly if the drainage openings are clogged with snow or ice.

Icing of the blades causes a change in the aerodynamic and weight characteristics of the rotor, with the result that engine revolutions are reduced, as is the amount of tractive force produced by the blades. Moreover, helicopter vibration can increase significantly. Consequently, each time before an engine is started, it is necessary to check the condition of the rotor and tail rotors and any ice which has formed on their blades must be removed. Particular attention should be given to the blades of the tail rotor because a thin transparent layer of ice occasionally forms on their surfaces which cannot be detected if helicopter inspection is performed without the use of special stepladders. Strong rocking of the helicopter when the engine is working is a sign of icing of rotor blades.

A disruption in the weight balancing of the tail rotor caused by icing of its blades leads to a higher vibration level of the tail beam and causes shaking to the helicopter. As a result of this, there is a higher stress applied to the horizontal hinge insert supports of the rotor and tail rotor.

The most serious attention must be given at parking areas to prevent snow and water from falling on the rotors. Particular care must be taken in removing the protective covers from the rotor and tail rotor blades because any freezing of the covers to the rotor blade surfaces can lead to damage. This can be prevented by warming the covers with hot air; particular care must be given to the temperature in the immediate blade area which should not exceed 80-70° C. After the covers are removed, the blades are warmed and then rubbed with dry rags to prevent freezing over.

When examining an engine prior to starting, a check must be made to ensure that the rotors of their compressors and free turbines have not frozen to the body. This is done by turning the rotors a few times, using the meter and a half long metal rod with a piece of rubber hose fastened to one end. If this operation requires considerable effort, then engine heating should be done by using a heating unit.

Engine starting at low temperatures is difficult because of the higher viscosity of the oil and lubricants and also because of poor fuel evaporation. Under these conditions, it is necessary to carefully control the charge state of the onboard storage batteries and the proper functioning of airfield starting facilities because any attempt to start an engine from low charged onboard storage batteries or malfunctioning electric power supply sources may lead to an extremely high (spattered) temperature of the gasses beyond the turbine and cause engine pumping.

When the ambient temperatures are low, it is recommended that the rotor reducers also be heated to a temperature at which their blades turn freely. The degree of oil rarefaction in the reducers must conform strictly to the ambient temperature.

When a piston engine is started at low temperature, gasoline may not be added until such time as the fuel-air mixture ignites in the cylinders. Otherwise, the condensate forming on the sparkplug electrodes hinders starting considerably. Even in this operation, positive results will not always be obtained if the butterfly valve is opened and the "step-gas" lever is raised. A premature engagement of the transmission, without sufficient heating up, increases cranking time and can lead to an overheating of the clutch coupling.

The following are indicators of a weight imbalance of the blades: shaking of the helicopter, a movement of the rotor blades out of the cone, and rocking during steering. One of the causes of the weight imbalance of blades can be an accumulation of water in the spaces of

its compartments. If there is a large amount of water, the center of gravity in the compartments is moved to the rear edge of the blades with the result that the antifriction characteristics of the rotor deteriorate.

A cause of moisture accumulation in the compartments of all-metal blades cellular filler is the clogging of drain openings. It is therefore necessary to periodically check them and, if necessary, clean them out by using a wire with a rounded end.

The centrifugal blade overhang limiters will sometimes seize at low temperatures because of excessively greased shafts. Therefore, when the temperature drops to  $-10-15^{\circ}\text{C}$ , it is necessary to remove the excess grease and, slightly lifting the blades, check their movement. If the overhang limiter shaft seizes, it should be washed out and then greased again.

The low temperatures sometimes cause the control cables to hang and occasionally to such a degree that they make contact with structural elements. In individual cases, the movement of the control elements is reduced. These are the reasons which demand a periodic check on cable tightness using a tension gauge.

In addition, reduced tension causes increased vibration of the cables and the bushing and roller bearing unit. There is also a greater probability that resonance vibrations will occur in this unit which causes it to wear out rapidly.

Such are but some of the more characteristic features of operating helicopters during periods of sharp temperature drops. A knowledge of these features will help the personnel to ensure flight safety and to raise the combat readiness of the equipment.

## FROM RATIONALIZATION TO INVENTIVENESS

(pp 40-41)

Major Technical Service V. Yamchuk  
honored RSFSR efficiency expert

Over the past five years, our chast' has maintained first place in the district in the organization and results of efficiency expert and inventive work. It was awarded first prize for achievements in this field during the All-Army competition honoring the 100th anniversary of V. I. Lenin's birth.

The successes made by the personnel in their technical creativity are quite logical. The chast' has modern equipment whose operation and maintenance requires broad knowledge, great experience, and a proficient approach to the solution of daily technical problems which are constantly brought up. All of these qualities are possessed by the officers as well as by the soldiers and sergeants, the majority of whom have a middle and middle-technical education. It is within their grasp to solve such important tasks as improving the methods and reducing the time required to perform adjusting operations and repairs to equipment and the creation of devices ensuring the automation of individual productive processes. Implementing the concepts of the innovators, various devices were created within the chast' to extend the service life of equipment as were many training aids and technical training means.

Because of the enthusiasm and initiative of the soldiers, repair and adjusting operations were specialized and several repair workstands were developed, equipped with diagnostic instruments to evaluate parameters.

The command and the party and Komsomol organizations are demonstrating constant concern for the efficiency experts and direct their creative searches for the solution of the more vital problems. Favorable conditions have been established for this work. In each podrazdeleniye there is a shop with measuring devices, tools, and machine tools. There is also an experimental production base. True, it is not large, but it is so equipped that the necessary complex models suggested by the efficiency experts can be made there. In

addition to the necessary materials and tools, it also has ready-made standard assemblies and stages by means of which it is possible to assemble the necessary radiotechnical devices and check their operating efficiency and characteristics.

As a rule, the youth show great interest in technical creativity. However, some of the soldiers do not have confidence in their own effort. Thus, a kind of psychological barrier is developed behind which are hidden many potentially creative capabilities. A favorable situation, thoughtful individual work with each beginning innovator, patience, and tact is required to uncover them and to direct them along the proper channel. It is not only necessary to help the young efficiency expert during the first stages, but also to give him some hints on how the work should be done. Herein lies one of the main duties of the commission on inventions which, in our case, is composed of officers who have rich practical experience in organizing efficiency expert work. The personal participation in technical creativity by commission members, especially of its chairman and secretary, helps to further understand the works and needs of the innovators.

The belief exists that far from every engineer or technician is able to become an efficiency expert, that talent and calling are required for this. Our experience makes it possible to affirm that anyone who has anything to do with it not only can but must improve equipment and the methods of its repair and operation. This is the reason why we strive to shift the center of efficiency expert work to the podrazdeleniye. This facilitates the application of a mass nature to technical creativity.

So it is not by chance that we give such great attention to the activity of the company and battalion committees on the organization of technical creativity. They are formed on communal beginnings. The committees include engineering and technical officers, secretaries of the party and Komsomol organizations, and active efficiency experts. The committees are headed, as they should be, by the podrazdeleniye commanders.

The duties of the committee are quite varied: its members actively take part in implementing the plans of efficiency expert work compiled by the commission on inventions of the chast' and make thematic tasks known to the personnel.

The committee also does much work to propagandize technical creativity and to give concrete assistance to the soldiers. Considerable success in this field was achieved by the committees headed by Major V. Rudenko and Engineer Major I. Belash.

An example of the work of bringing in youth into technical creativity is the work done by the committee member in one of the podrazdeleniya, Engineer Major I. Korzun. On his recommendation, a young soldier, Private G. Netrebo, was able to develop a necessary

but simple control device for a job; then, with the assistance of the officer, he worked out his first suggestion. It was adjudged to be an efficiency expert item and its author was awarded a monetary prize; his comrades warmly greeted his successful beginning in creative work. A year later, the members at the district conference on inventions reviewed with great interest a signalling device for the security of individual sites which had been made on a high technical level. It was developed by Netrebo who was now a sergeant.

Because of the concern shown by the committee, a friendly collective of innovators is at work in this podrazdeleniye. In one year, they developed 33 valuable efficiency expert suggestions. The author of one of these, Private First Class V. Kanareykin, was awarded a gold medal by the USSR VDNKh.

Recently, Sergeant G. Netrebo, Private First Class V. Kanareykin, and other efficiency experts were discharged into the reserve upon completing their period of service. It can be said with confidence that the creative approach to assigned tasks which they learned in the army and the ability to critically examine any complicated technical device has made them valuable workers for the national economy.

The solution to complex technical tasks by the efficiency experts of the chast' has opened the road not only to develop efficiency expert suggestions whose value go beyond the limits of the chast', but also to inventions. True, it was not an easy thing to make the step from efficiency expertise to inventiveness. It was necessary to clarify for the efficiency experts the essence of inventions on the examples of simpler technical decisions covered by patents. The commission on inventions had to do much work. Its secretary, Engineer Major Ye. Savitskiy, was sent to take courses at the All-Union Society of Inventors and Efficiency Experts where he heard lectures on the fundamentals of patent handling, on the order and rules to make up requests, and other matters.

Studies were held with the efficiency experts aktiv during which such matters were discussed as how to make up a description of the invention and its main element — the formula, they learned the significance of "a substantive innovation," "priority," and other matters.

The study of patent information was organized within the limits of possibility so that authors, upon engaging in complex developments, would know in which direction to develop equipment in their fields of interest. For this purpose, the library subscribed to necessary literature and, in particular, to such periodicals as the bulletins entitled "Discoveries, Inventions, Commercial Models, Trade Symbols," "Questions on Inventions," and "The Inventor and the Efficiency Expert."

The results of this work were eight requests filled out on proposed inventions. The first positive decision on the issuance of author rights was received by Engineer Major Ye. Savitskiy. The district command warmly congratulated the inventor for his creative success.



Thus, the efficiency experts and inventors of our chast' are implementing the instructions of the Directive of the 24th CPSU Congress on raising the incentive role of patent matters and patent information.

## REQUESTS DEPARTMENT

(p 41)

### Requests

21. Engineer Major Yu. Znamenskiy: Information is requested on how to dry high pressure cylinders and absorbers.

The method we use of blowing them out with dry air takes up much time because the humidity has to be frequently checked by an indicator.

22. Engineer Lieutenant Colonel V. Tert'yakov: We are interested in a method or a portable item to check the density of welded seams in pipe connections during assembly.

We encountered difficulties in checking the completed pipelines for solidity.

### Requests Fulfilled

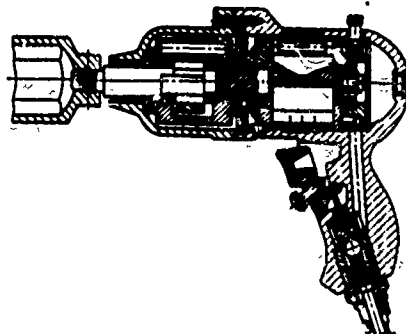
17. Senior Technician-Lieutenant A. Repin (No 7, 1971) was interested in a device using an electric or pneumatic tool to remove pins and bolts from motor vehicle engines and assemblies.

As reported by M. Frolov, the senior engineer at the "production-technological service to agricultural production" pavilion at the VDNKh USSR, a device of this type — the PIM-1763 (P3130) reversible pneumatic socket tool — was demonstrated at the pavilion. It was used to tighten and unfasten bolts and nuts during assembly and disassembly jobs.

It consists of a reversible pneumatic rotating motor, a handle with starting device, an impact-pulse mechanism, and a housing. The motor is located in the front part and includes a stator, rotor with four blades, and a front and rear cover closing off the stator. The reversing ring is located in the back cover, it changes the direction of the compressed air entering the motor.

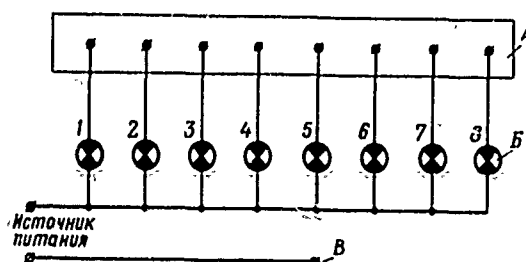
Before beginning work, a socket to fit the bolt or nut to be worked on is placed on the spindle. The socket is then placed over the nut or bolt and the impact wrench started by depressing the trigger. These are the technical characteristics of the impact wrench: maximum moment on the wrench — 20 kilogram-meters, thread diameter (for steel) — M6-M18 mm, number of idle revolutions by the spindle — 10,000 rpm, air consumption for tightening — 0.9 cubic meters per minute, air pressure in the net — six atmospheres, size — 212 x 76 x 178 mm, weight — 2.5 kilograms.

The PIM-1763 impact wrench is series produced by the Gorodok "Soyuzsel'khoztekhnika" repair factory, Ukrainian SSR. Its list price is 20 rubles.



# THE EFFICIENCY EXPERT RELAY.

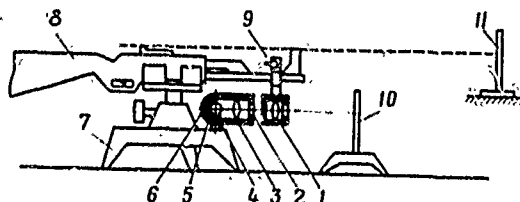
(pp 42-45)



A device developed by Soviet army employee A. Medennikov helps to quickly determine the numeration of cable leads when they are unsoldered into plugs, sockets of various types, and tips. It can also be successfully used to number the leads of cables and braided wires.

The device consists of sockets A to which the inserts of the plugs, terminals, clamps, or hooks for tips are attached, a 1.5-24 volt light B, and a power source and separate lead C.

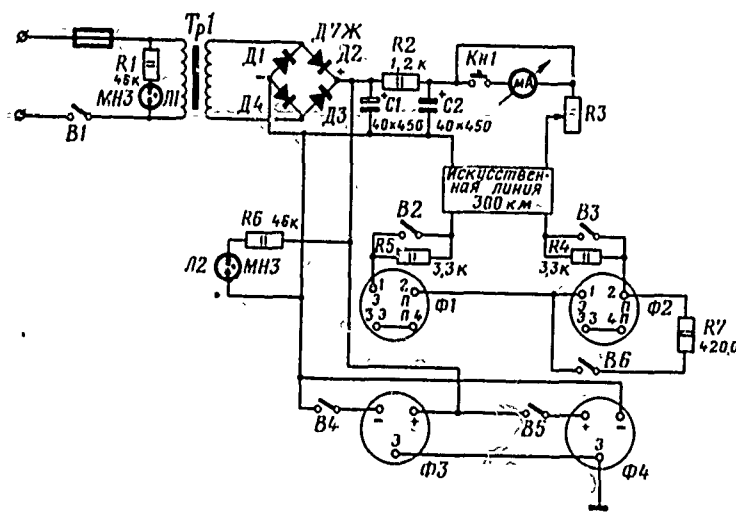
The finished end of the cable (plug, tip) is connected to socket A. Any lead from the other end of the cable is connected to the separate outlet C. The light which lights up indicates the lead number. The number of leads in a cable to be unsoldered can be unlimited.



As reported by Lieutenant Colonel N. Tamanov, an optical cap to control sighting practice was suggested by Engineer Major A. Ganin and

Sergeant reenlisted service V. Yefimov. It consists of an objective 1, which is fastened to the barrel of the submachine gun 8 by screw clamp 9, and an illuminator 4 mounted on the sighting stand 7. The illuminator has a reflector 6, an electric light 5, a condensing lens 3, and a target glass 2 with cross hairs. The illuminator may be powered from a 6 or 12 volt storage battery.

Preparations for training are done by placing the submachine gun on the sighting stand and training it on target 11, set up at an actual distance. The size of target 11 depends on the focal length of the objective. A second, control, target 10 is placed opposite the illuminator in such a way that the cross hairs of the target glass would be projected in the center of the target. The illuminator is turned on by closing the contact under the trigger. The trainee aims and "fires." When the contacts are closed, an image of the cross hairs appears from whose position it is possible to evaluate the sighting accuracy.

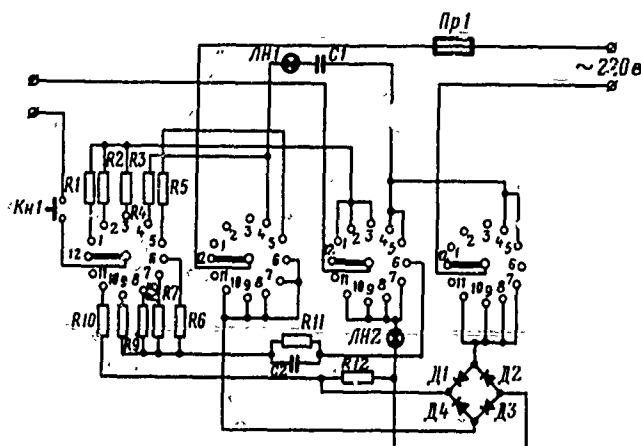


As reported by Major V. Matchenko, the telegraph apparatus check and adjustment panel suggested by Senior Sergeant reenlisted service A. Ruznetsov makes possible direct shop checking and adjustment of telegraph sets operating "on the line" and "on itself."

Power is obtained from the 220-volt alternating current network. The voltage is stepped-down to 110 volts on passing through transformer Tr1. It is then fed through rectifiers D1-D4, smoothing filters C1-S2, and onto the motor and line plugs F1, F2, F3, F4. The plus of the smoothed current is applied to the dummy line through resistor R3, which is a resistance rheostat from 0 to 1,200 ohm calibrated every 100 ohms. A milliamperemeter is connected to this line by button KN1. At the same time, the positive voltage is fed to the second socket of line plug F2 and the negative voltage through the dummy line to the first socket of line plug F1. Connecting the second socket of plug F1 and the first

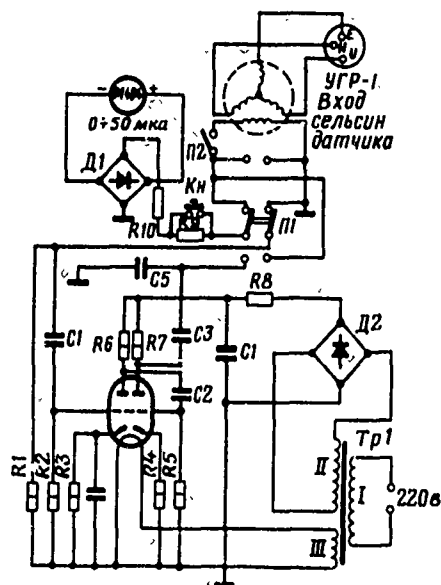
socket of plug F2 sets the operating conditions for two sets similar to "on line" operation.

The "self" operation of the telegraph sets is checked by using the panel to which resistor R7 (or the electromagnet of the CT-2M apparatus) is mounted and is connected to sockets 1 and 2 of line plug F2 through tumbler switch V6.



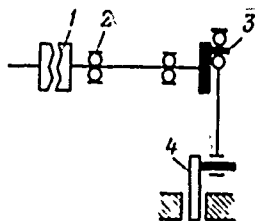
An adaptor to check the operating efficiency of the AVO/5M device was suggested by Soviet army employee A. Vaselkov. A direct or alternating voltage and a direct or alternating current of a given magnitude can be obtained at its output; it can also be connected to the output to calibrating resistances of three nominals.

The operating efficiency of the device is determined by the readings of the indicator. Resistance is measured on all three scales, voltage on one and current on four.

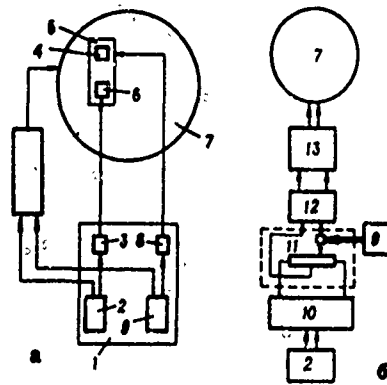


The standard selsyn-receiver developed by Soviet army employee V. Chernyavskiy is intended to check selsyn-counters and course selectors in UPK-3, UPK-SI, and PA-AGD units under both fixed and field conditions.

It uses a selsyn-receiver from a PA-AGD aviation unit with a 360-degree scale graduated every one degree. The vernier scale computes angles to an accuracy of 0.1 degrees. The panel uses a detector volt meter with a measuring range of 0.5 and 15 volts and a tube volt-meter with a measuring limit of 25 and 150 millivolts to determine full coordination of the standard and checked selsyn.



A bit to punch openings for a horizontal-milling machine was developed by Soviet army employee G. Kravchenko. The horizontal shaft is mounted on two radial ball bearings 2. A crank 3 is at the end of this shaft to transmit advance-return movement to plunger 4, to which the punching tool is fastened. The bit engages with the machine tool spindle by a clutch coupling 1. The bit mechanism is mounted in a welded case whose flange is fastened to the machine tool bed.



The device to teach drivers how to handle transport vehicles was developed by Engineer Colonel A. Kuperman, Engineer Lieutenant Colonel I. Shur, and Soviet army employee A. Dombrovskiy (author's certificate for an invention No 247810). It is successfully used at the Riga Higher Military Engineer Aviation School imeni Yakov Alksnis.

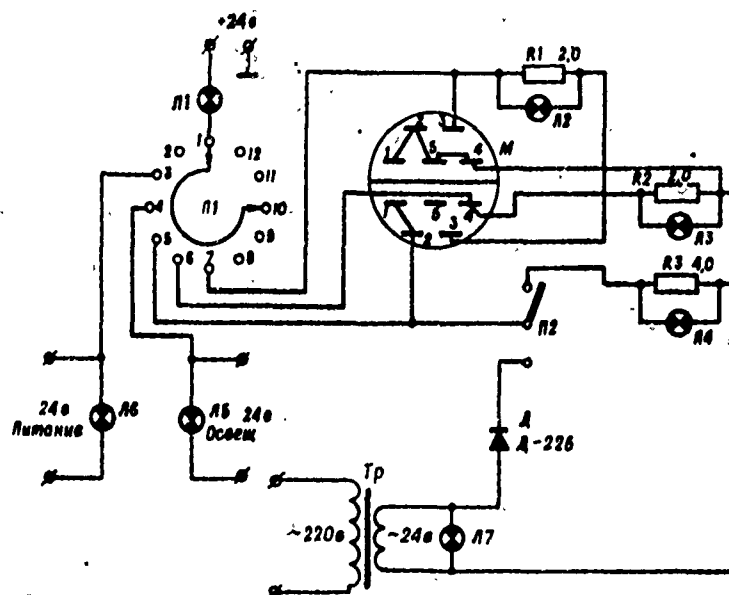
This training device differs from known similar-type training devices in that it permits any maneuvering to be done with a scale model without changing its position relative to the driver. The terrain mock-up is of a repeat type automatically controlled by a reversible electric motor powered through a control voltage amplifier. The magnitude of the voltage is proportional to the sine of angle of steering wheel turn and the speed of the scale model formed by a sine electric transducer and tachogenerator.

The functional diagram of the training device is shown in figure a, the functional diagram for driving the terrain mock-up is shown in figure b.

The training device consists of a stationary driver's cab 1, a moving model 5, a rotating terrain mock-up 7, and an automatic system for driving the terrain mock-up with a power unit 2 and coupled to a selsyn-counter 3. Selsyn-counter 8 is coupled to the steering wheel drive 9. The model 5 has selsyn-receivers 4 and 6 coupled respectively to the drive and turning wheels.

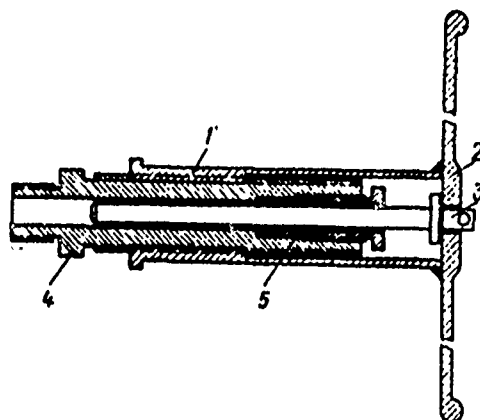
The system powering the terrain mock-up includes a tachogenerator 10 connected to a power unit 2, a sine electric counter 11 connected to the steering wheel drive 9, a booster 12, and a reversing motor 13 which rotates the terrain mock-up.





A panel to check the VZA storage battery charging rectifier of an RAS-KV and RAS-KV-K radio was developed by Soviet army employee P. Adgin. It is used to check (outside of the radio unit) the VZA rectifier's conformity to technical conditions. The rectifier is connected to the panel by couplings and grid prongs.

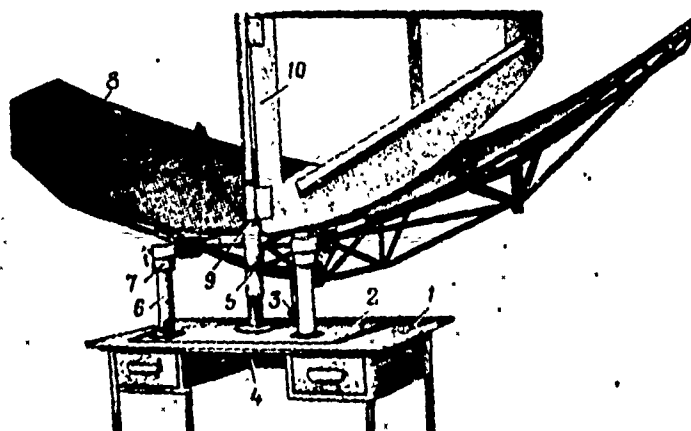
Power supply and lighting is checked by short-term switching of switch P2. The burning of bulbs L5 and L6 indicates a 24-volt direct current. The electrical circuits are checked for short circuits by using the P1 disc coil switch. If bulb L1 lights up at this moment, it means that a short circuit has occurred.



The oil press, designed for a pressure of 250 kg/cm<sup>2</sup>, following modernization performed by Major I. Krivokhizh and Soviet army employees

D. Burkov and L. Ladyzhenskiy, develops a pressure of  $2,000 \text{ kg/cm}^2$  and more. The modernization is in making the press sleeves from vinyl chloride, ring-shaped, and immovable. The drive screw is also immovable and simultaneously serves as the cylinder 4 for the rod. The diameter of this screw was increased to 30 mm so that the threads would be stronger. The immovable sleeves 5 provide dependable packing and long-term work of the press.

A special nut 1 fastened to the pilot wheel 2 moves along the drive screw and displaces the 10 mm diameter rod 3, which is made from stainless steel. The press is filled with transformer oil.



Soviet army employee R. Churashev suggests that the parabola and alignment of radar antenna mirrors be checked by means of a special device. It is mounted on a table 1 and consists of a plate 2 to which two supports with nuts 7 are fastened, a support 5 with nut 9, and a clamp 4. The template 10 is fastened to support 5 in such a manner that it can displace vertically and rotate around the vertical axis. The antenna to be checked 8 is fastened by a jack 3 and two bracket arms of the antenna framework to support 6.

The mirror is placed in the plane of the template surface by tilting the antenna along the large axis of the paraboloid by means of nut 7 and along the smaller axis by jack 3. Then, by rotating the template, the antenna curvature is checked with a simultaneous alignment of mirror surface.

The device will improve the quality of mirror restoration, will improve labor productivity, and will also improve production standards.

### Bearings From Wood Plastics

Sleeve bearings made from layered wood plastics are distinguished by good wear resistance which approximate the strength of textilite and nonferrous metals. The greatest wear resistance is in the face surfaces of layered wood plastic and the least is on the surface parallel to the glued layers. This should be taken into consideration when designing sleeves and bushings for the bearings. Wear on the journals of shafts operating in pair with layered wood plastic inserts is less than when using bronze or antifriction cast iron.

The negative qualities of wood plastics is their absorption of water and expansion; at the same time, the absorptive power of the material makes it possible to use water as a lubricating substance.

Wood plastics have a relatively low modulus of elasticity with the result that the bearings have a greater springiness. This is reduced by using thin inserts collected into a cassette. Another shortcoming of this plastic is its low heat conductivity; therefore, considerable attention must be given to lubricant selection and to the method of its delivery which all has an effect on the intensity of heat take-off.

It is recommended that the following conditions be observed in designing bearings made from layered wood pulp plastics.

The following is used for the thickness of the inserts: about five millimeters for a shaft diameter of up to 50 millimeters, 8-10 millimeters for a diameter of 60-100 millimeters, and 10-12 millimeters for diameters of more than 100 millimeters.

In order to facilitate heat take-off at large specific pressures and surrounding speeds, the thickness of the insert should not be large, its length is approximately the same as its inner diameter (a lesser length if oil is the lubricant).

When determining the clearance between the shaft and the bearings, consideration is given to the heat expansion of the shaft and bearing, the fineness with which the surfaces are processed, and the cooling and lubricating conditions. If the wood plastic does not work against the face surface, then consideration is given to possible changes in size from insert swelling. If it operates with its face to the surface of the shaft journal, then during lubrication and low specific pressure, a clearance is accepted for third class precision and a fourth class precision for high specific pressure. At a diameter  $d$  of the shaft journal of more than 25 millimeters, a clearance of  $0.04$  millimeters +  $0.002 d$  is recommended for low specific pressures and  $0.04 + 0.003 d$  for larger specific pressures. Larger clearances should be taken for wood plastic bushings than for metal ones in order to prevent shaft seizure during heat expansion. When working at an average intensity, a clearance of  $0.10$ - $0.15$  mm should be taken for shafts with a diameter of  $25$ - $100$  mm and the clearances increased for more intensive work.

It is recommended that bushings be pressed into cassettes with a clearance primarily for oil lubrication. If lubricated with water, the bushings swell; consequently, the roll clearance should be small. The amount of roll clearance prior to pressing in of the bushing is  $0.5$ - $1.5$  percent of the inner diameter of the bushing for oil lubrication.

Liquid mineral oils, water, emulsions, and lubricating grease are used as the lubricants. A circulating lubrication with machine oil is used for loads of up to  $20 \text{ kg-f/cm}^2$  and at speeds of up to four meters per second. Further increases in specific loads up to  $200 \text{ kg-f/cm}^2$  and speeds up to  $7$ - $10$  meters per second require a water lubricant. It is recommended that emulsion be used for more rigid work conditions of the bearings.

## Drive Belts, Selecting the Belt for Work

Work Conditions	Drive Belts	
	Cotton Cloth	Rubberized
Specific tractive capability	Average	High
Sharp oscillations in the work load (shocks)	Permissible	Not recommended
Permissible short-term overloads	By 30-40%	By 20-30%
Retains initial tension	Unsatisfactory	Good
Crossing drives, take-offs, sheaves or flanged pulleys	Unsuitable	Suitable (without any facing)
Permissible temperature increase	Stable up to 50° C	Oscillations up to 60° C (without facing)
Increased humidity	Unsuitable	With two-sided facing
Water vapor	Unsuitable	Suitable (with facing)
Dust	Not recommended	Suitable (without facing)

### Drives With Rubberized Cloth Belts

Flat rubberized cloth drive belts are manufactured in three types:

Type A — notched, used for small pulleys and high speeds (more than 20-30 meters per second);

Type B — layer-rolled, used for heavy work with interrupted loads and at average speeds (up to 20 meters per second);

Type C — spiral-rolled, used for work with small loads and at low speeds (up to 15 meters per second).

GOST 101-54 provides for belt widths up to 1,100 millimeters.

Belts of all types are made specific sizes. Type A and B belts may be made endless: their length, agreed upon at time of order, must

not be less than eight meters for a belt width of up to 90 millimeters, and not less than 20 meters for belt widths of 100 to 250 millimeters.

### Characteristics and Use of Cast Bronze

Brand of Bronze	Characteristics and Area of Use
Br. AZh 9-4L	<p>Possesses great strength, hardness, and plasticity (greater than stannous bronze), and also a high wear resistance under conditions associated with the heat processing of steel (NRS <math>&gt; 45</math>). It is suitable for the lower and average load limits (<math>p_v \approx 75 \text{ kg-f} \cdot \text{m/cm}^2\text{sec}</math>). It can take impact work. Items are forged at <math>700-900^\circ \text{C}</math>.</p> <p>Used to manufacture bearing bushings and inserts operating in conjunction with heat processing of shafts at <math>v</math> to 2.5-5 meters per second (at speeds in excess of 2.5 meters per second, lubrication must be profusive); worm gear wheels during heat processing of the worm gears (NRS <math>&gt; 45</math>), large loads and low speeds; pump friction discs and drums; friction discs; thrust rings.</p>
Br. Szo	<p>A high-quality antifriction alloy with a high fatigue limit and heat conductivity used for filling steel pipe billets, to manufacture bushings and bearings operating at loads of <math>p_v &gt; 100 \text{ kg-f} \cdot \text{m/cm}^2\text{sec}</math> and high surrounding speeds on the order of 5-10 meters per second; requires good lubrication (preferably under pressure).</p>

Width and Layers (Per GOST 101-54)

Ширина ремней в мм <i>a</i>			Рекомендуемое число приладок в зависимости от применяемой ткани	
<i>b</i> тип А	<i>c</i> тип В	<i>d</i> тип В	<i>f</i> Бельтинг ОПБ-5, ОПБ-12 и уточная шнуровая ткань	<i>g</i> Бельтинг В-820
—	20; 25; 30; 40; 45	—	—	2
—	—	20; 25; 30; 40	—	3
20; 25; 30; 40; 45; 50; 60; 70; 75	—	50; 60; 70; 75	—	3-5
80; 85; 90; 100	—	80; 75; 90; 100	—	3-6
125; 130; 200; 230	150; 200; 250	125; 150; 200; 230	3 (только для типа А) <i>h</i>	4-6

Key: *a* — Belt Width in Millimeters; *b* — Type A; *c* — Type B; *d* — Type C; *e* — Recommended Number of Layers Depending on the Cloth Used; *f* — Belting ОПБ-5, ОПБ-12, and Weft Cord Cloth; *g* — Belting В-820; *h* — Only for Type A.

## LITERATURE FOR TANK PERSONNEL

(insert)

Tanks and Tank Troops. A collective of authors. Moscow, Voyenizdat, 1970.

The first part of the book reviews the contemporary state of armored equipment, sets forth comments on the component parts of tanks and armored personnel carriers, improvements in armament, electrical and navigational equipment, and means of communications, and also the repair and operation of vehicles.

The second part covers questions on the use of tanks in modern battle, showing their role in various types of combat operations.

Rybakov, K. V.; Fueling of Tracked and Wheeled Vehicles. Moscow, Voyenizdat, 1971.

The basic requirements are set forth, as is the reasoning, for the fueling of wheeled and tracked vehicles under field and fixed conditions; recommendation is given on the best mutual placement of vehicles to be fueled and fueling facilities, information is provided on the layout and operation of fueling facilities, and recommendations given for the struggle against fuel and oil losses.

Grigor'yev, M. A.; Purification of Oil and Fuel in Motor Tractor Engines. Moscow, Mashinostroyeniye, 1970.

The author sets forth the theory, design, calculations, and methods to test filters to purify oil and fuel in internal combustion motor-tractor engines. The book provides an analysis of engine life relationship to the quality of oil and fuel purification and gives examples on reducing wear on parts through the use of highly efficient filters.

Petrov, M. M., Sotnikov, V. F.; Methodology in Learning the Fundamentals and Rules of Tank Firing. Moscow, Voyenizdat, 1969.



The authors succinctly set forth the organization of exercises on learning the fundamentals of tank firing and give methods instructions on holding tank personnel fire training exercises.

Stepanov, A. P.; Amphibious Vehicles. Moscow, DOSAAF Publishing House, 1971.

At the present time, the armed forces have a large number of various types of amphibious vehicles (tanks, armored personnel carriers, self-propelled-crossing devices, and so forth). The author sets forth the basic designs, operation, and driving rules for such vehicles, uncovers some theoretical matters determining the design and operational-technical parameters of amphibious vehicles.

Vishnyakov, V. A.; The Tank on the Pedestal. Moscow, Voenizdat, 1970.

The developmental history is given for the legendary Soviet "34" and its predecessors and heirs and how the attempts of the Hitlerites were paralyzed during the Great Patriotic War to achieve qualitative superiority of all tanks over Soviet armored vehicles.

Krinetskiy, I. I., Dranovskiy, A. I.; Automatic Driving of Wheeled and Tracked Vehicles Over Permanent Routes. Moscow, Mashinostroyeniye, 1970.

The methods and means of automatic orientation in the movement of self-propelled elements over permanent routes are set forth. Tracked and wheeled vehicles are examined as elements of automatic control.

A description is given of system elements and automatic control systems for moving objects, the methodology is provided to calculate and study them, examples are given for systems of automatic driving of tracked and wheeled vehicles over permanent routes.

Farobin, Ya. Ye.; The Theory of Turning Transport Vehicles. Moscow, Mashinostroyeniye, 1970.

The book analyzes the turning of wheeled and tracked vehicles. Experimental materials are given on the features of curvilinear movement of vehicles over roads and roadless terrain, individual examples are given on turnability indexes identical for all kinds and types of vehicles. The static and dynamic turnability of ordinary and coupled tracked vehicles, half-tracked vehicles, and vehicles with self-adjusting wheels are given.

Akatov, Ye. I., and others; Engines for Army Vehicles. Moscow, Voyenizdat, 1971.

A review is given of the theoretical bases of the working process of engines, adjustment, work modes and characteristics, and the theoretical bases for superchargers and the processes accompanying the operation of fuel system elements.

Karpenko, P. I., Lyndin, V. S.; Tanks Under Water. Moscow, Voyenizdat, 1971.

The methodology is given on holding exercises on underwater tank driving during tactical maneuvers including the crossing of water barriers.

The contents and forms of party-political work during the process of tank personnel skin diving training are described.

Army Vehicles. Theory. Textbook. Moscow, Voyenizdat, 1970.

The book covers questions on the dynamics of rectilinear movement and turning of vehicles, power transmissions and converters in the mechanisms, traction calculations, smoothness of drive, and roadability and the fording of water barriers.

Concise Fuel Reference-Dictionary. Compiled by K. F. Kushnirenko, Moscow, Voyenizdat, 1971.

The reference-dictionary gives a short explanation of special military-technical terms and meanings associated with the transportation, pumping, storage, and quality control of lubricants and special fluids. Physical-chemical indexes are given for fuel, lubricants, and special fluids, as well as their use.

Il'yin, V. A.; Tin Plating and Lead Plating. Third publication, revised, and augmented.

A description is given of the methods of electrolytic depositing of tin and lead, using various types of electrolytes. Methods are given to prepare the electrolytes, their characteristic features, and the causes of failures during the work process.

As opposed to the second edition, new electrolytes to deposit tin are reviewed. A number of new examples are given for the use of tin plating and lead plating in instrument building and machine building technology.

Nikandrova, L. I.; Chemical Methods to Obtain Metal Coatings.

A review is made of the methods of chemical nickel plating, copper plating, silver plating, tin plating, and chemical palladium-plating of metals. The composition of the solutions used and their properties and the fields in which the coatings can be used are given.

Bodner, V. A.; Systems for the Automatic Control of Aircraft Engines.

Contemporary methods are set forth for the synthesis of aircraft engine control systems on the basis of the criteria of accuracy, mutual relationship of the various control circuits, and the features of flight states. The sequence of designing the systems with a consideration for the coordination of engine, reducer, and fuel regulating equipment characteristics is reviewed.

Koltunova, L. N., Roykh, I. L.; Vacuum Coating of Steel.

The book describes in detail the methods to obtain protective vacuum coatings, the physical-chemical properties, and the possibilities for applying protective vacuum coatings made from aluminum, titanium, chrome, zinc, cadmium, and other metals.

The effects of the application conditions on the anticorrosive and mechanical properties of the described coatings are covered.

Data are provided on the use of anticorrosive and wear-resistant vacuum coatings: the protection of high strength steel and the possibility to replace tin plating sheet iron with aluminum plating in a vacuum.

Abibov, A. L., Boytsov, B. V., and others; The Use of Structural Plastics in Aircraft Manufacturing.

The wide introduction of plastics, whose mechanical and technological properties are no worse than for metals and their alloys, has been quite prevalent in the past few years in aircraft manufacturing.

The authors have systematized and summarized domestic and foreign know-how in the field of using plastics in aviation and missile building. The book provides the physical, mechanical, and chemical properties of plastics, describes the technological processes of using plastics in building large-size cylindrical and spherical sheathes, triple-layer panels with light fillers, and other structural elements.

Akhmedzyakov, A. M., Chizhov, B. N.; Processing the Results of Jet Engine Testing.

In the testing of both new and repaired air-breathing jet engines (VRD), a deviation is noticed in their characteristics from the prescribed. This occurs as a result of the inevitable production errors. Consequently, an additional finishing-off of the parameters is performed after testing.

The value of the book proposed by the authors is that it not only provides improved methods for processing VRD test results, but also the methods to correct engine characteristics during the test process. The methods described for processing test results and engine finishing are accompanied by numerical examples and recommendations.

Contemporary Rotor Theory. Under the editorship of doctor of technical sciences A. K. Martynov.

The book is the fruit of the collective efforts of renowned Soviet specialists, doctor of technical sciences G. I. Maykapar, candidate of

technical sciences B. E. Baskin, Ye. S. Vozhdayev, and others. It has been written on the basis of many years of theoretical and experimental research.

The book reviews aspects of the vortical theory of the rotor, with a consideration of its work (at axial speeds, with the presence of a horizontal component speed, at oblique blow-in).

Calculation and Analysis of Aircraft Movement. An engineering reference.

Equations are given for the movement of winged aircraft (LA) for different methods of target homing and methods to solve these equations. A description is given of the characteristics and methods of researching LA as objects of control, the optimization criteria of their movement depending on the prescribed flight mission.

Odinokov, Yu. G.; Testing Aircraft for Strength. A training aid.

The book sets forth the methods to calculate the strength of basic aircraft elements with a consideration for their load conditions, power schematics, and structural features.

Wing calculations take into account the form of its plane, the magnitude of elongation and temperature stresses as a result of aerodynamic heating. Calculations are given for the aircraft's chassis for strength and a calculation of the shock-absorbing devices.

A special chapter is devoted to aeroelasticity; it reviews the flutter-type elasticity vibrations of a wing, divergence and reverse of ailerons, methods to balance the control stick, and other matters.

#### HYDRAULIC POWER STEERING UNIT OF THE GAZ-66 VEHICLE (backpiece)

Hydraulic steering is intended to reduce the effort applied to the steering wheel when turning the drive wheels and to absorb shock loads originating when the wheels hit an unevenness. It consists of a valve, operating valve, power cylinder, and oil lines.

The double-action vaned pump is mounted on special engine brackets and is activated with a compressor by pulley which is linked by two wedge-shaped belts to the crankshaft pulley.

The operating valve of the power unit, fastened by two bolts to the front end of the longitudinal steering arm, regulates oil flow built up by the pump to the left or right cavities of the power cylinder depending on the direction to which the steering wheel is turned. There are four threaded openings in the valve housing. The oil line connecting pipes are screwed into them. Oil is delivered through one under pressure from the pump and is returned through the other to the oil tank. The other two connect the valve cavity with the left and right cavities of the power cylinder. There is also a slide valve in the operating valve housing which can move to either side of its central position by 1.5 mm.

Under pressure from the oil delivered from the control valve, the power cylinder activates the lateral steering arm and turns the guide wheels. A rod and piston moves back and forth inside the cylinder. Cast iron piston rings are used. Part-lined coupling blocks are bolted at each end of the cylinder. The cylinder is fastened by a ball hinge to a bracket arm mounted on the front axle reducer.

Hydraulic steering unit maintenance is the periodic checking of the oil level in the reservoir and replacing it, lubrication of the power cylinder hinge, and checking the tightness of the belts and of all elements.

Belt tension can be changed by increasing the position of the pump. However, its angle must be such that the oil level would reach the screen of the reservoir drain filter. If sufficient belt tightness cannot be achieved by angling the pump's position, then it is expedient to fasten the pump to the additional opening. Tension is normal when the belt can be depressed by a finger to 15-20 mm between the pulleys.

Oil in the hydraulic steering system is changed by raising (removing) the vehicle's front wheels and the pump reservoir cover opened and the oil drained. It is also necessary to disconnect the pressure and power hoses from the operating valve and the hoses from the connecting pipes of the power cylinder. All of the oil can be drained from the power cylinder only if the steering wheel is moved to the right and left as far as it will go several times. Upon completing this operation, the rest of the polluted oil must be removed from the reservoir, the pump filter screens washed, and all elements removed from the reservoir and the entire hydraulic steering system also washed out.

Oil is poured into the cleaned system in a specific sequence. All hoses are tightly put on, then the oil is poured into the reservoir up to the intake filter screen and pumped at low engine revolutions. The steering wheel is turned to its limit 2-3 times to both sides. The oil level must remain constant in the reservoir. If the level has dropped, the required amount of oil is added.

If the pump must be disassembled during the operating process, it is first necessary to replace the mutual position of the distribution disc relative to the stator and the position of the stator relative to the pump housing. The rotor, stator, and vane setup must never be disrupted: all of its items have been selected individually at the plant. The same should be kept in mind when removing the rear cover of the pump in which the bypass valve is mounted. When replacing the rubber packing rings which lie in the joints, they must be carefully raised at their places of seating.

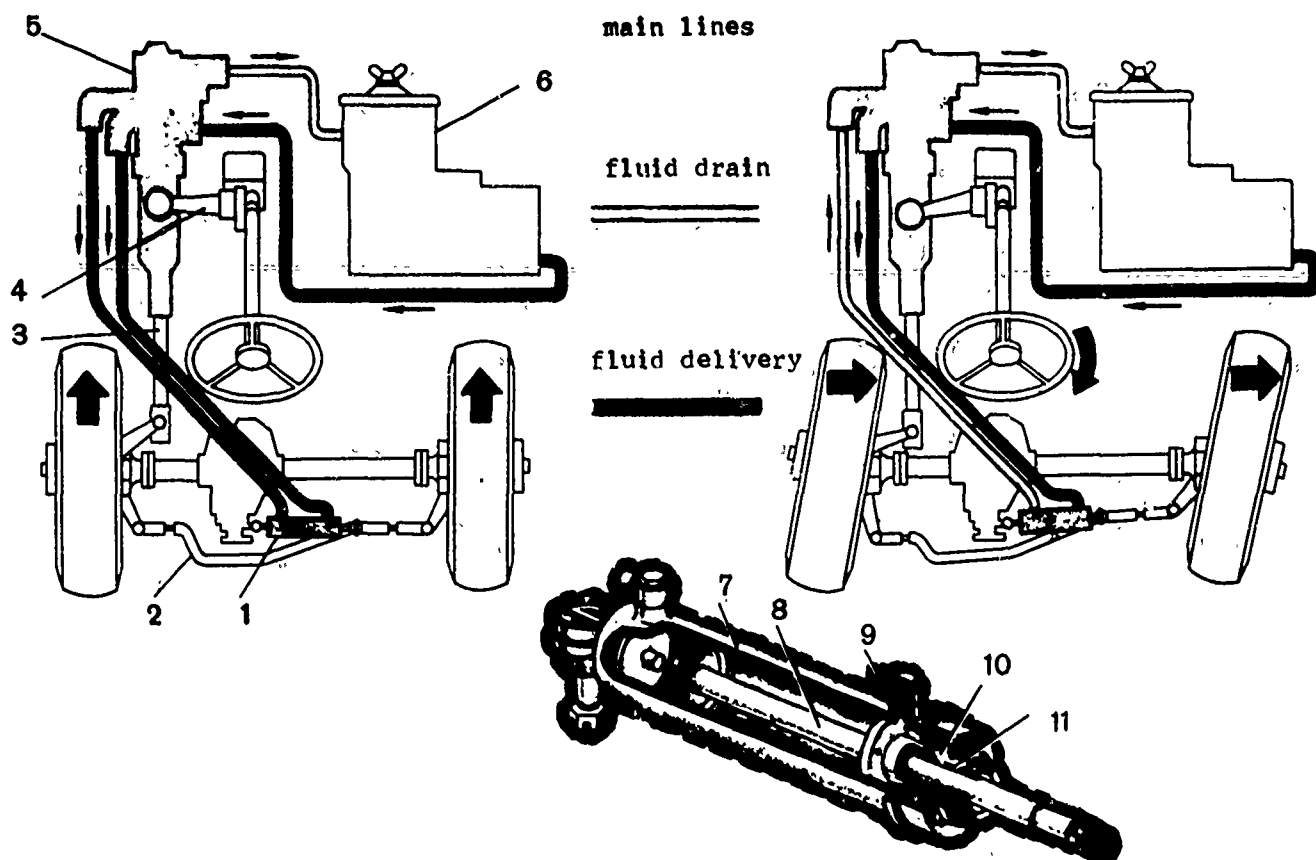
When assembling the pump, it is recommended that an exact placement of the stator relative to the housing be obtained by using the joint pins. The proper position of the stator is determined by the arrow on the stator, which must coincide with the rotating direction of the pump shaft.

When the efficiency of the pump drops or there are interruptions in its work, it should be disassembled and a check made to ensure that the bypass valve moves freely within the cover. The indentations must also be cleaned out or the cover changed with the valves set. If any deep scratches are found on the face surfaces of the rotor, housing, and distribution disc, then these surfaces must be polished. In the case of wear to the vanes or if they seize, then the rotor must be replaced in unit with the stator and the vanes.

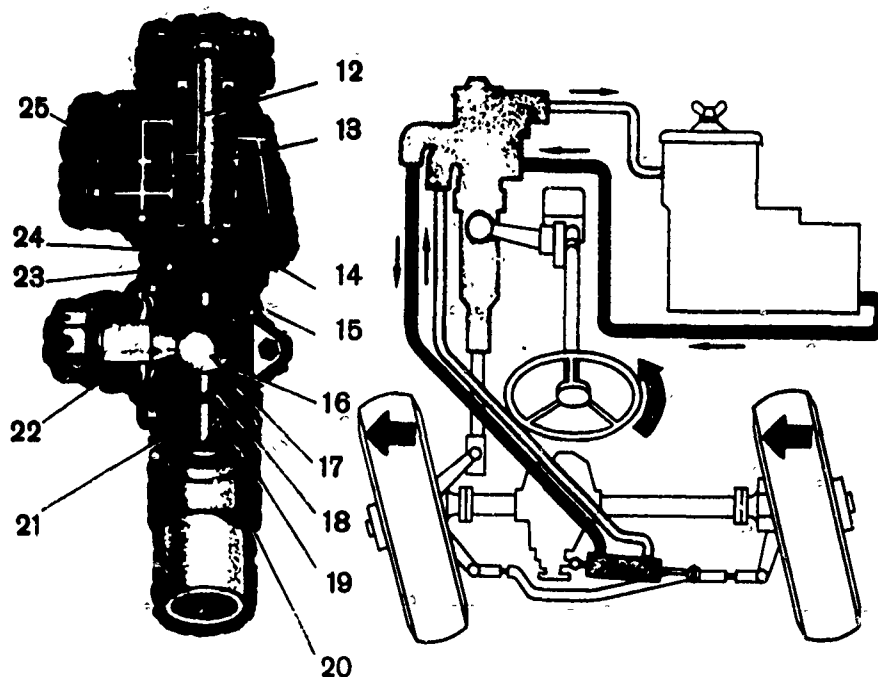
It sometimes happens that the pump operates but the hydraulic steering unit has no effect on the steering mechanism. The cause of this can be either a seizing of the bypass valve or a weakening in the tightness of the safety valve. In the first case, it is recommended that the pump be disassembled, the parts cleaned and washed, and the entire system washed out if pollution is heavy. Any indentations noted in the valve or socket are cleaned out. In the second case, the pump should be disassembled and the seat turned.

An increased noise in the operating pump indicates that there is either insufficient oil in the reservoir, or the drive belts are not sufficiently tightened, or there is air in the system, or pump parts are severely worn.

In conclusion, we will mention that if noise can be heard in the front part of the pump at low revolutions of the crankshaft, this is indicative of severe bearing wear. It is expedient to replace this bearing.







- Key:
- |                               |                    |
|-------------------------------|--------------------|
| 1 — Power Cylinder            | 13 — Slide Valve   |
| 2 — Lateral Steering Rod      | 14 — Housing       |
| 3 — Longitudinal Steering Rod | 15 — Nut           |
| 4, 22 — Pittman Arm           | 16 — Socket        |
| 5 — Control Valve             | 17 — Pin           |
| 6 — Pump                      | 18 — Thrust Rod    |
| 7 — Cylinder                  | 19 — Spring        |
| 8 — Rod With Piston           | 20 — End Piece     |
| 9 — Coupling Box              | 21 — Limiter       |
| 10 — Cylinder Head            | 23 — Joint Pin     |
| 11 — Packing                  | 24 — Reducer       |
| 12 — Bolt                     | 25 — Reverse Valve |

## TECHNOLOGY AND ARMAMENT-TRANSLATION

### ARMY

C459 COMD-GEN STF COL  
C461 INFANTRY SCH  
C470 ARMY WAR COL  
C545 CMBT DEVL P COMD  
C557 USAIIC  
C620 USASRD  
C768 OACSI-USAITAD  
C788 OACSI-SOV/EEUR DIV  
C072 CDC CONFOR GP  
C532 MEWTA-EL WARLABS

### NAVY

D159 NAVAIRDEVCE

### AIR FORCE

E018 AF/RDQLR-SAMSO  
E408 AFWL  
E411 ASD  
E420 FRD(3)  
E429 SAMSO (IND)

### UNIFIED & SPECIFIED COMMANDS

H101 USAFE 497RTG (IRC)  
H300 USAICE (USAREUR)  
H500 CINCUSNAVEUR  
  
K100 PACAF (2)  
  
L040 SAC 544TH ARTW (2)

### ARMY MATERIAL COMMAND

C509 ABERDEEN R&D CTR (8)  
C514 FRANKFORD ARSENAL  
C517 WATERVLIET ARSENAL  
C519 MUNITIONS CMD  
C535 AVIATION SYS COMD  
C538 WHITE SANDS MSL RG  
C560 AVIATION MAT LAB  
C590 TANK AUTOMOT COMD  
C619 MIA REDSTONE (5)  
C697 ABERDEEN PRV GRD

AMCRD-I

AMCRD-T

STEAP-TL

AMXST-OC

AMXST-IS3 (25)

AMXST-ST1

AMXST-ST2

AMXST-ST3

AMXST-GE

AMXST-SR

AMXST-SD

AMXST-TD

AMXST-SR

AMXST-CE

AMXST-CB (2)

AMXAM

### OTHERS

DDC-IR (12)  
CIA/CTS  
S030 FRD LIB OF CONG  
DIA/DS-4C (44)