JPRS-UEQ-89-004
22 FEBRUARY 1989

JPRS Report

Science & Technology

USSR: Engineering & Equipment

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JPRS-UEQ-89-004 *22 February 1989*

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Technology/Ecology in Power Engineering Viewed

18610167 Yerevan KOMMUNIST in Russian
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[Article by Professor L. Kuloyan, doctor of technical sciences, and Docent V. Marukhyan, candidate of technical sciences: "The Unity of Technology and Ecology"]

[Text] The gradual and (in some areas of the country) rapid depletion of the reserves of fresh water is creating serious difficulties for the operation of thermal and nuclear power plants, as well as for construction of new ones.

In contrast with organic or nuclear fuel, there are no economical methods of water transport, especially when it is a question of a major consumer, such as a thermal power plant (TES), or particularly a nuclear plant (AES). The most radical solution is to replace water with air as the cooling agent. However, due to the physical properties of air itself, the introduction of cooling systems at the power stations entails major difficulties. Therefore, the problem is being tackled by condensation cooling facilities, including a cooling tower of surface (radiator) type, and a condenser, usually of the mixing type.

In the USSR, only our republic has condensation cooling facilities for relatively high power (200-210 MW) generating units. The introduction and placement of these in service under the complicated natural climatic conditions of the Razdan region was made possible by the extremely persistent work of the engineers and technicians of the station and the assistance of the power engineering organizations of the country. The operation of the generating units (starting in 1971-1974) has confirmed the ecological benefits of the water economy, the absence of fog formation, and so on. The water saved (on the order of 9-12 million cubic kilometers per year) made it possible to economize the water resources of Sevan and expand the scale of irrigated farmland in the republic.

Reliable TES operation and long term operation of the equipment depend significantly on the water chemistry regime of the generating units. The aluminum pipes of the cooling tower form a closed circuit of cooling water. At the same time, this is supplied to the steam boilers. While the most stringent demands are placed on the purity of the feed water. The presence of the piping dictates such organization of the water regime as guarantees corrosion resistance not only of steel and brass, but also of aluminum. The Razdan GRES was a pioneer in the handling of this extremely difficult problem. And this was made possible by the creative collaboration of the Razdan power engineers with members of the central power engineering organizations.

After lengthy experimental studies, the best suited of the different alternatives of the water chemistry regime was selected. This guarantees suppression of corrosion processes for all three metals. The aluminum cooling tower, a product of the Hungarian People's Republic, is an expensive part of the generating unit. The nearly total suppression of corrosion of its tubes, as well as the consequent elimination of periodic chemical cleaning procedures (with the generating units standing idle), have substantially increased the working reliability and service lifetime. The new regime should also solve another critical problem, involving the suppression of formation of deposits in the boiler shield pipes. Comprehensive studies of the authors have led to the conclusion that lithium treatment with lithium hydroxide should be used for correction of the water regime in the boilers, instead of the traditional phosphating.

The innovation required performance of theoretical and experimental studies to assess the influence of the physical-chemical, regime, and other factors. The lithium treatment of the boiler water sharply reduced the formation of interior deposits on the boilers, thereby eliminating unscheduled shutdowns of the generating units for boiler cleaning and replacement of damaged shield pipes.

According to data of the GrES, the annual economic impact of the newly developed technology on the level of more than 6 million rubles has already been corroborated by the fifteen years of operation. Thanks to this, the generating units of the Razdan GrES are among the most reliable in the system of the USSR Ministry of Energy. The water cleaning and water regime technology developed and successfully demonstrated at the Razdan GrES is a brilliant example of the implementation of the strategic policy of the party in developing the economy on a foundation of scientific-technical and technological progress. It is in perfect harmony with the increased demands for economization of natural resources and protection of the environment.

This program is therefore of great economic importance to the entire Soviet Union. This is especially urgent today for the Armenian SSR, the power system of which is expected to expand primarily by enlargement and modernization of the existing TES. A decision has been made to accelerate the expansion of the Razdan GrES (resulting in a doubling of its capacity) by installation of four generating units of 300 MW capacity. And no less important, all of these are to operate with dry cooling systems, i. e., once again with aluminum (radiator) cooling towers, but of an improved design.

Thus, the scientific project "development and introduction of a new high efficiency technology of prevention of corrosion and formation of deposits in generating units of the Razdan GrES with aluminum cooling towers," submitted by a team of designers consisting of: A. K. Ayvazyan, F. Kh. Akopdzhanyan, A. V. Borovskiy, A. A. Kota, Ts. R. Oganesyan, G. R. Santuryan and V. G. Sokolovskaya, is consistent with the main requirements on those competing for the State Prize of the Armenian SSR in the field of science and engineering. The designers are worthy of receiving the prize for 1988.

Press Meetings Held to Abate Public Nuclear Concerns

18610096 Moscow STROITELNAYA GAZETA in Russian 2 Oct 88 p 4

[Interview with director Vladimir Konstantinovich Bronnikov of the Zaporozhye nuclear power plant: "Nuclear Rumors Are in the Air"]

[Text] Zaporozhye and Dnepropetrovsk are seething with rumors: something has happened at the Zaporozhye nuclear power plant of Energodar. Like all rumors which are not opposed by official information, they abound in morbid details. Some one says that a container "with nuclear fuel" has burst, another says that an accident has occurred at one of the generating units. Our own correspondent, L. Sharomov, interviewed the director of the Zaporozhye nuclear power plant, Vladimir Konstantinovich Bronnikov, via telephone.

Nothing has happened at our plant, he says. But there is indeed a wave of rumors, a genuine panic, for reasons which are unclear. There has been a flood of telephone calls, all with the same question. I give the official reply: Everything is normal, everything in order, at the Zaporozhye AES. What is more: on 30 September at 18:00 hours, the regular monthly press conference for the public and members of the press was held at the Youth Center of Energodar. The subject, like that of previous conferences, was the outcome of the operation of the plant in the previous month as a source of influence on the environment. We reported that no deviations in the operation of the AES had taken place in September, compared with the preceding months. The plant operated in normal mode.

And so, immense relief. Everything is calm at the plant. Preparations are underway to start up the third generating unit after its scheduled maintenance. Soon, the fourth generating unit will also be shut down for PM. These steps are taken in connection with the winter preparations. Special attention is being given to the start up and adjustment work at the fifth generating unit. STROITELNAYA GAZETA has reported on this work in the article "A Fast and Reliable Method" of 28 September.

But how to account for these rumors? The answer is now obvious: there is a need for glasnost. The monthly press conferences are an important matter, but not all residents in the neighborhood of the nuclear power plants of the Zaporozhye, Dnepropetrovsk, and Kherson provinces are invited to them. The residents of all provinces of the Ukraine regularly read about the radiation situation in Kiev in the newspapers of the republic. Why not publish information on the radiation level (compared with the normal radiation background) on a weekly basis in the newspapers of cities adjacent to such "facilities of impact on the surroundings?" And in all regions of the country.

Having a nuclear power plant as a neighbor is not the most pleasant of things for the residents of heavily populated provinces. And how much more at ease will they feel, when they know that their powerful "neighbor" is healthy and peaceful.

What We Know About Radiation

18610105 Moscow VYSHKA in Russian 11 Sep 88 p 2

[Article by G. Odzhagov, Baku]

[Text] As a result of the accident at the Chernobyl AES people have encountered a phenomenon that is not entirely ordinary and in many respects incomprehensible—radiation. You do not perceive it with the sensory organs, you are unaware of it when it acts (irradiation), and you do not see it. All possible rumors have therefore arisen about the state of affairs both in the vicinity of the accident and beyond its boundaries. As a rule, these rumors are exaggerated and distorted. This has resulted in a situation where people have suffered enormous psychological loads that can, first and foremost, be explained by their weak knowledge about the properties of radiation and ways and means of protecting themselves against it and by the insufficient effort to explain them.

The public is of the opinion that there is increased radioactivity in Baku, and there is talk of the following situation as if it actually took place. After landing at Baku Airport, some delegation from Japan discovered how quickly their pocket dosimeters began emitting a signal indicating increased radioactivity. As is customary in such situations, there are no eyewitnesses. Nevertheless, many people heard about it.

And here is another example. More than once, people from different age groups and occupations have asked me whether it is permissible to bathe at the Apsheronsk beaches. They say the Caspian shore has been subjected to high radioactivity.

All of these rumors are groundless and so absurd that they would not even be worth mentioning if I did not frequently encounter analogous questions at the lectures I give and during my civil defense activities.

Radioactivity is a physical process that cannot be slowed down, accelerated, or stopped. All things that live on this earth under the effect of natural background radiation have been and continue to be continually subjected to the effect of radioactive irradiation. Each second, 10 atomic nuclei are destroyed in each cubic centimeter of living and nonliving matter. Besides the radiation created by artificial radioactive substances, there is a natural background that is created by cosmic rays and by the radiation of natural radioactive substances, for example, the radium that is present in the soil and in the materials of which buildings are made.

The level of the natural background from cosmic radiation in the region of the latitudes above 50 degrees at sea level is essentially constant. It amounts to approximately 30 m/rad per year (3.42 μrad/h). It increases rapidly as the altitude increases, reaching a maximum at an altitude of 10 to 20 kilometers.

The doses of cosmic radiation received by passengers on aircraft are becoming increasingly important in view of the development of aviation passenger transport.

Speaking of cosmic sources of irradiation of the public, one should address the issue of the value of the protective ozone layer that surrounds our planet. The development of aviation, in particular, the increase in the number of aircraft flying at supersonic speeds, is resulting in the destruction of the ozone shield. The ozone layer, which is 1 to 1.5 kilometers thick at an altitude of 20 kilometers, screens the earth's surface from the high-energy components of ultraviolet radiation. The breakdown of the ozone shield may result in a respective increase (approximately 20-fold) in the incidence of skin cancer in the population living in the area in which breakdowns are occurring.

A second source of artificial radiation that is constantly acting upon humans is γ-radiation. It is created by the presence of the respective natural radionuclides in objects of the environment (mineral ores, soils, building materials, etc.).

The examples presented, which characterize the strength of the dose of external radiation, certainly do not constitute an exhaustive list of the entire variety of phenomena observed in nature. Additional study, both broader and deeper, of the natural radiation sources in our country is needed.

Besides these external sources, the human body itself contains radioactive materials that it has obtained from natural sources (potassium 40).

The natural background created by cosmic rays and the radiation of natural radioactive substances ranges from 80 m/rad to 100 m/rad yearly (between 9 and 11 μrad/h).

Besides the aforementioned small levels of natural radioactive radionuclides contained in soil, which determine the so-called natural radiation background, the earth contains regions where the strength of the absorbed dose (the natural background) outdoors is significantly higher. Such regions occur in Brazil, France, Nigeria, etc. The reason for this is deposits of radioactive minerals.

Besides being subjected to the natural background, the public is also subjected to irradiation from artificial irradiation sources. These may be arbitrarily divided into two groups: those that contaminate the environment with radionuclides and those that do not. The first group includes accidents at power reactors. In the entire period of the existence of nuclear power there have been three such accidents. They occurred at Windscale (Great Britain in October 1957), at one of the AES power-generating units in Pennsylvania (the United States in March 1981), and in the no. 4 power-generating unit at the Chernobyl AES (April 1986).

Nuclear weapons testing presents the greatest threat of sources of all-out (global) contamination by radioactive substances. It is a source of additional irradiation of the population throughout the world. These tests were begun in 1945. In the period between 1945 and 1988, 423 nuclear devices of different types and powers were tested in the atmosphere. When nuclear bombs explode, clouds containing radioactive aerosols with different dimensions, structures, and complexities of their chemical structure are formed.

The radioactive substances formed during test explosions create a radiation effect—internal irradiation (from the inhalation of radioactive substances and from the ingestion of food products and drinking water that have been contaminated with radionuclides) and external radiation (from radioactive substances that are either present in ground-layer air or have fallen onto the earth's surface).

In the second group, radiation sources used for medical purposes play the dominant role in the irradiation of the population. Irradiation for medical purposes is especially interesting since it is the largest contributor to the dose received by the population. Unlike other types of irradiation, only limited sections of the body are subjected to its effects. We will present several examples. A person receives 3 rem from dental x-rays, 1 μrem from watching one hockey match on television, 30 rem from the irradiation during a stomach (local) roentgenographic examination, and 370 rem from the irradiation during fluorography.

The natural radiation background is the major contributor to the irradiation dose to the population and constitutes 69.5 percent of the total dose. The remaining sources play a lesser role (medical examination accounts for 29.2 percent, products of nuclear explosions account for 0.8 percent, wastes from AES account for 0.001 percent, and consumer goods (clocks, televisions) account for 0.4 percent.

All of this indicates that even though there are no AES within the territory of the Azerbaijan SSR one cannot exclude the possibility of irradiation by artificial radiation from the propagation of radioactive substances as a result of accidents at AES located in neighboring republics or from the possible use of nuclear weapons by the enemy. Each citizen should therefore know the methods of protecting himself against radioactive substances and should know how to use individual protective agents.

The actions of the public in a contamination zone are reduced to public health measures and the observance of the respective behavior rules. People should thus move to locations with tightly closed air vents (to seal them off from the penetration of street dust). This is especially important in the case of children and pregnant women if

evacuating them is impossible. Inside the dwelling itself, damp cleaning should be done daily. When necessary to go outside, people should dress so as to cover all open sections of their body. Using a respirator is mandatory. When entering a dwelling, a person should carefully wipe their feet on a damp rug (rag), remove their clothes in open air, and should wash very dirty clothing with powders or soap.

It is indispensable that water be poured on the streets and roads in population centers and in the areas surrounding enterprises so as to reduce the content of dust in the air, which is one of the main carriers of radioactive substances.

These rules and restrictions are not complicated; however, following them is a very important part of the system of protecting people from the effect of radioactive substances.

UDC 539.4:621.643.4:621.039.5

Using Planning Methods When Studying Stresses in T-Joints of Power-Generating Equipment at AES

18610110 Moscow MASHINOVEDENIYE
in Russian No 5, Sep-Oct 88 pp 94-97

[Article by B. N. Drachenko, B. B. Portnov, A. V. Seleznev, and S. N. Komarova, Moscow]

[Text] Determining the stresses in T-joint type structural nodes formed when the vessel cowling and pipelines in power-generating equipment at AES are connected is a critical aspect of designing such equipment. Theoretical analysis of the stress in T-joints is complicated by the presence of stress concentrators—the openings on the cowling and on the branch pipe that are adjacent to the opening. The hypotheses of the classical theory of elasticity that are used during the calculations require experimental confirmation, particularly in the case of designs with the spatial configuration of an opening under the branch pipes. For this reason, experimental methods and both full-scale designs and models are being used to research the stressed state of T-joints of intensively loaded power-generating equipment at AES. Research-planning methods may be used to reduce the labor-intensiveness of the research that arises because of the variety of type sizes of T-joints existing in actual practice.[1] The type sizes of T-joints under examination are classified by specific geometric features (parameters), and the stressed state of the structures is examined in the general case as a function of geometric parameters. The efficiency of this approach lies in the selection of some previously selected minimum number of investigated models with the derivation of empirical formulas that are adequate to determine the magnitudes of the stresses in T-joints under the effect of various force factors. The present article examines the use of planning methods in researching the concentration of stresses in T-joints under the effect of axial thrusts Q_z and Q_y applied respectively to the main pipeline (vessel) and branch pipe of the T-joint (Figure 1). The specified force factors together with the bending moments form a system of quasistatic self-compensating loads on the pipelines. Together with the internal pressure of the coolant, they make a significant contribution to the stressed state of the T-joints during the process of the equipment's operation.

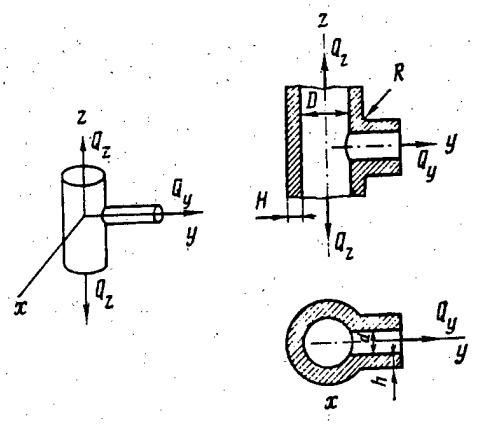

Figure 1.

The design of a T-joint with a radial branch pipe described by the dimensions D, d, H, h, and R (the inner diameters and thicknesses of the walls of the main pipeline and branch pipe, respectively, as well as the fillet radius [Figure 1]) is examined. It is common knowledge that the stressed state of structures is determined by the system of external loads and the geometry. In addition, the stresses resulting from a system of loads my be specified as the linear superposition of the elastic stresses from each force factor. Allowing for this, in the present study, the stresses in the T-joints were examined separately for each force factor. Models made of optically sensitive material based on ED-16 epoxide resin were used in the research.

The following ranges of the geometry of the T-joint type sizes used are characteristic for the pipeline systems of power-generating equipment at AES with water-cooled, water-moderated [VVER]-type reactors:

$$0{,}04 \leq \frac{H}{D} \leq 0{,}15, \quad 0{,}05 \leq \frac{d}{D} \leq 0{,}5, \quad 0{,}25 \leq \frac{h}{H} \leq 2, \quad 0{,}05 \leq \frac{R}{H} \leq 1. \qquad (1)$$

The planning provided for research based on the type sizes of T-joints with the geometric parameters satisfying the factor region (1). Depending on the existing a priori information or the hypotheses concerning the dependencies of the magnitudes of the stresses on the geometric parameters that are being sought (i.e., H/D, d/D, h/H, and R/H), different schemes of planning a multifactorial experiment may be used. These include linear orthogonal plans, fractional factorial designs, and the steep ascension along the response surface being sought.[3] Table 1 presents a scheme for planning an experiment that has been based on models (type sizes 1 through 16)

and indicates the values of the dimensionless stress coefficients α^{Qz} and α^{Qy} in the T-joint type sizes studied. The quantities α^{Qz} and α^{Qy} were determined as the ratio of the magnitudes of the maximum stresses in the T-joint during the effect of the force factor under examination to the magnitudes of the respective rated stresses:

$$\alpha^{Q_z} = \frac{\sigma'_{max}}{\sigma'_{nom}} = \frac{\sigma'_{max}\pi H(D+H)}{Q_z}, \quad \alpha^{Q_y} = \frac{\sigma''_{max}}{\sigma''_{nom}} = \frac{\sigma''_{max}\pi h(d+h)}{Q_y}, \qquad (2)$$

where σ'_{max} and σ''_{max} are the magnitudes of the maximum stresses in the T-joint under the respective effects of the axial tensile stress on the main pipeline Q_z and the axial tensile stress on the branch pipe Q_y and where σ'_{nom} and σ''_{nom} are the respective values of the rated meridianal stresses in the main pipeline (during the effect of the force Q_z) and in the branch pipe (during the effect of the force Q_y), which are calculated as the ratio of the magnitude of the load to the area of the pipe's cross section.

The following empirical formulas were derived in accordance with the experimental values obtained for the coefficients α^{Qz} and α^{Qy} based on type sizes 1 through 16. These formulas describe the change in the quantities α^{Qz} and α^{Qy} as a result of the geometric parameters H/D, d/D, h/H, and R/H within the ranges of (1):

$$\alpha^{Q_z} = 3{,}2 - 0{,}4\frac{h}{H} + 5{,}1\frac{d}{D} - 6{,}2\frac{hH}{HD},$$
$$\alpha^{Q_y} = 1{,}8 - 2\frac{d}{D} + 5{,}4\frac{h}{H} + 9{,}9\frac{Hd}{DD} - 6{,}4\frac{Hh}{DH} + 18{,}7\frac{dh}{DH} - 2{,}5\frac{hR}{HH} - 130\frac{hd}{DD}. \qquad (3)$$

The formulas labeled (3) were derived in accordance with an earlier work.[3] During the derivation, an allowance was made for the fact that the planning scheme used is a scheme for a complete four-factor experiment, 2^4, with the geometric parameters varied on two levels, i.e., the lower and upper bounds of the respective ranges of (1). The statistical value of the regression factors was determined on the basis of information about the error of the experiment's reproducibility. The experience accrued in previous research thus confirmed that, when general dispersion estimates are used, the reproducibility of the respective experimental values of the coefficients α^{Qz} and α^{Qy} are as follows: $s^2(\alpha^{Qz})$ is approximately equal to 0.04 and $s^2(\alpha^{Qy})$ is approximately equal to 0.16. Thus, at the level of a 95 percent confidence limit, the maximum absolute error of the experimental values of the coefficient α^{Qz} in one model amounts to plus or minus 1.96 times the square root of [s^2 times (α^{Qz})] is approximate equal to plus or minus 0.40, and when a determination is made in each model of the coefficient α^{Qy}, the maximum absolute error amounts to plus or minus 1.96 times the square root of [s^2 times (α^{Qy})] is approximately equal to plus or minus 0.8. An analysis of the respective experimental and calculated values of the coefficients α^{Qz} and α^{Qy} according to the table shows that the relative error of the calculation of the values of the coefficients based on type sizes 1 through 16 (when the calculations are performed in accordance with the formulas labeled (3)) does not exceed 10 percent. In other words, the relative error is located within the bounds of the error of the experimental research. The

Table 1.

	T-joint number	Geometric parameters				Value α^{Q_z}		Value α^{Q_y}		
		H/D	d/D	h/H	R/H	Experiment	Calculation according to (4)	Experiment	Calculation according to (5)	Calculation according to (6)
T-joints as per design	1	0,04	0,05	0,25	0,05	3,4	3,29	3,0	3,05	2,87
	2	0,04	0,05	0,25	1	3,2	3,29	2,5	2,45	2,27
	3	0,04	0,05	2	0,05	2,2	2,16	13,0	12,92	12,85
	4	0,04	0,05	2	1	2,2	2,16	8,0	8,08	8,01
	5	0,04	0,5	0,25	0,05	5,8	5,59	4,0	3,90	4,32
	6	0,04	0,5	0,25	1	5,6	5,59	3,4	3,30	3,72
	7	0,04	0,5	2	0,05	4,4	4,45	24,5	24,47	24,42
	8	0,04	0,5	2	1	4,5	4,45	19,6	19,63	19,58
	9	0,15	0,05	0,25	0,05	3,1	3,12	2,7	2,75	2,55
	10	0,15	0,05	0,25	1	3,0	3,12	2,1	2,18	1,95
	11	0,15	0,05	2	0,05	0,9	0,80	10,1	10,17	10,27
	12	0,15	0,05	2	1	0,9	0,80	5,4	5,33	5,43
	13	0,15	0,5	0,25	0,05	5,5	5,42	2,5	2,50	2,47
	14	0,15	0,5	0,25	1	5,5	5,42	1,9	1,90	1,87
	15	0,15	0,5	2	0,05	3,2	3,09	9,6	9,62	9,63
	16	0,15	0,5	2	1	3,0	3,09	4,8	4,78	4,80
Additional T-joints	17	0,06	0,3	1,5	0,05	3,7	3,57	13,2	13,47	13,3
	18	0,08	0,2	1	0,5	3,3	3,32	6,4	6,72	6,4
	19	0,08	0,5	2	0,05	4,1	3,96	14,4	19,0	14,3
	20	0,12	0,2	0,5	0,5	3,5	3,65	3,5	3,54	3,4

bounds of the statistical value of the regression coefficients in the empirical formulas were determined in accordance with a previously published work.[3] Only those regression coefficients whose statistical value is not open to doubt are given in the formulas labeled (3).

Verifying the accuracy of the formulas labeled (3) is an important stage in validating the empirical formulas derived. The sense of this verification lies in confirming or rejecting the hypotheses concerning the type of the approximating formulas. To do this, the values of the coefficients α^{Qz} and α^{Qy} were determined for an additional four type sizes (17 through 20) with geometric parameters within the ranges of (1). Comparing the experimental and respective calculated (in accordance with formula (4)) values of the coefficients for type sizes 17 through 20 made it possible to draw the following conclusions (see Table 1). The first formula in (3) adequately describes the results of the research on the values of the coefficient of the concentration of stresses α^{Qz} in type sizes 17 through 20 since the absolute deviation of the experimental and calculated values lies within the experiment's error bounds, amounting to +0.4. The second formula in (3) does not adequately describe the results of research on the value of α^{Qy} for type sizes 17 through 20 since, for example, the absolute deviation of

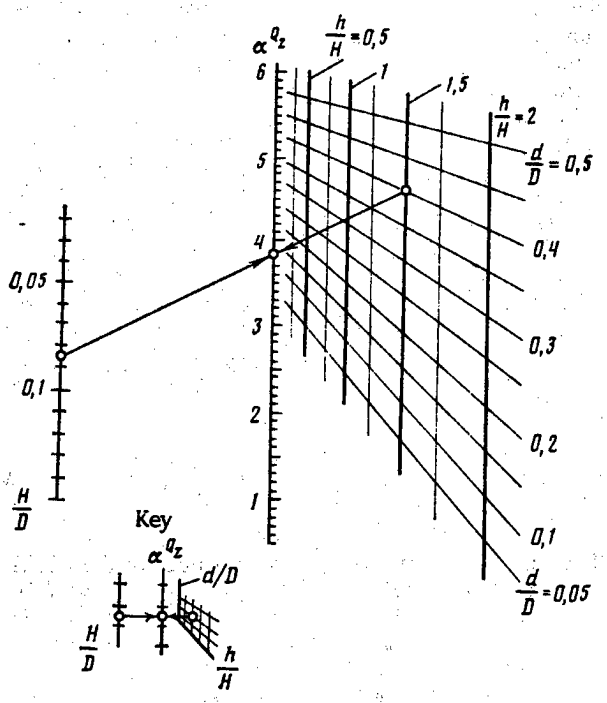

Figure 2.

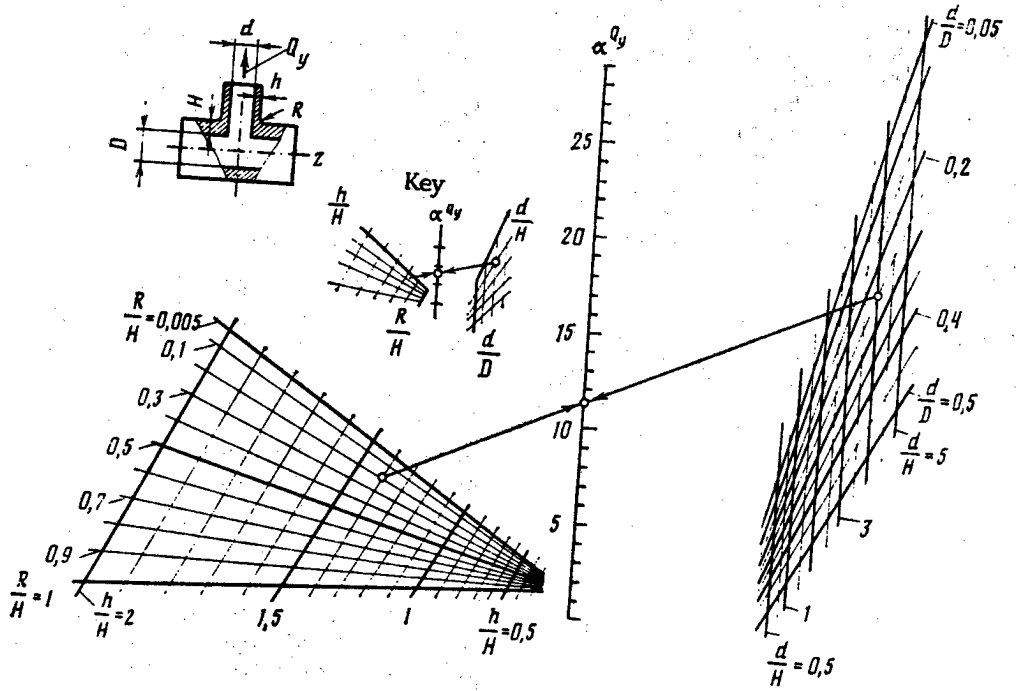

Figure 3.

the calculated and experimental value of α^{Qy} for type size 19 amounts to 4.60. In other words, it exceeds the value of the error of the research, amounting to plus or minus 0.8. In view of the inadequacy of the second formula in (3), which indicates the nonlinearity of the value being sought for each of the parameters H/D, d/D, h/H, and R/H, a general regression analysis procedure with the search for an empirical formula that adequately describes the existing experimental data was applied to the results of the research on the value of the coefficient α^{Qy} for type sizes 1 through 20. As a result of the regression analysis, which was done in accordance with a special computer program, the following adequate empirical formula (which describes the experimental values of the coefficient α^{Qy} for type sizes 1 through 20 with an error not exceeding 10 percent) was determined:

$$\alpha^{Qy}=1{,}5+1{,}49\frac{d}{H}\frac{h}{H}-1{,}37\frac{d}{H}\frac{d}{D}\frac{h}{H}+4{,}3\frac{h}{H}-2{,}5\frac{h}{H}\frac{R}{H}-5{,}6\frac{d}{D}\frac{h}{H}. \quad (4)$$

The results of a calculation of the values of the coefficient α^{Qy} are presented in Table 1. It is evident from formula (4) that the geometric parameters d/H, d/D, h/H, and R/H were assumed to be variable factors in the value of the coefficient α^{Qy}. The adequacy of formula (4) indicates that the quantity α^{Qy} is linear with respect to each of the specified parameters.

By using formulas (3) and (4) and making an allowance for formula (2), it is possible to determine the magnitude of the maximum stresses in T-joints with specific geometric parameters given known values of the forces Q_z and Q_y. For the case of the load Q_z, the maximum stresses act on the inner surface in the loop of the opening in the plane passing through the branch pipe's symmetry axis and perpendicular to the symmetry axis of the main pipeline. When the T-joint is loaded with an axial force Q_y applied to the branch pipe, the maximum stress acts along the outer surface of the area of the tie-in in the symmetry plane perpendicular to the axis of the main pipeline.

The research conducted indicated that, in the range (1) of the type sizes of T-joints that are characteristic of power-generating equipment at AES with VVER reactors, the values of the coefficients α^{Qz} and α^{Qy} may be determined in accordance with formulas (3) and (4). Nomograms for formulas (3) and (4), which have been plotted in Figures 2 and 3 respectively, make it possible to determine the magnitude of the maximum stresses in the T-joint under the effect of the respective loads and given the specific dimensions of the T-joint. The mean-square error of using formulas (3) and (4) and the respective nomograms is characterized by the error of the experimental research (up to 10 percent) and the approximation error of the experimental data (up to 10 percent), i.e., it does not exceed 15 percent in the ranges of the geometric parameters (1).

The results presented indicate the distinctive features of applying planning methods to research on the concentration of stresses in standard designs of power-generating equipment at AES and are recommended for use in engineering design practice. When combined with the results presented in a previous work,[4] the experimental data obtained is recommended for use in developing a method for computer-aided design of T-joints subjected to the effect of operating loads.

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Construction of Waste-free and Ecologically Clean Peak-Load Electric Power Plants

18610127 Kiev ENERGETIKA I ELEKTRIFIKATSIYA in Russian No 3, Jun-Aug 88 pp 16-20

[Article by A. A. Madoyan, doctor of technical sciences]

[Text] The fate of the environment surrounding us is making people increasingly uneasy and even alarmed. This is related to the fact that until recently humans' efforts in the name of better living conditions were without a doubt harming the environment. This harm is now evident, even without using special instruments. That is why the main requirement today is to use only those technologies that, no matter the scale of their development, will not interfere with the ecological equilibrium that has evolved on earth over the course of millions of years. This comment is fully applicable to the fuel and power generation complex as well.

Power generation, while providing electricity for the national economy, has significantly raised the ecological cleanliness of many sectors. This is particularly true with regard to transport, municipal services, and agriculture. At the same time, because it is a closed sector, power generation itself, as a producer of "clean" electric power, is in need of serious technological updating to ensure that it is completely waste-free and ecologically clean.

The main types of electric power plants in operation at the present time are as follows: TES fueled by solid, liquid, and gas fuel; AES fueled by uranium and plutonium; and GAES. The economic profitability of obtaining and using these and other types of fuels is constantly changing, depending on explored reserves, improvements in the technologies, and demand. Thus, before 1960, in both the United States and USSR, the major portion of the production of primary power was based on solid fuel. Then, oil and gas were recovered at advancing paces. As is evident from Figure 1, after 1980 the rate at which different primary power resources were being produced in the United States shifted again, this time in favor of using solid fuel. According to forecasts, the production of primary power resources throughout the world[1-7] after 2000-2010 will again be characterized by a significant reduction in the predominance of oil and gas. A steady increase in the production and use of nuclear power, coal, and nontraditional power sources (solar, geothermal, wind, etc.), particularly hydraulic power, is hypothesized. By 2020, nontraditional types of power will move into third place after nuclear power and coal. It is characteristic that a steady increase in coal recovery up until 2150 is even being predicted by pessimistic forecasts in the United States. Optimistic forecasts predict that this will be the case until 2200 (Figure 2b). The absolute maximum recovery of solid fuel in the United States ranges from 68 to 116 EJ. (1 EJ = 10^{18} J = 34.25 million tons equivalent fuel, with 1 ton equivalent fuel being equal to 7 GCal, which is equal to 29.2 GJ, which in turn equals 8.18 MWh.) The main prerequisite for such an intensive increase in coal recovery and the use of solid fuel in the future is the scientifically and experimentally proven possibility of constructing waste-free and ecologically clean thermal power plants [BEChTES] fueled by coal.[8,9]

The successful introduction of waste-free technologies and ecologically pure types of production in such countries as the United States, Japan, and the FRG has significantly improved the competitiveness of TES fueled by coal, especially since, in virtually all cases, the result is the production of a scarce consumer product. The main decisions ensuring an improvement in the

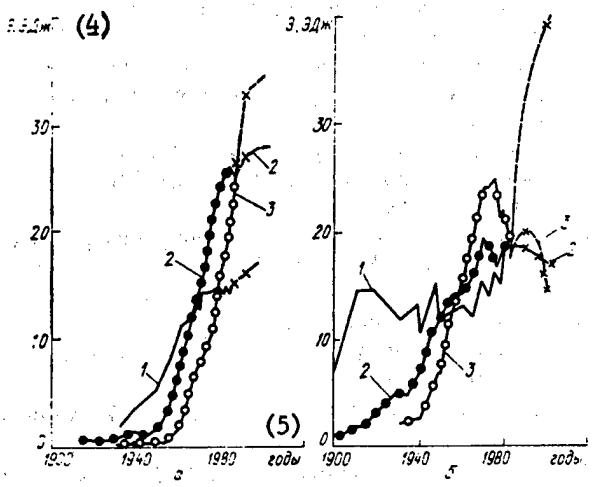

Figure 1. Production of Primary Power Resources
Key: a. USSR b. United States 1. Coal 2. Oil 3. Gas 4. Production of energy resources, EJ 5. Years

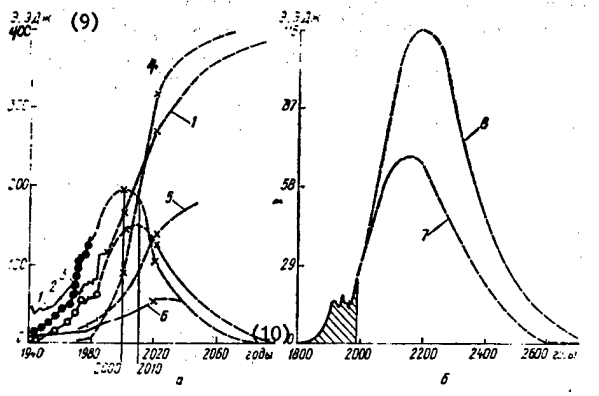

Figure 2. Production of Primary Power Resources
Key: a. World b. Coal recovery for two forecast values in United States 1. Coal 2. Oil 3. Gas 4. Nuclear power 5. Solar, geothermal, and other nontraditional types of power 6. Hydraulic power 7. Pessimistic forecast of coal recovery in the United States 8. Optimistic forecast of coal recovery in the United States 9. Energy, EJ 10. Years

production cycle and the creation of waste-free and ecologically clean TES are as follows:

- preliminarily enriching and standardizing the quality of coal at the recovery site;
- using fuel preparation and fuel supply systems that transport coal without losses or dust;
- using a fuel preparation procedure that includes the removal of toxic components (sulfur compounds, alkali metals, halogens, fuel nitrogen, and other microadmixtures);
- improving the heating process by using design, mode, and organizational measures (affecting the oxide formation mechanism, etc.);
- ensuring a high efficiency of dust removal in fuel preparation and stack gas-scrubbing systems; burning up (salvaging) unburned carbon;
- processing and salvaging slag and volatile fly ash while producing by-products and catching ferrosilicon and other components;
- using efficient methods of completely removing toxic wastes from stack gases while salvaging the scrubbing products and heat;
- using the low-potential heat from the thermal power plant and cleaning the service wastewaters;
- using efficient noise-damping methods;
- ensuring ecologically clean oil and fuel oil treatment.

In all cases, in-cycle production equipment to suppress the formation of toxic wastes is a priority. Serious developments are being made toward this end, both in the USSR and abroad. The existing engineering decisions include relatively simple modal measures, well-founded design modifications of burner devices, and the development of new types of heating devices. For example, the feasibility of reducing nitrogen oxide wastes at coal-powered electric power plants to 75-80 percent has been proved by using experimental furnaces with new equipment for reducing the formation of nitrogen oxides (NO_x).[10]

The research that has been conducted on the oxide formation mechanism based on atomic oxygen has made it possible to find effective ways of controlling the process of the oxidation of nitrogen, air, and sulfur. As a result, in-cycle (furnace) systems for suppressing the formation, bonding, and decomposition of sulfur and nitrogen oxides may be used for waste-free and ecologically clean TES. New fundamental decisions such as the use of two-zone and air fountain furnaces, furnaces with a circulating or boiling pressurized layer, and steam and gas units with in-cycle gasification of solid fuel are being subjected to extensive research along with improvements in the traditional technologies for burning solid fuel. For example, adding dolomite or lime (chalk crumbs) when burning solid fuel in a boiling layer makes it possible to bind the sulfur contained in the coal and significantly reduce the formation of nitrogen oxides. However, despite the introduction of operations to reduce toxic emissions from TES, the main task for waste-free and ecologically clean TES is the complete salvaging of slag ash, gas, thermal and other wastes. The real possibility and feasibility of producing a consumer product from the wastes and gas emissions of coal-powered TES has been proved in both domestic and foreign practice.[11-27]

Throughout the world, it has become customary to consider secondary resources as primary resources. For example, the percentages of slag and ash wastes used at TES are as follows: 84 percent in Finland, 72 percent in France, 60 percent in England, and 20 percent in the United States.[11] Using slag and ash wastes, which are an important raw material source for the enterprises in a number of sectors, simultaneously solves the problems of freeing up primary raw material and materials and protecting the environment against the contaminants in TES wastes. Dozens of methods of using slag and ash wastes including organizing their warehousing and processing and supplying materials and products to consumers are widely known. As is evident from Table 1, most consumer products are highly profitable and are quite scarce and valuable. This is especially true in the case of such products as concrete and reinforced concrete structures and brick.

Table 1

Sector of Economy	Site or Method of Use	Type of Material	Indicator of Economic Efficiency, %
Construction	1.1. In production of reinforced concrete structures (as filler)	Ash agloporite	100[1]
		Aluminiferous expanded clay aggregate	46.1
		Ash gravel	46.1
	1.2. In the production of:		
	1.2.1. Cellular concretes (autoclave material)	Slag ash	92.3
	1.2.2. Concretes and solutions:	Ash	76.9
	a) At water development works		76.9
	b) Instead of cement	Ash	46.1
	c) Instead of sand	Ash	3.1

Table 1

Sector of Economy	Site or Method of Use	Type of Material	Indicator of Economic Efficiency, %
	1.3. In road construction		
	1.3.1. To stabilize soil	Ash and slag	76.9
	1.3.2. As an embankment to enclose dams	Ash and slag	0.7
	1.4. In the production of brick:		
	1.4.1. Silicate brick (autoclave material)	Ash and slag mixture	30.8
	1.4.2. Clay brick	Ash and slag mixture	5.4
	1.5. In the production of portland cement, clinker, and other types of cement (as an active additive)	Ash and slag	5.4
	1.6. In the production of wall panels (inner) based on cassette technology	Ash	30.8
	1.7. To produce alumina	Slag ash	11.5
	1.8. As an embankment warmth-keeping jacket for walls	Slag ash	0.7
Power engineering, municipal services, and other sectors	2.1. In protective coatings for pipelines, gas lines, and blades of drawing and blowing machines	Slag ash	100
	2.2 In the refractory materials (ash sitall, shale sitall and others)	Slag ash	7.7
Agriculture	3.1. To chalk acid soils	Dry ash	11.5

1. The efficiency of using ash agloporite is assumed to be 100 percent.

Introducing ashes into concretes and solutions to replace some of the cement and sand significantly improves their construction and engineering properties while conserving 40 to 80 kilograms of cement per cubic meter of heavy concrete. The different degrees of the economic efficiency of using ash and slag wastes (see Table 1) are determined by the consumer properties of the ash and slag, which are primarily characterized by their physicomechanical properties and their chemical and minerologic makeup. The use of ash as a filler for wear-resistant and insulating protective coatings, for use in chalking acid soils, in manufacturing ash glass ceramic, etc., is especially promising for the future.

Unfortunately, installations that extract ferrosilicon from slag and ash wastes at a cost of about 30 rubles per ton, which have been tested and which have demonstrated their efficiency in actual practice, are not yet being used. Technologies for the integrated processing of the mineral portion of coals, which yield alumina, aluminum sulfate, etc., are being introduced slowly.

The scales on which ash and slag wastes from TES are used will increase signficantly over the next few years. This in turn will make it possible to use multiash coals. Much has recently been said about the fact that nuclear power is the cleanest power. These comments undoubtedly refer to most modern nuclear technologies and to the comparatively old decisions being applied at TES. Indeed, the wastes at AES are a millionfold less than the ash at coal-powered electric power plants. As has been shown previously, however, the ash from TES may be used completely without any harm to the national economy rather than being buried in ash dumps. The wastes from AES can only be buried, which requires strict precautionary measures and appropriate conditions for storing the wastes for an extended period.

Removing sulfur and nitrogen oxides from the stack gases at TES is one of the most important issues among the safety measures connected with the problem of protecting the atmosphere. Sulfur-catching units using a "wet" lime cleaning method have become widespread at TES around the world. The method is based on using a lime suspension ($CaCO_3$) with the production of potassium sulfite ($CaSO_3$), which is processed into gypsum ($CaSO_4nH_2O$), to scrub the stack gases. Figure 3 illustrates the dynamics of the introduction of sulfur-catching units at TES in the United States, Japan, and the FRG by equivalent capacity and number.

The high reliability of sulfur-catching units operating on the basis of the "wet" lime method of scrubbing gases in combination with the simplicity of their technology and very low cost has resulted in their wide-scale use. The accessibility and inexpensiveness of sorbents used is another important advantage of the method. Any alkali industrial wastes may be used in this scrubbing scheme. The ammonia cycle method, which is based on scrubbing stack gases with an aqueous solution of ammonium sulfate and bisulfite, is distinguished by a comparatively more complex production circuit and high capital expenditures. The method's advantage is that it produces such consumer products as sulfur dioxides and sulfur.

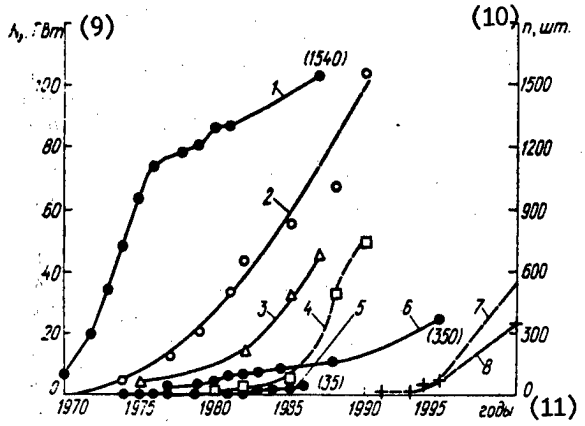

Figure 3. Dynamics of the Introduction of Sulfur-Catching Units at TES

Key: 1. Number of sulfur-catching units (maximum number) at TES in the United States 2. Equivalent capacity of the sulfur-catching units in TES in the United States 3. Equivalent capacity of the sulfur-catching units in TES in Japan 4. Equivalent capacity of the sulfur-catching units in TES in the FRG 5. Number of sulfur-catching units (maximum number) at TES in the FRG 6. Number of sulfur-catching units (maximum number) at TES in Japan 7. Equivalent capacity of the sulfur-catching units in TES in the Ukraine (optimistic forecast) 8. Equivalent capacity of the sulfur-catching units in TES in the Ukraine (pessimistic forecast) 9. N_E Equivalent capacity of the sulfur-catching units, GW n 10. Number of sulfur-catching units, units 11. Year

Although it is not very valuable, the ammonium sulfate that is also produced in the process is nevertheless used completely. The ozone-ammonia method of scrubbing gases is distinguished by its high demand adaptability and its assurance of the simultaneous removal of SO_2 and NO_x from the gases. The main shortcoming of the method is that it requires high-power ozonizers. The ammonium sulfate produced as a result of the scrubbing is a mediocre fertilizer.

Considering actual circumstances, the lime method, which of all of the existing scrubbing methods is the one most ready for wide-scale introduction, is the most feasible for wide-scale introduction at TES in the UkSSR all the way up until the year 2000. Figure 3 gives the equivalent capacity of sulfur-catching units in the republic according to optimistic and pessimistic forecasts. The fact that the republic's explored reserves of such sorbents as lime will satisfy the need generated by TES for the foreseeable future is especially important.

Under the conditions of the Donetsk Coal Basin, for example, chalk crumbs, a waste from soda production, are a more promising sorbent. It is presently available in an amount that is twice the demand imposed by sulfur-catching systems in the UkSSR's TES through the year 2000. As is evident from Figure 4, the total expenditures for sulfur catching are comparable with the reduction in its deleterious effects throughout the entire period under examination. Thus, the construction of coal-powered waste-free and ecologically clean TES ensuring the use of secondary resources that are in turn a very important source for a number of enterprises in the chemical, construction, and other industries is one of the most important national economic tasks under conditions of the intensive development of the UkSSR's economy.

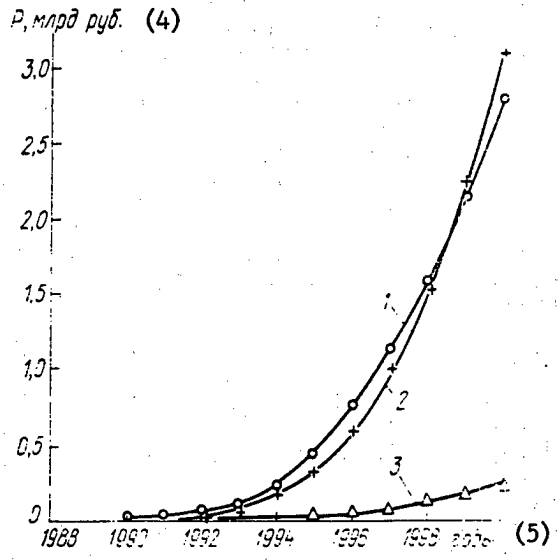

Figure 4. Estimated Values of the Characteristic Economic Indicators of Sulfur Trapping Based on TES Under the UkSSR Ministry of Power and Electrification

Key: 1. Total costs for sulfur purification 2. Reduction in damage due to toxic wastes from TES 3. Income from realizing gypsum 4. Cost (in billions of rubles) 5. Year

When examining the development of power generation in the UkSSR it is, above all, necessary to remember the explored number of large reserves of power-generating coals. In view of the high transport costs and losses under actual conditions, transporting power-generating coals to electric power plants in the Ukraine from other basins is clearly unprofitable. Dozens of explored sections for placing shafts with reserves of about 10 billion tons in one region alone are already known in the UkSSR. Thus, the presence of significant geologic coal reserves in the territory of the UkSSR makes constructing several TES in the near future feasible. Moreover, in the near future a significant portion of the facilities at TES in the South will need to be replaced with new ones because of obsolescence and physical aging. It is widely acknowledged that locating sulfur-catching units at existing electric power plants is basically impossible or very difficult in view of the lack of free areas. It is therefore necessary in all cases to proceed not by replacing the main thermomechanical equipment in their old housings but rather by organizing the construction of replacement TES with an entire set of enviromental protection measures in adjacent sites.

The fundamental feasibility of the construction of waste-free and ecologically clean TES in the European portion of the USSR over the next few years has also been determined by purely branch-related factors. First, the sharp reduction in the use of liquid and, subsequently, gas fuel that has been projected after the year 2000 must be taken into account. Second, it is necessary to meet consumer demand for high-quality (unchanging frequency) electric power at different times of the day and year. Third, there is the infeasibility of operating AES at half-peak, much less peak loads. Fourth, there is already a shortage of peak-load electric power, and the demand for it is increasing constantly in highly developed countries.

The direct quantitative link at any given moment between the production and consumption of electric power and the impossibility of storing the finished product (except by using methods of accumulating thermal power, which are insignificant from the standpoint of volume) impose special requirements on the development of power generation in the republic as a principal sector. These requirements include the need to store, not finished product, but rather the potential to instantaneously produce widely varying amounts of power. The only way of doing this is to have an installed capacity reserve that ensures coverage of the peak part of consumption.[28] The lack of a sufficient number of peak-load electric power plants is straining the economy in all sectors of the national economy, particularly in municipal services and agriculture. Considering that the basic part of the electric load graph in the European portion of the USSR is completely covered by AES, the construction in the UkSSR of coal-powered waste-free and ecologically clean TES that may be designed to operate in a peak-load mode[28] is a necessity of the first order.

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UDC 666.97.035.55

New Technology for Producing Resistors From Betel Composition Material

18610142 Novosibirsk IZVESTIYA SIBIRSKOGO OTDELENIYA AKADEMII NAUK SSSR: SERIYA TEKHNICHESKIYE NAUKI in Russian
No 15, Issue 4, August 88 pp 122-126

[Article by G. A. Pugachev and P. V. Semikin, Siberian Power Engineering Scientific Research Institute, Novosibirsk]

[Text] Conductive concrete (betel composition material), which was created in Siberia,[1] has made it possible to accomplish the nationally important task of creating inexpensive bulk resistors for high-voltage switches for the country's power generation systems.

The technology for manufacturing betel composition material, which is produced by vibrating plastic conductive mixtures, had a number of important flaws and did not enjoy wide-scale use in the production of betel resistors. The betel composition material produced in accordance with this technology had a low density and, consequently, a low strength. In addition, the results it produced from the standpoint of electrical resistance were not sufficiently reproducible. When the products dried, the excess water that was necessary to make an easily packed mixture created a microporous structure that reduced the betel's strength characteristics.[2]

The properties of betel composition material were improved (see Table 1) by using different types of conductive additives, changing the compositions of the mixtures, and using new production techniques to produce the resistors. Thus, first dry and then wet mixing of the betel's components, reducing the amount of water, and intensive packing of the mixtures by dynamic and static pressing made it possible to increase the mixture's homogeneity, the density of the conductive concrete, and thus its physicomechanical and electrophysical characteristics and reproducibility.[3] The technology for pressing rigid mixtures was used for the industrial manufacture of betel high-power bulk resistors intended for general power generation purposes at the Moscow pilot production engineering enterprise Energotekhprom.[4]

Properties of Conductive Concrete Produced by Using Different Technologies

Process No.	Characteristic	Measurement Unit	Value: Vibrating Plastic Mixtures	Value: Dynamic Pressing of Rigid Mixtures	Value: Static Pressing of Rigid Mixtures
1	Specific conductance	ohms x m	10^{-2}-10^{+4}	10^{-2}-10^{+4}	10^{-2}-10^{+4}
2	Compressive strength	MPa	5-25	10-70	10-70
3	Tensile strength	MPa	1-3	2-4.5	2.5-4.5
4	Average density in product	kg/m^3	1,800-2,200	2,200-2,300	2,200-2,320
5	Dispersion energy during an aperiodic voltage pulse lasting 10^{-4} s (ρ_b=1 ohm x m)	J/m^3	$(0.8\text{-}1.5)\times10^{+8}$	$(2\text{-}2.5)\times10^{+8}$	$(2.5\text{-}3)\times10^{+8}$
6	Same, but during sinusoidal voltage at a frequency of 50 Hz with an application time of 0.05 s (ρ_b= 0.2 ohm x m)	J/m^3	$(0.4\text{-}0.5)\times10^{+8}$	$1.5\times10^{+8}$	$(2\text{-}2.5)\times10^{+8}$

The wide-scale popularization of betel resisters as high-voltage equipment in power generation systems throughout the country is, however, being impeded by the need to increase the operating reliability and power generation capabilities and stabilize the electrophysical characteristics of betel composition material. Further explorations have resulted in the creation of a new technology for producing betel resistors by pressing dry conductive mixtures.[5] The essence of the technology lies in creating ultradense contacts among the carbon particles, eliminating excess water, and fixing the position of the carbon particles during the hydration of the binder. Dry homogeneous mixture is pressed under a pressure of 150 MPa and is saturated with water or steam (Figure 1) while being maintained at that same pressure. Because the resistor is produced and heat treated simultaneously, the production cycle is shortened. The resistive elements are manufactured in a special mold (Figure 2) that makes it possible to remove the restrained air from the packed mixture and to feed pressurized water or steam into the pressed betel mixture. After impregnation, the product is pressed out, held under normal conditions for 24 hours, and dried at a temperature of 378 K until a constant mass is achieved.

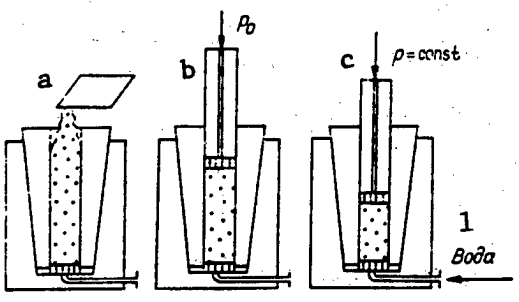

Figure 1. Main Production Operations Entailed in Dry Pressing Technology

Key: a. Dry mixture is poured into mold b. Dry mixture is pressed c. Packed mixture is saturated with water without removing pressure 1. Water

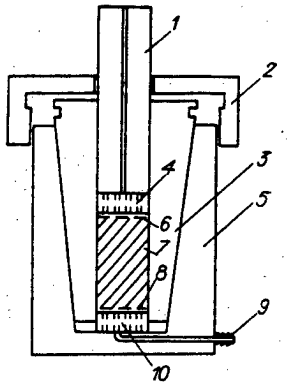

Figure 2. Mold in Assembled Form

Key: 1. Punch with holes 2. Cover 3. Removable insert 4. Upper coarse filter 5. Mold 6. Fine filter 7. Specimen 8. Fine filter 9. Connection 10. Lower coarse filter

We investigated the properties of resistors manufactured in accordance with this technology and consisting of two-component conductive composites: cement plus carbon. The following components were used: medium aluminate portland cement from the Chernorechensk plant (activity, 37-40 MPa), type PM-15 nongranulated carbon black, and electrode pitch coke ground to a specific surface of 900 m^2/kg. The concentration of carbon components in the mixtures was assumed to equal 0.24 to 0.26 in order to produce low-ohm betel.[6] The coke-to-cement ratio amounted to 0.2 in mass percents, whereas the carbon black-to-cement ratio was only half that amount on account of the more developed surface of the latter's particles. Proceeding from the specifics of the technology, we first investigated the the rheological properties of the dry mixtures during the pressing process and then studied the saturation of the

packed mixtures, i.e. the rate of impregnation and moisture. Third, we worked out pressing methods. The main control characteristic in the technology for manufacturing betel, i.e., the electrical resistance, was measured by using an Shch-300 universal instrument, with the mixture insulated from the metal parts of the mold. The inner surfaces were covered with technical-grade lacquer, and textile linings were placed between the copper contact plates and filters. The dry mixtures were pressed with a screw press. The pressing pressure was fixed with a dynamometer, and the deformation was fixed with Aistov instruments that were diametrally located on a punch.

We determined the porosity of the mixtures as the pressing pressure was varied from 0.1 to 150 MPa by proceeding from the volume occupied by the mixture and the true density of the components (Figure 3). When the pressing pressure is changed from 0.1 to 64 MPa, the porosity of the mixtures with the coke and carbon black is reduced to 60 percent, which confirms the loose packing of the particles. At the same time, the electrical conductivity of the packed mixtures is reduced; however, they each change to different degrees. In the mixture with the coke, the reduction of the specific electrical resistance ($\rho_{mixture}$) from the initial value amounted to 50 percent, whereas it amounted to 85 percent in the mixture with the carbon black. Increasing the pressure from 64 to 150 MPa reduced the value of $\rho_{mixture}$ only insignificantly, i.e., the electrical resistance of a mixture beginning with a pressure of 64 MPa virtually remains constant. However, the mixtures' porosities are more than cut in half, reaching 29 percent in the mixture with the coke and 27 percent in the mixture with the carbon black. The particles of the packed mixture are in a stress-strained state, which is confirmed by the elastic aftereffect after the pressing pressure is removed. The elastic aftereffect of the mixture with the carbon black amounted to 10.3 percent, whereas that of the mixture with the coke amounted to 7.5 percent.

Impregnating dry mixtures with water or steam had its own distinctions. The higher the pressing pressure and, consequently, the denser the packing of the particles, the longer the impregnation process lasted (Figure 4). Thus, after being pressed at a pressure of 150 MPa for 30 minutes, the mixture with the coke is impregnated with pressurized (pressure, 0.1 MPa) water to a height of 0.02 m. Reducing the pressing pressure to 60 MPa makes it possible to reduce the impregnation time by a factor of 2.5. Increasing the time for which water is fed into the mixture attenuates the impregnation process. Based on the research that was conducted, the following conclusions may be drawn:

1. The technology of deep pressing betel mixtures is the most suitable for producing high-power resistors (intended for use in generating electricity) with characteristics that are 1.5- to 2-fold higher than industrial resistors.

2. It became possible to forecast the conduction of betel on the basis of the electrical resistance of the dry mixture.

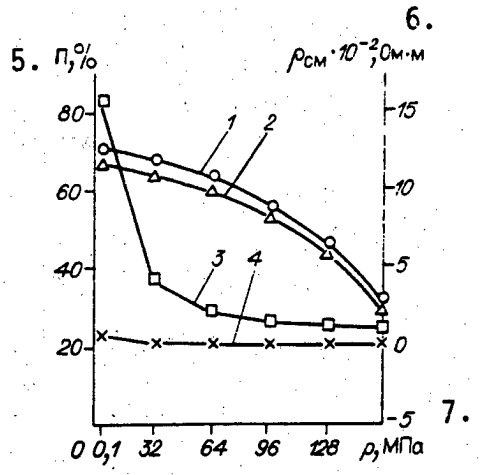

Figure 3. Porosity (1, 2) and Conductivity (3, 4) of the Dry Mixtures as Functions of Pressing Pressure

Key: 1. Cement + coke 2. Cement + carbon black 3. Cement + carbon black 4. Cement + coke 5. Porosity, % 6. Resistance, cm x 10^{-2}, ohms/m 7. Pressure, MPa

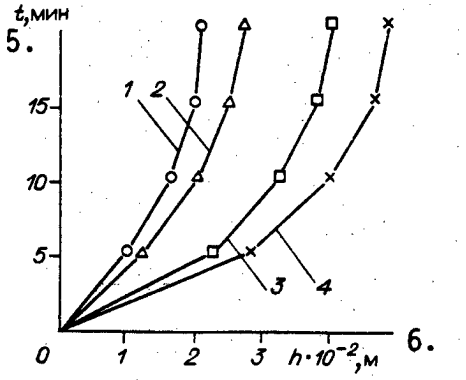

Figure 4. Time Required To Impregnate Packed Dry Mixture (1) and Cement (2-4) as a Function of the Thickness of the Layer

Key: 1. Pressing pressure, 150 MPa; water pressure, 0.01 MPa 2. Pressing pressure, 150 MPa; water pressure, 0.01 MPa 3. Pressing pressure, 60 MPa; water pressure, 0.01 MPa 4. Pressing pressure, 60 MPa; water pressure, 0.15 MPa 5. t, min 6. Height x 10^{-2}, m

3. The research resulted in the following production conditions for the principal production operations: time required to mix the dry components, 20 minutes; pressure at which the dry mixture should be pressed, 60 to 65 MPa; pressure at which the mixture should be maintained while it is simultaneously impregnated with pressurized steam (pressure, 0.8 MPa), 1 hour; time for which the product should be maintained under normal conditions, 24 hours; and time for which the products should be dried at a temperature of 423 to 433 K until they achieve a constant mass, 24 hours.

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New Hydrodynamic Bearing for Power Generators

18610061 Moscow KRASNAYA ZVEZDA in Russian
6 Oct 88 p 4

[Article by M. Glukhovskiy under the "Science and Technology" rubric: "Achilles Heel of Hydrodynamic Generators"; first paragraph is KRASNAYA ZVEZDA boxed, boldface introduction]

[Text] Soviet power engineers have solved a large scientific-technical problem. They have created new bearings for high-power hydrodynamic power generators that make it possible to guarantee their totally reliable operation.

The myth that Achilles died from Paris' arrow, which pierced him in his only vulnerable spot, his heel, involuntarily comes to mind when you recall scholars' and engineers' multiyear struggle to protect the highest-power units, hydrodynamic power generators, and make what has traditionally been their weakest link invulnerable, i.e., their step bearing. In both direct and figurative senses, it has long been the Achilles heel of the modern power-generating giants.

One of the most crucial assemblies of any hydraulic unit is its support, a gigantic slide bearing. It must receive the enormous load that is created by the weight of the machine's rotating parts and the water pressure in the turbine's impeller. This load reaches 50 kg/cm^2. Is it any wonder that a comparatively short time ago dozens of damaged bearings were still being fixed at hydroelectric power plants? The deleterious effect on the national economy was estimated at many millions of rubles.

What was not done to increase the bearings' reliability! But, as often happens, the solution was found not where it was originally sought but rather in an entirely different place. In this case, the solution was found among aviation designers.

Scholars from the Kuybyshev Aviation Institute imeni Academician S. P. Korolev developed a contact-hydrodynamic theory of lubrication and, on its basis, created a fundamentally new design for aircraft slide bearings. Should not the solution that had been found be used in hydraulic engineering?

While pondering this, Yu. Vayborodov, a docent at the institute, turned his attention to the fact that the rippling of the step bearing's face and the high friction coefficient of the babbitt used there caused accidents. Given the large surface area, an ideally even surface could not possibly be achieved. The result was an uneven load. But what if the surface of each segment was made elastic by using a fluoroplastic for a coating?

A hydraulic power generator is not a machine on which any idea can permissibly be tested straight off. A wrong step may prove too costly. Several years were required to comprehensively test the new decision on an exhaust pump.

Workers at the Volga GES imeni V. I. Lenin decided to first test the elastic bearing under operating conditions. A set of segments coated not with ordinary babbitt but rather with an elastic metal and plastic material that was faced with fluoroplastic was manufactured in the workshop. And then came that frightening moment that should yield the final answer. No, the power engineers had not made a mistake. The unit started up easily and stopped smoothly, so as to again pick up rotation speed afterward. Time confirmed the high reliability of the updated bearing. It has not failed once.

UDC 061.75 IMASh

50 Year Anniversary of Machine Building Institute

18610165 Moscow VESTNIK MASHINOSTROYENIYA in Russian No 10, Oct 88 pp 69-74

[Excerpts from article under the "Technological News" rubric by Academician K. V. Frolov, Candidate of Technical Sciences A. A. Parkhomenko, and Doctor of Technical Sciences M. K. Uskov: "The Stages of a Half-Century Biography: On the Fiftieth Anniversary of the A. A. Blagonravov Machine Science Institute, USSR Academy of Sciences"]

[Excerpts] In our time, fifty years is considered young in science, but at the same time a perfectly mature age. Such is, perhaps, the case when talking of the biography and scientific career of an individual scientist, designer, or specialist. But if talking about the half-century career of a major scientific institution, its work from "birth" to the present day, then the age criterion becomes something different. For a scientific research institute, fifty years is a very solid and responsible age: it is associated with many complex phases of development, the establishment of new directions of research, the formation of scientific schools, and the alternation of generations of scientists.

Over the course of many years, the Blagonravov Machine Science Institute of the USSR Academy of Sciences continues to be a major prestigious center of scientific and technical investigations.

A fifty year career in science cannot, of course, be simple, untroubled, and free of conflicts. Understanding this career requires a special and very deep study. This may be not only interesting, but also quite instructive. The goal of the present article is to clarify the main stages in the scientific "biography" of the institute and to demonstrate what its members have accomplished and how in the elaboration of the theory and practice of Soviet machine science.

Machine building is generally acknowledged to be the prime sector of material production and a key line of scientific and technical advance. At the present day, machine building is one of the fundamental pillars of the economy and its main technical base. Dynamic growth and quality improvements in engineering and technology, mastery of new kinds of industrial products, mechanization and automation of manufacturing processes in the economy—all of this is being accomplished on the foundation of developing a multiple-sector machine production.

The scientific foundations of machine building which secure its high technical and manufacturing potential are created by machine science, the science of machines. Combining a broad group of far-reaching and multifaceted investigations in the various fields of machine production, modern machine science is creating a dependable basis for analysis, design, fabrication and application of new machines and equipment. Just as the level of development of the economy as a whole is dependent on the progress in machine building, the level of quality and the scientific-technical arsenal of the latter is dependent on progress in machine science.[passage omitted]

The organization of the Institute of Machine Science was dictated by the direct need for developing the scientific bases of machine construction, development of which required the creation of machines of original Soviet design and cutback on imported Western goods.

The creation of the Institute of Machine Science within the system of the USSR Academy of Sciences was itself no accident. During the years of the first five year plans, the network of scientific research and design institutes of the sectors in the basic, primary branches of machine construction was already quite broad. However, these first-organized institutes were commonly very weak in scientific respects: the problems tackled by them were generally confined to their sectors, and did not impact on the overall scientific and technical policy in the machine industry. Often research would be duplicated, and there was almost no coordination among the sectors. The time had come to create an authoritative interbranch science organization to tackle the most crucial theoretical and practical problems of the machine industry in its entirety. A major institute of the academy could be such science organization.

The basic areas of activity of the institute, as proposed by the Department of Technical Sciences, were to be the four most important problems for the machine industry: the theory of mechanisms and machines, friction and wear of machines and parts thereof, dynamic strength of machine parts, and metalworking.

After the program proposal for creation of the institute was approved by the presidium of the academy, a general meeting of the academy adopted the corresponding resolution, and the Department of Technical Sciences issued a directive for organization of the academy's Institute of Machine Science on the premises of the existing Commission of Machine Science as of 13 November 1938. This date became the official birthday of the institute, the start of its many years of fruitful activity. The foremost science and administration center of Soviet machine science became part of the basic research organizations of the country.[passage omitted]

The restructuring in the postwar years led to considerable expansion of the scientific projects of the institute. The work force was greatly enlarged. Starting in the late 1940s, research and design of machine automatons and automatic lines intensified.

Problems in the theory of machine automatons and results from study of their characteristic mechanisms (cam-type, hydraulic, pneumatic, hydropneumatic) were incorporated in a whole series of projects of the institute, in particular, the two-volume monograph "Methods of Analysis of Machine Automatons."[passage omitted]

After the reorganization of the academy in the 1960s, the institute was transferred to the system of the State Committee on Automation and Machine Building and then, after its transformation, to the USSR Ministry of the Machine Tool and Tool Industry. During this period it was named the State Scientific Research Institute of Machine Science (GosNIIMASh).

The main efforts of the members of the institute during the 1960s focused on solving the urgent problems of machine science put forward by the rapidly developing machine industry.

Chief among these were problems in the theory of machines and mechanisms, including testing of machine automatons and automatic lines, methods of analysis of machine parts for strength, vibration, friction and wear, and problems in the theory of precision. The scientific projects found broad practical adoption in the design, fabrication, and application of machines of various manufacturing purposes.

A whole series of projects carried out by the experts of the institute during this time were of priority significance. Thus, the cycle of studies involving creation and adoption of a pulsing step drive unit was awarded the 1967 State Prize. Stepping systems and stepping motors found application in the control of the most diverse machine tools and technological processes. The institute devoted deep study to the process of selective transfer (the so-called "non-wearing effect"), which made possible a many fold increase in the wear resistance of a number of articulations in machines. The selective transfer effect has been entered in the State Register of Scientific Discoveries of the USSR. The method has found effective application in the aviation and a number of other technological sectors.

The system of bioelectrical control of mechanisms and devices worked out by the institute was brought into practice and received international recognition. In 1970, the work on bioelectrical control systems received the USSR State Prize. Subsequently, the Institute of Machine Science became one of the foremost organizations in the investigation and development of biotechnical problems and in the study of a number of primary theoretical and practical aspects of complicated man-machine systems.

In order to cope with the difficult problems confronting the heavy and the power generating machine industries, the institute developed a simulation of elastic temperature stresses (by "freezing" the "free" temperature expansions in optical models and "thawing out" the complete model). This method was used in investigation of the structure of the shells of nuclear reactors in connection with evaluations of their strength and allowable thermal operating regimes. In order to study the stresses in full scale parts under elastic and plastic deformations, kits and instruments were developed for measurement in optically sensitive coatings. This made it possible to study the stressed conditions in high-power stamping presses, rotors of turbogenerators, and other types of energy generating equipment.

The procedures, apparatus, and methods developed by the institute for investigating stress and deformation in parts and assemblies of machines found diverse applications in industrial production. The results achieved in this field made it possible to investigate the forces, deformations, and rigidity under operating conditions in a number of unique machines and structures created by the Soviet machine industry (hydroturbines of the Dnepr, Tsimlyansk, Kuybyshev hydroelectric stations, high pressure boiler shells of the Mosenergo heating and power central, the nuclear reactor structures of the Novovoronezh power plant and the Rheinsberg power plant in the GDR, the reactors of the Shkoda plant in Czechoslovakia, and so on).

During the 1970s, a number of new directions emerged in the projects of the institute, concerning the development of research in the area of man-machine systems, vibration engineering and technology, acoustic dynamics of machines, the creation of industrial robots and manipulators, the theory of reliability, the automation of intellectual labor, and so on. The investigations on problems of strength and plasticity represent a valuable contribution both to theoretical knowledge and to practice. The results of scientific research in the field of strength were widely adopted into practical computations and design of new machines, not only in the machine industry of the USSR, but also that of other countries, notably the GDR, Bulgaria, and Czechoslovakia.

Significant advances and results were achieved in one of the new areas of contemporary machine science: acoustic dynamics of machines. The major projects in this field of research, successfully utilized in the practice of Soviet ship building and engine construction, received two USSR State Prizes.

The scientific level and practical effectiveness of the research in the area of tribotechnology (the science of friction and wear of machines) was largely dependent on the theoretical and experimental projects of the institute in this field. The investigations carried out by the institute have a fundamental base which was created over the years of its existence by the scientific schools of prominent scholars in the field of tribotechnology. The projects of the scientists of the institute and its scientific school in the field of friction, wear, and lubrication have received international recognition. One of the examples of successful application of these accomplishments was the

creation of the friction elements in the Lunokhod spacecraft. A large group of scientists of the institute was awarded orders and medals of the Soviet Union for work in this field of technology.[passage omitted]

In 1980, the Institute of Machine Science (which had been given the name of Academician A. A. Blagonravov) was returned from the USSR Ministry of the Machine Tool Industry to the system of the USSR Academy of Sciences. The period of the 1980s was characterized by new scientific projects which received high praise from official circles and found effective application in production. Thus, the cycle of studies on creation of methods of analysis of structures made from composite materials was awarded the USSR State Prize in 1985. Four projects of the institute, put into effect at the enterprises, the research institutes, and the design bureaus of the machine building industry, were awarded the prizes of the USSR Council of Ministers. Among those receiving the award were a project for creation of the scientific foundations for analysis and improvement of the strength of power generating equipment in terms of criteria of crack resistance (1983), the major research and application project "Metal-fluoroplastic bearings" (1984), and others.

For facilities of the nuclear power industry, as well as the organizations manufacturing power generating machines, analytical and model investigations of the stressed and deformed state and the thermomechanical stressed state were carried out for the series produced nuclear reactors VVER-1000 and newly designed reactors up to 1500 MW in power, special power generating layouts, and fast reactors. A complex of measures was developed to assure tribological reliability of high-temperature nuclear gas reactors (VTGR), including the creation of analytical methods to estimate the lifetime (in terms of criteria of wear) of the primary elements of the reactor and the typical friction elements, as well as methods to assure the serviceability of the friction elements in an extreme environment (the magnetic-powder lubrication method, wear-resistant hard coatings). Work is being done together with a number of research institutes on process gas reactors up to 400 MW in capacity, which are entirely new to the Soviet machine industry.

We cannot fail to mention the development of the scientific bases of acoustic design of complicated machines and systems of machines with allowance for the interaction among themselves and with the environment. The proposed methods and recommendations on acoustic design have found practical application in the creation of important items of innovative technology. The principles, means and methods of vibroacoustical diagnostics of the technical condition of machines with a view to enhancing their reliability have been worked out.

On the basis of research conducted by the institute, modern methods and automated stands have been developed for experimental study of man-machine systems. New approaches to the use of computer-aided tomography, laser engineering, and other advances of scientific instrument design in the biomechanics and ergonomics of man-machine systems have been created; new means and appliances have been developed to intensify the activity of the human operator and prevent various pathological deviations in the health of those attending the machinery.

Successful solving of the complicated scientific problems of the modern machine industry is made possible by the scientific potential of the Institute of Machine Science, the large and competent team of scientists and specialists. Since its inception, many prominent scientists have worked at the institute, enriching Soviet and world science with their efforts. The first director of the institute (1938-1952) was the prominent Soviet machine scientist and academician Ye. A. Chudakov, creator of the scientific foundations of Soviet automotive design, vice president of the USSR Academy of Sciences, twice laureate of the USSR State Prize. Afterwards, the institute was directed by academician A. A. Blagonravov, a major specialist in the field of machine science, automation, and defense technology, twice Hero of Socialist Labor, laureate of the Lenin and USSR State Prize. Heading the institute for more than 20 years (1954-1975), he was president of the Interkosmos council and permanent representative of the USSR to the United Nations on peaceful exploration and utilization of outer space. As of 1976, the institute has been headed by academician K. V. Frolov, vice president of the USSR Academy of Sciences.[passage omitted]

An important sphere of activity of the institute is the organization, preparation, and convening of representative scientific forums. Thus, the institute was the organizer of seven All-Union Congresses on the theory of machines and mechanisms, attended by many hundreds of scientists and specialists from the research institutes and design bureaus, professors and teachers from the higher institutes of learning, and leading engineers from the machine building enterprises.

Numerous conferences, meetings and symposia on problems of friction and wear in machines, the theory of precision and reliability, strength of machine structural materials and structures, vibration and vibration protection, the theory and principles of operation of industrial robots and manipulators, have become regular events. Forty years ago, a permanently sitting science seminar on the main problems of the theory of machines and mechanisms was created at the institute. Chapters of this seminar are operating in 18 major cities of the Soviet Union: among them, Leningrad, Kiev, Kharkov, Sverdlovsk, Tbilisi, Dnepropetrovsk, Tashkent.[passage omitted]

In recent years, the institute has become the central organization for publication of the international scientific collection "Problemy mashinostroyeniya i avtomatizatsiya [Problems in Machine Building and Automation]." More than 20 such international collections have

been published in six years (1982-1988), being the primary scientific information publication on machine building in the CMEA countries.

Today, in connection with the growing demands to accelerate the scientific and technical progress, the Institute of Machine Science is confronted with new scientific and practical problems. The scale and scope of the problems being solved have grown significantly, and the geographical framework of the activity of the institute is being greatly enlarged. Business contacts are being established with many scientific and production organizations. In the different regions of the country—Leningrad, Sverdlovsk, Saratov, Kuybyshev, Gorkiy—chapters of the institute have been created and have begun operation. In addition to carrying on scientific research, they are supposed to encourage wide ranging adoption of scientific advances in the practice of design, manufacture, and application of highly reliable and efficient machines, instruments, and apparatus.

Thus, the "Gorkiy automotive plant" PO [production association] has organized sector-based problem laboratories which are part of the institute's chapter in the city of Gorkiy: a laboratory for strengthening processes in mass production of machines and a laboratory for vibroacoustics of automobiles. These are faced with the tasks of developing and introducing into mass production new methods of assuring reliability and longevity of automobiles. Two base laboratories have been created as part of the Uralsk chapter of the institute in the city of Sverdlovsk at major industrial enterprises: one for machine reliability and working life at the PO "Uralmash," the other a membrane technology laboratory at the PO "Uralkhimmash." The main area of activity of the laboratory at "Uralmash" is working on scientific and practical problems of assurance of reliability, working life, and repairability of heavy machine products, while that of the laboratory at "Uralkhimmash" is the creation of membrane apparatus and modular assemblies for production of specially pure hydrogen. As part of the institute's chapter in Leningrad, a laboratory base is being created at the Izhorsk and other machine building plants.

As of 1986, the Blagonravov Machine Science Institute has been the central organization of the interbranch scientific-technical complex (MNTK) "Reliability of Machines." The chief functions of this complex are the development of modern methods for optimal design of machines and equipment based on systematic investigation and testing of the primary elements responsible for reliability and working life; creation and adoption of efficient systems for inspection of machines and constructions exposed to influences of high mechanical stress, vibrations, temperatures, intensified wear and corrosion. At the same time, the complex is creating and organizing the production of diagnostic means, machines, and appliances, as well as sensors, primary transducers, and other accessory elements for diagnostic and testing equipment of general industrial application; and developing the necessary scientific-technical documents governing the requirements and methods of assuring long working life and high reliability of machines and constructions. The functions of the complex also include the organization of special further education of the engineering personnel and upgrading of qualifications of specialists in the field of analysis, diagnostics, and inspection of machines and constructions.

The "Reliability of Machines" complex is made up of scientific research institutes and organizations, design bureaus, scientific-production and production associations of a number of the ministries of the USSR, the USSR Gosstandart, the USSR Academy of Sciences, and the academies of sciences of the union republics. The creation of such vast scientific and technical complex is an unprecedented undertaking, and the difficulties of the start-up period are understandable.

As the complex operates under the conditions of the radical economic reform, a good many difficult and unprecedented scientific, organizational, and production problems are occurring. Solving of these requires continual, steadfast, and (most importantly) coordinated efforts from both the Institute of Machine Science and all organizations making up the complex. The work of the complex has begun, and it should become increasingly productive for science and industry.

The current problems of improving the effectiveness of scientific research and the urgent demands for accelerating the scientific and technical progress in the machine industry are confronting the members of the institute with a broad range of new problems. It is no easy matter to solve them. The development plans of the institute to the present day make no provision for construction of new buildings and supply of the necessary equipment. The needs of the scientific laboratories for modern computing equipment are being ill served. The experimental base, in need of major modernization, is not suited to the demands of the day. A certain imbalance has taken shape in the work force: traditional fields of research are better supplied with qualified personnel than are certain new fields of science.

The institute is searching for the most effective means, methods, and forms of conducting research projects in order to intensify the scientific activity and improve in every way the actual contribution of the theoretical and practical projects to the practice of the machine industry. The large and fruitful scientific experience in traditional and new areas of the science of machines amassed by the Blagonravov Machine Science Institute of the USSR Academy of Sciences over the five decades of its existence is a solid foundation for accomplishment of the complex and critical tasks confronting the Soviet machine industry today.

USSR Gosstandart's Implementation of Measures To Increase Production Quality Examined

18610098a Moscow STANDARTY I KACHESTVO in Russian No 9, Sep 88 pp 6-7

[Article: "In USSR Gosstandart"]

[Text] The CPSU Central Committee's Party Inspection Committee examined the matter of the implementation of the CPSU Central Committee and USSR Council of Ministers decree "Measures To Radically Increase Production Quality" by the directors of the USSR Gosstandart and a number of machine building ministries.

The decision adopted, a discussion of which was published in the 25 June edition of PRAVDA, noted that the USSR Gosstandart is not providing the necessary coordination of the ministries' activities regarding intensifying the role of standards in accelerating scientific-technical progress and is making weak use of integrated standardization for the interbranch linking of quality indicators for new technology and products and materials that are themselves parts of sets. International standards are being introduced slowly and incompletely. Monitoring of the introduction of progressive standards, including during the development and testing of new technology, is not strict enough. Data for the legal committee for preventing and halting the manufacture of poor-quality products are not being used completely.

The directors of the machine building ministries, associations, and enterprises are not taking the necessary measures to increase product quality decisively. At many plants production equipment is in a neglected state; the required diagnostic, testing, and measurement resources are lacking; and the activities of the technical inspection services are not being improved.

At the 9 July meeting in the CPSU Central Committee, which was devoted to matters of structural policy and priority directions in machine building, it was noted that there are well-founded grievances against machine builders with regard to the technical level, quality, and durability of machinery and equipment.[1] This is confirmed by the general reduction in the manufacture of products belonging to the highest quality category from 39.7 percent in 1985 to 35.3 percent in 1987. The CPSU Central Committee set the task of concentrating efforts on accelerating scientific-technical progress in 55 priority directions in machine building.

An expanded meeting of the USSR State Committee on Standards in which the leading machine building ministries participated was convened on 16 July. Workers from the apparatus of the CPSU Central Committee and CPSU Central Committee's Party Inspection Committee took part in the meeting. The decree adopted as a result of the meeting stipulates the following.

The decision of the CPSU Central Committee's Party Inspection Committee should be taken as the basis for the further work of the USSR Gosstandart to implement the decree issued by the CPSU Central Committee and USSR Council of Ministers on 12 May 1986 entitled "Measures To Radically Increase Production Quality."

It is recommended that the ministries included in the machine building complex analyze the status of the implementation of the specified decree. The results of the analysis should be used as the basis for a board meeting (that would include the USSR Gosstandart). At this board meeting, plans for specific measures to increase products' technical level and quality would be adopted, as would plans to accelerate work related to restructuring standardization activity geared primarily toward the priority directions in machine building. The personal accountability of the directors of the scientific research institutes, design offices, and plants for the timely introduction and complete observance of the standards would be increased, and the reassessment of technical conditions so as to raise them to the highest world levels would be accelerated.

It is recommended that the administration of the USSR Gosstandart and the committee's subdepartmental institute intensity their coordinating role in increasing the quality and reliability of products being manufactured. It is also recommended that they work jointly with the directors of the ministerial subdepartments and their scientific research institutes and design offices to analyze the reasons for the shortcomings noted by the CPSU Central Committee's Party Inspection Committee and that they take the necessary emergency measures required to eliminate them.

The decree prescribes that, together with the directors of the associations and enterprises, the USSR Gosstandart's territorial organs and state acceptances take timely measures to prevent and halt the manufacture of products that do not conform to standards and specifications and that they use all of the rights granted them to do so.

The principal measures of the USSR Gosstandart and machine building ministries to eliminate the shortcomings noted in the resolution of the CPSU Central Committee's Party Inspection Committee concerning fulfilling the decree of the CPSU Central Committee and USSR Council of Ministers entitled "Measures To Radically Increase Production Quality" were approved at the meeting.

Footnotes

1. PRAVDA 10 July 1988.

All-Union Conference on Increasing Reliability Held in Tula

18610098b Moscow STANDARTY I KACHESTVO in Russian No 9, Sep 88 pp 41-43

[Article by A. I. Kubarev, G. F. Isyemina, All-Union Standardization in Machine Building Scientific Research Institute]

[Text] An all-union scientific-technical conference entitled "Production Design Methods for Improving Reliability and Their Standardization" was held in Tula in May of this year. It was organized by the USSR Academy of Sciences, USSR State Committee for Science and Technology, USSR Gosstandart, RSFSR Ministry of Education, Administration of the USSR Council of Scientific Research Organizations, Central Administration of the All-Union Scientific-Technical Society of Machine Builders, Tula oblast committee of the CPSU, administration of the Tula oblast organization of the USSR Society of Scientific Research Organizations, and Tula Labor Red Banner Polytechnic Institute. Two hundred eighty persons from different cities throughout the country took part in the conference.

Four sections were presented within the framework of the conference:

Design methods for increasing product reliability; Production methods for increasing product reliability; Reliability testing and inspection; Size analysis of machinery and production processes.

Six reports were presented at the plenary session including a report by B. N. Sokolov, first deputy chairman of the USSR Gosstandart, entitled "Role of Reliability Issues in Accelerating Scientific-Technical Progress."

The report noted that previously existing organizational and methodological principles of ensuring the reliability of machine building production were not justified. They did not make it possible to increase the reliability of most types of machine building products to the level of modern requirements. The task established by the 27th CPSU congress, i.e., to increase the reliability of redesigned and updated technology 1.5- to 2-fold, must be fulfilled. First and foremost, this will require a change in the attitude of designers and technologists toward the reliability of technology that is being re-created.

Experience shows that the greatest efficiency is achieved in the case where all reliability-related development is shifted to the experimental design stage and where only products that have been shown by experimental and estimate methods to have a reliability that is no less than that required are launched into series production.

Speaking of other reasons for the slow solution of the problems entailed in increasing reliability, Sokolov pointed to the discrepancy between theoretical developments in the area of reliability and engineering practice. This discrepancy came about because, for many years, reliability appeared to be a discipline of statistical probability rather than an engineering discipline.

Sokolov noted that domestic and foreign practice have shown that the integrated solution of the problems entailed in the reliability of individual types of technology is most effective when based on reliability assurance programs, including measures during the design, manufacture, and operation phases. Unfortunately, the reliability services have still not made this approach the foundation of their activity.

To a large degree, reliability level is determined by the scientific-technical level of normative and technical documentation. The report noted that during a 1987 expert appraisal of 2,867 drafts of state standards for machine building products that were being revised and redeveloped the standards were revised to include such progressive indicators as specific consumption of materials, economy of power consumption, reliability, and productivity.

The USSR Gosstandart obliged its institutes to analyze and generalize data on the economic impact anticipated from the re-established standards. In this context not only did the 1987 appraisal include a consideration of data about the economic efficiency of standardization, it also included the specification of indicators of the economic efficiency of new technology manufactured in accordance with these standards. The economic impact amounted to 1,048,219,000 rubles.

Furthermore, the report showed the effectiveness of work to certify products according to quality category and state tests. The reasons for the insufficient objectivity of state tests were analyzed. The main reasons were the poor degree to which the testing services have been furnished with equipment (on average, they have less than 70 percent of the required equipment), a lack of modern scientific technical documentation on tests (programs and methods) corresponding to the world level, and understaffing. For the specified reasons, in 1987 the USSR Gosstandart denied the certification of 7 of 44 head testing organizations seeking recertification.

In the overwhelming majority of cases, the machine building sector's currently existing normative base on state tests does not meet the current requirements for methods of testing machine building products and requires further improvement.

To ensure the certification of all production as well as to organize tests of machine building products that are either exportable or hold promise of being exportable, the draft of a program to create certification centers has been developed.

In 1987, there were more than 2,100 instances in which the USSR Gosstandart's territorial organs halted the shipment of products that did not conform to standards and specifications in an effort to curtail the manufacture of low-quality products.

Sokolov placed great hopes in the Reliability of Machinery Interbranch Scientific-Technical Complex, which is headed by K. V. Frolov, vice-president of the USSR Academy of Sciences. The initial results of the complex's activities indicated that the USSR Academy of Sciences' Machine Building Institute was able to assemble the most qualified personnel and coordinate the work of academic and sectorial institutes, higher education institutions, and industrial enterprises in the field of testing and diagnostic equipment, which has already made it possible to begin manufacturing testing equipment corresponding to and surpassing the level of the foreign analogues.

The task of the USSR Gosstandart as a participant in the interbranch scientific-technical complex is to create normative-technical and metrologic support for the complex's tasks.

A. S. Pronokov, doctor of technical sciences, presented a report entitled "Problems of Parametric Reliability of Machines." He characterized the status of scientific research on the specified direction and noted the increasing role of this problem in machine building production. The author linked parametric reliability with physical breakdown processes and discussed conditions under which parametric failures in initial operation sections are impossible. The author feels that it would be useful to regulate the reliability margin for machine building products, as is done for strength.

V. N. Ulyanov, deputy head of the Main Administration of the USSR Gosstandart's State Acceptance, presented a report entitled "Activity of State Acceptance With Regard to Increasing Quality and Reliability of Products Manufactured." He characterized the main problems and verification objects when products are accepted from the standpoint of reliability indicators by using the activity of the state acceptance service at the Red Proletariat MSPO [not further identified] as an illustration. At this enterprise, each machine tool is subjected to approval tests in accordance with a testing program. The established operating time between failures of T_e = 16 hr/d was verified during these tests. At the enterprise, reliability indicators were determined both for each model machine tool as a whole and for each different type of component product and each component product manufactured by a different plant. Ulyanov noted that joint efforts have yielded effective results in places where the administration understands that the state acceptance is not only a state inspector but also an entity that helps the enterprise manufacture high-quality and reliable products.

V. F. Tereshchenko, deputy head of the Center for Standardization and Metrology in Tula, presented a report entitled "Role of Center for Standardization and Metrology in Increasing Level of Enterprises Work To Fight for Quality and Reliability." The report was based on data from the Central Region Center for Standardization and Metrology, which includes 11 oblasts, and on specific data relating to enterprises in the Tula oblast. According to Tereshchenko, the main task of the Center for Standardization and Metrology is to achieve the manufacture of products with parameters that conform to the most exacting consumer requirements and that do not lag behind the best world analogues from the standpoint of their value. The regional Kachestvo [quality] programs play a very important role in accomplishing this task.

The comprehensive program Kachestvo in the Tula oblast is an example of the merging of territory and sectorial interests within the framework of a single document. This program was examined at the USSR Gosstandart's board meeting and recommended for wide-scale dissemination. Speaking about the first results of the program's implementation, Tereshchenko noted that in 2 years the relative proportion of products with the state Emblem of Quality reached 66.3 percent of those products subjected to certification and that enterprises launched the production of 58 new types of products intended for technical and production use and 757 types of consumer products.

Yu. G. Zarenin (Kiev), doctor of technical sciences, spoke at the plenary session. His presentation was devoted to the problem of the feasibility of standardizing production design methods of increasing reliability.

D. M. Belenkiy (Rostov-na-Donu), doctor of technical sciences, presented a report entitled "Ensuring Machines' High Reliability." Based on an examination of reliability from the standpoint of consumer cost, the author justified the concept of an "integrated reliability indicator" and showed the feasibility of making an integrated assessment of the effectiveness of measures to increase reliability on the basis of this indicator. The author recommends that the distribution of the maximum values in the sample be used to process operating information and the results of stand tests. His report also covered the problems in evaluating the provision of equal strength to all components and assemblies in machines and presents the characteristics of the main directions in the activity of the reliability laboratory of the Rostov Construction Engineering Institute.

The section directors presented communications at the final plenary session, and a resolution based on the conference results was adopted.

In particular, it mentioned the fact that the Reliability of Machines Interbranch Scientific-Technical Complex together with the machine building ministries and departments must develop, and the USSR Gosstandart

must approve, a set of practical instructions concerning engineering and technical methods of ensuring reliability that can be used directly by designers, technologists, and operating staff. These would include instructions concerning the following:

program and methodological support for estimating the reliability of the components and assemblies of machines and instruments;

establishment of tolerances for dimensions and parameters;

rules for designating and establishing reliability norms;

an estimate of the need for spare parts;

a determination of the intervals for maintenance and repairs;

methods and means for technical diagnosis;

modes for trial and break-in production runs;

selection of plans for reliability tests and accelerated testing modes;

methods of comparing the reliability of domestic technology with foreign analogues in the absence of information about their reliability indicators;

production techniques and methods of increasing reliability as production objects and production processes.

In 1988, the Reliability of Machines Interbranch Scientific-Technical Complex, working jointly with the ministries and departments, should develop a program to provide industry with testing equipment and a plan of measures for introducing scientific developments in the field of reliability and progressive domestic and foreign experience into the machine building complex.

Based on the example of several products, the introduction of modern finishing methods to ensure reliability and the scientific developments of the USSR Academy of Sciences should also be organized in the union republics, and this experience should be disseminated to all machine building enterprises.

It is recommended that the ministries and departments establish a list of products that should be finished to ensure their reliability. This finishing should be based on reliability assurance programs, and the subdepartmental organizations should be obliged to develop such programs.

The USSR Gosstandart should entrust the state acceptance service with monitoring the curse of the implementation of reliability assurance programs.

It is recommended that the ministries and departments do the following:

Develop well-founded technical and economic normative reliability indicators and criteria for failures and limiting conditions for all types of technology for which these indicators and criteria are not regulated by existing standards;

Develop methodological materials and computer programs for estimating the reliability of the principal types of products.

It is suggested that the USSR Gosstandart certify the specified methodological and program complexes and develop conditions under which estimates of reliability based on certification methods will be sufficient to confirm the reliability level that has been achieved.

It is recommended that the enterprises and associations accelerate the creation (intensification) of reliability services, charging them with organizing work to ensure reliability in all stages of the life cycle, including organizing an author's inspection, particularly of products' reliability during the process of their operation and the organization of work to implement (on the basis of this information) production design measures to increase reliability.

It is recommended that the ministries and departments do the following:

develop (revise) systems to maintain and repair technology, linking maintenance and repair intervals with normative values for the reliability indicators of products and their assemblies;

complete the creation of methods for the integrated testing of the sectors' products (including accelerated testing when necessary) in 1989;

organize (at all enterprises) work to discover the parameters of production processes exerting a decisive effect on reliability and introducing requirements related to the indispensability of systems monitoring of these parameters (above all, automated monitoring) into technical documentation;

conduct size calculations with an allowance for reliability norms and the real conditions under which products function;

generalize work related to the size analysis of machining production processes and create practical methods with the necessary normative data.

It has been deemed necessary to expand the amount of research and the coordination of work related to matters of precision and size analysis. From this standpoint, the following steps are requested:

The All-Union Scientific-Technical Society of Machine Builders should create a section (coordination council) on the problem of precision and size analysis, charging it with developing fundamental directions and research on the topics of precision and size analysis, generalizing practical experience, coordinating work, and getting applications materials and recommendations to industrial enterprises ready for publication;

The USSR Gosstandart should, under the authority of its Reliability in Technology Scientific-Technical Council, create a scientific methodological commission called Methods of Calculation and Size Analysis in Performing Reliability Tasks. Specialists from the Tula Polytechnic Institute should be called upon to direct the commission;

The Reliability in Technology Scientific-Technical Council of the USSR Gosstandart (chaired by B. V. Gnedenko, academician of the UkSSR Academy of Sciences) should develop proposals for making an allowance for the reliability level achieved when establishing (revising) the prices of new (updated) products intended for industrial use. The council should also ask the USSR State Committee on Prices to take them into account when developing a method of establishing prices for machine building and instrument making products;

A policy whereby higher prices for new types of technology with higher reliability indicators would be designated after the confirmation that the reliability level has been achieved should be included in the USSR State Committee on Price's new price formation system;

The All-Union Scientific-Technical Society of Machine Builders should (beginning in 1988) organize all-union competitions for better work in the field of reliability.

The complete text of the conference resolution was sent to the interested organizations.

The most interesting of the conference reports will be published in a collection of works of the All-Union Standardization in Machine Building Scientific Research Institute.

UDC 658.562:621

Guidelines for Quality Groups, Worker Input Discussed

18610082 Moscow MASHINOSTROITEL in Russian No 7, Jul 88 pp 2-4

[Article by V. P. Kochin and N. A. Larionov, engineers, under the "Quality—Key Link in Acceleration" rubric: "Quality Groups at Machine Building Enterprises"]

[Text] Everyone knows what high produce quality is. But considerably fewer people know how to achieve it.

High produce quality requires that all of the links in a production product exist in a well-developed system and that production relationships be well tuned. The falling out or slowdown of one of the links will destroy the entire system, and a high product quality will not be achieved. There are no, and there can be no, trifles here. Produce quality is a direct function of labor quality.

In 1986 the CPSU Central Committee and USSR Council of Ministers adopted a resolution entitled "Concerning Measures for Radically Increasing Product Quality." It stated that increasing the quality of products and work performed is a national affair. The creation of quality groups at associations and enterprises and in shops and sections was deemed a feasible way of increasing workers' involvement in the solution of problems related to increasing quality.

In the past few years, the mass creation of similar units has been observed in socialist and capitalist countries alike. In the People's Republic of Bulgaria, creative quality groups are being created at virtually all enterprises. There are about a thousand of them in the country. Quality circles have been created in the Hungarian People's Republic, GDR, CSSR, and Mongolian People's Republic. More than 2 million quality circles, called "zero-reject groups," have been created in Japan. They involve 85 percent of all workers. The proposals made by such groups bring firms up to $25 billion in profit annually. Fewer quality circles exist in the United States than in Japan. Only between 10 and 15 percent of all workers are involved in them.

Abroad, quality circles use the voluntary cooperation of workers to generate ideas. "Brainstorming" is often used.

According to the experience of a number of firms in Japan, quality circles facilitate the solution of such problems as economizing physical and labor resources; improving relationships between workers; and reducing absenteeism, complaints, transfer requests, etc. Workers who are assembled into quality circles collaborate continuously to improve production and to remove bottlenecks in their organization and in the technology used in a specified section. They gather, announce their proposals, discuss them, add to them, and propose them in the firm's management.

The firm is interested in increasing the qualifications of circle members. They therefore organize training for circle members with paid study time as overtime.

Production problems are not the main problems addressed in Japanese quality circles. Creating a microclimate and an atmosphere of collective creativity is important. Proposals do not have specific authors; ideas are born and mature in a joint search. All group members receive a material reward for each proposal.

In our country, work to create creative units that are full of initiative—quality groups—has been turned around. Most have been created and are successfully functioning at machine building enterprises and in associations.

A whole series of guides and methodological materials, including the Standard Policy on Quality Groups in Associations, at Enterprises, and in Organizations (the USSR State Committee on Labor and Social Problem [Goskomtrud SSR], USSR State Bureau of Standards [Gosstandart SSSR, and All-Union Central Council of Trade Unions [VTsSPS]) has been centrally developed and published to assist enterprises and organizations in developing a similar activity.

The USSR Gosstandart (All-Union Standardization Scientific Research Institute [VNIIS]) developed a model standard for an enterprise that is related to the operation of quality groups and recommendations for increasing the creative activity of workers at enterprises and associations by creating quality groups that take the initiative. These documents and other materials may serve as the methodological basis for the organization and functioning of quality groups.

In our country quality groups are social creative units of workers, engineering and technical personnel, and white-collar workers. The units comprise volunteers in shops, sections, departments, and other enterprise subdivisions who, for purposes of collective creativity, work to discover reserves for increasing product quality, prepare proposals for using these reserves, and introduce these proposals. The extensive experience that has been accumulated by efficiency experts and inventors confirms that collective creativity is five to seven times more effective than is individual creativity.

Group activity activates and makes use of the human factor. A voluntary assembly of people with similar interests in a small group of up to 10 people is optimal (larger groups turn into discussion clubs filled with idle talk).

In our country quality groups are considered an element of the social politics that includes shaping a new person and bringing people closer to the creative process based on current knowledge. This form of bringing people together makes it possible to implement the concept of practicing self-management; assuming responsibility for matters with which one has been entrusted; and fighting for the honor of one's plant, shop, or section. Each person's creative potential is uncovered. Quality groups are becoming centers of psychologically compatible coworkers in which each individual is interested in developing a common concept.

In the future, quality groups will be able to serve as the basis for forming highly qualified, solidly united production collectives (brigades).

The number and make-up of workers in quality groups is determined on the basis of production expediency and specific working conditions. Sites with a large quantity and wide range of products may have two variations of the quality group: groups consisting of workers from one speciality and workers who have different specialties but work within the framework of one brigade.

When the range of products is narrow, quality groups may include between 4 and 10 workers, scientific-technical personnel, and white-collar workers. The number of groups depends on the size of the enterprise. Such groups have been created in individual enterprises in Tula and Ulyanovsk, for example, with the total number of participants in them ranging from 30 to 1,000.

Quality group leaders are selected at a meeting of the collective. The management of the shop or enterprise approves the composition of the quality group and its leader.

Quality groups make it possible to use the professional skill of its members in implementing proposals to increase product quality and production efficiency at specific workplaces.

Other units exist at enterprises as well. These include groups of efficiency experts and inventors, scientific organizations of labor, etc. Statistical data indicate that in our country an average of two efficiency proposals are developed per every seven members of the All-Union Society of Inventors and Efficiency Experts [VOIR] per year. In actively working quality groups, on the other hand, several proposals emerge in each session. Quality groups are much more efficient than are efficiency experts. In Japan up to 60 proposals per each quality circle member are developed each year.

The operating experience of several quality groups demonstrates their high effectiveness. The quality group at the Latvian Household Chemicals [Latvbytkhim] Production Association developed and manufactured an original attachment for valve assembly lines. The assembly process was rendered virtually waste-free, which resulted in a yearly savings of about 250,000 rubles. The previous norm for defective products was 6 percent, which would have amounted to 7.6 million valves by 1990.

By the end of 1987, the Ternopol Combine Plant imeni the 25th CPSU Congress has created 41 quality groups, with 261 persons participating in them. The production association's quality groups have introduced about 100 proposals, including one changing the design of forgings that resulted in a change to the practice of machining the components on multispindle semiautomatons. This increased both produce quality and labor productivity.

At the chemical machine building plant in Dimitrograd, for example, 12 quality groups consisting of 60 persons (including 36 workers) have been created. In 1987 the

quality groups proposed and introduced 10 proposals that resulted in an economic impact of 4,600 rubles. The plant's quality group proposed changing the sealing node of the button on the PRSh-741 respirator. Thanks to the proposal's introduction the product's quality was improved, and the amounts of metal and labor required to manufacture it were reduced. The yearly economic impact from introducing this proposal alone amounted to 1,700 rubles.

Forty-five quality groups have been created and are successfully operating at an Ulyanovsk motor plant, the AvtoUAZ Production Association. The groups include 277 persons, 170 of whom are workers. They introduced 92 proposals in 1987. Thanks to the introduction of these proposals, the number of reports of unsatisfactory equipment was reduced 13 percent. Based on a proposal made by one of the groups, a crankshaft grip that included nicks on the crankpins was introduced. A device to grip the crankshaft by the body (not by the thread) for quickly turning the pins into the cylinder block was developed and introduced.

A total of 153 quality groups consisting of 977 persons (including 525 workers) were organized at the Ulyanovsk Auto Plant imeni V. I. Lenin. Thirty-three of their proposals were implemented in 1987, resulting in an annual savings of about 100,000 rubles. Based on one quality group's proposal, changes were made in the setting insert designs and the fourth step in the operation of hot-stamping a cardan shaft. A pouring screen to filter dirt inclusions out of molten metal has been used in the casting shop.

Five quality groups involving 34 persons (including 18 workers) have been created at the Reducing Gear [Reduktor] Plant in Barysh (the Ulyanovsk oblast) of the USSR Ministry of the Machine Tool Industry. In 1987 they introduced 11 proposals resulting in an economic impact of about 6,000 rubles.

Thanks to the active participation of quality groups, a special indicator for hardening a supporting and turning device for assembly cranes with a load capacity of 100 to 250 tons was introduced at the Ulyanovsk No 2 Machine Shop of the USSR Ministry of Installation and Special Construction Work [Minmontazhsptesstroy].

These examples are evidence of the tangible benefits of quality groups, whose function in enterprises is that of creative units struggling to attain high produce quality and production efficiency. The aforementioned examples also demonstrate how quality groups facilitate increases in productivity and labor quality.

Some enterprise managers pay lip service to quality groups. They lack interest in the way in which the groups are organized and simplify their functions. What is more, after receiving valuable proposals from the quality groups, such managers fail to provide the groups with appropriate working conditions, organize training for group members, or provide them with mental and physical incentives. Under these conditions, groups that have been created will gradually disintegrate.

From the outset, those conditions that are most conducive to quality groups must be created, and group members and leaders must receive continuing training through special programs. The CPSU Central Committee and USSR Council of Ministers decree entitled "Restructuring the System for Increasing the Qualifications of and for Retraining Supervisory Personnel and Specialists in the National Economy" established the need for the continuous training of personnel. Standard programs for training quality group leaders and members have been centrally developed in the USSR Gosstandart's Institute for the Improvement of Professional Skills and have been published in the press.

Practice shows that no two quality groups are alike. They have different potentials, and their members have different levels of psychological compatibility and preparation. Standard operating programs are needed, training must be coordinated, and there must be a constant exchange of experience. Each region must have its own training program that allows for local peculiarities along with standards for the specific enterprise.

In Ternopol and Ulyanovsk, for example, curricula for training quality group leaders and members at the enterprises and organizations have been developed by the USSR Gosstandart's Centers for Standardization and Metrology. They are already being used to train workers. Enterprise standards have been developed for many of the oblast's enterprises.

In the Ternopol Oblast, during the 4th quarter of 1987, two sections of quality group managers were trained (243 and 234 individuals). In the second quarter of the current year, quality groups were trained in Ulyanovsk at the Quality Section of the region Hall of Technology. Lecturers were invited for this purpose from the oblast TsNTI [Center for Scientific-Technical Information and Propaganda], from Gosstandart USSR research institutes, All-Union Machine Builders organizations and from VOIR [All-Union Association of Inventors and Rationalizers], as well as managers and specialists of foremost enterprises of the city of Ulyanovsk. Legal and methodological foundations were developed for the establishment, existence and operation of quality groups at machinebuilding enterprises. The number of quality groups is rising continually. Such creative and pioneering undertakings, with their high rate of economic and social effectiveness, must be supported and developed everywhere.

UDC 658.342.1

From Conditions at Workstation to Overall Production Conditions

18610103 Moscow MASHINOSTROITEL in Russian No 8, Aug 88 pp 39-43

[Article by O. B. Yuryev]

[Text] The second exhibition dedicated to the experience accrued by industrial enterprises relative to the certification and rationalization of workstations was held during the first quarter of this year at the USSR Exhibition of the Achievements of the National Economy [VDNKh SSSR].[1] About 1,000 exhibits from 280 enterprises, associations, and organizations of 34 of the country's ministries and departments provided serious confirmation of the fact that the celebrated experience of the Dnepropetrovsk Combine Plant imeni K. Ye. Voroshilov, which was approved in due course by the CPSU Central Committee, did not remain experience with only regional significance.

Most of the exhibition's participants presented convincing evidence of the effectiveness of certifying workstations, with the role of automating production and eliminating manual labor being especially great. Six flexible manufacturing systems and 30 flexible manufacturing modules for machining casing components and bodies of revolution have thus been slated to be put into operation in the Gomel Machine Tool Production Association imeni S. M. Kirov by the end of the 12th Five-Year-Plan. Just one of the flexible manufacturing systems that will begin operation this year will make it possible to free 22 persons from manual labor and will have an economic impact of 49,500 rubles. A robotized line with an economic impact of more than 38,000 rubles has already been installed in the section for producing consumer goods.

The Pskov Gearing Plant has been conducting yearly certifications since 1984. In 1986-1987, 359 workstations at the plant were rationalized and repeatedly certified. As a result, 65 low-efficiency workstations were eliminated. The technical and economic level of using high-productivity equipment, numeric control machine tools, and robotics was adopted as the principal criterion. At the present time, 60 percent of the plant's fixed production assets are highly productive, with numeric control machine tools accounting for 13 percent. Eighteen robotics complexes are operating extensively. It seemed as if there were no poor indicators. However, the certification of the workstations was repeated this year, but this time in accordance with stricter standards.

The Pskov plant's style of operation shows convincingly that certification is not a one-time campaign but rather a continuous process of constantly improving production. There is one more confirmation of this.

The Kalinin Welded Structures Plant Tsentrosvar is a young, modern, and highly mechanized enterprise. But here a great deal of attention has been focused on improving the technical level of workstations and especially on using mechanization and automation equipment based on the periodic integrated certification of workstations in finishing operations.

A multirow automated line for the thermal cutting of sheets is operating successfully at the plant. The feeding of the sheets with a frame to a gas cutting machine, the discharge of the cut sheets, the unloading of the pattern frame, and the removal of the components and the wastes are all automated.

High-efficiency plasma cutting machines with numeric control, which have significantly intensified the process of manufacturing components, are used extensively at the plant. The machines have been equipped with portal loaders to reduce the manual labor entailed in auxiliary operations and in loading and unloading operations.

In addition to thermal cutting, mechanical cutting is also used to cut out rolled sheets. Guillotine cutters equipped with mechanized roller conveyers and magnetic manipulators essentially constitute mechanized complexes. Using such complexes reduces the time of each cycle in the lifting and transport operations and creates the conditions for highly productive labor on the part of workers. Thanks to the introduction of these and a number of other measures in the plant's finishing operations, the mechanization level was 86.8 percent by the beginning of 1987, and the level of mechanized labor had reached 88.5 percent.

Party, union, and many social organizations at the Tsentrosvar Plant are involved in successfully solving the problems associated with implementing the integrated certification and rationalization of workstations for workers, engineering and technical personnel, and white collar workers. Each year, besides the staff subdivisions, up to 150 persons are involved in this work. This includes the leading workers and engineering and technical personnel, the best efficiency experts, those engineers who are brigade curators, the most active members of the scientific-technical associations and the All-Union Society of Inventors and Efficiency Experts, and the creative brigades for the scientific organization of labor.

All-out action programs are being adopted on the advice of the plant's council on the scientific organization of labor and management under the director's chairmanship, approved and monitored by the party committee and local trade union committee, and implemented by the plant certification commission, which is headed by the chief engineer through the operation of the shop (department, service) certification commissions. The permanent production conference, labor collective council, and shop party and trade union organizations all

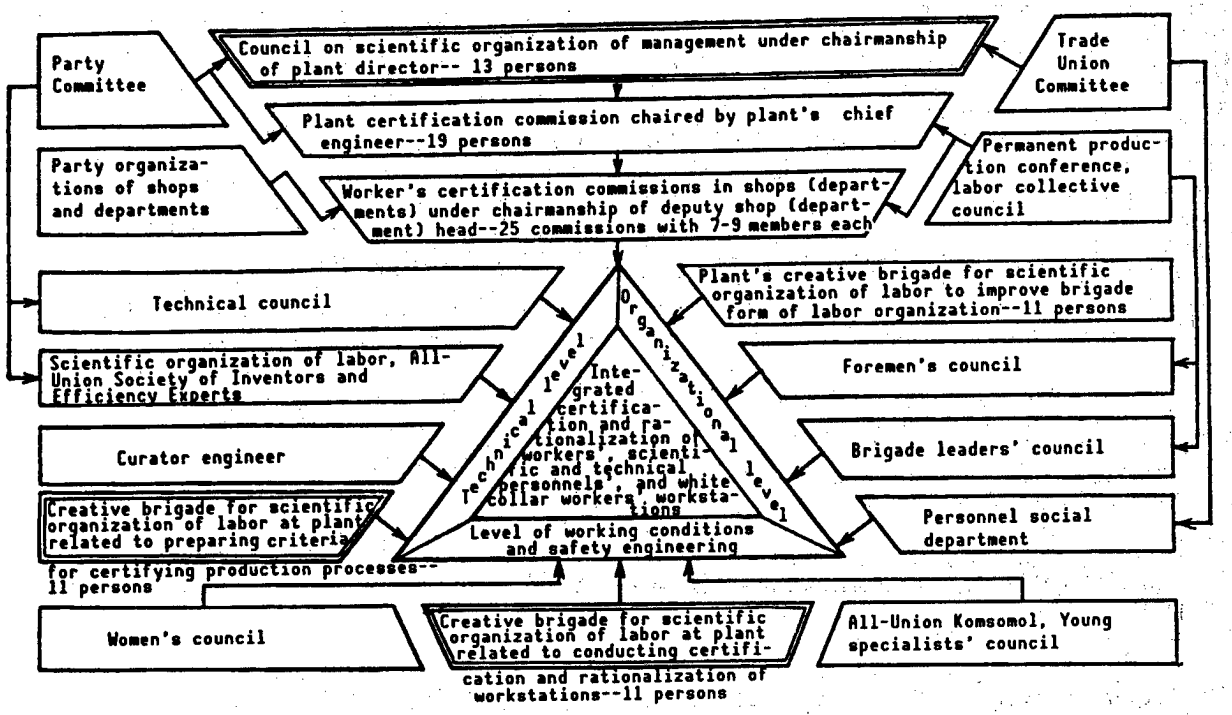

Figure 1.

monitor the program actively. The role and direct participation of the plant's social organizations in increasing the level of labor organization at its workstations are shown in Figure 1.

A computer-aided system for keeping account of and certifying workstations for each subdivision was developed and introduced at the Minsk Cutting and Broaching Machine Tools Plant imeni S. M. Kirov. Using the system makes it possible to free certification commissions from making numerous calculations and formulating numerous documents and makes it possible to have on-line information about the certification of workstations. Using a computer permits a fourfold reduction in the amount of time required for processing and obtaining data about the status of workstations during the course of their certification. Figure 2 diagrams the work entailed in using a computer in certifying, rationalizing, and keeping account of workstations.

Specialists and visitors to the exhibition have shown a great deal of interest in those exhibits showing the results of certification and rationalization conducted at a specific workstation. One example is the beautiful solution by the initiative group at the AvtoZIL production association that freed drill operators in one operation from an operation that, while monotonous and fatiguing, did not require any high qualifications. To do this, a new drill operator's workstation was created. To be more precise, it was an operator's station at which an industrial robot was used to load and drill products. The role of the operator was reduced to controlling the robotized drilling complex from a panel. The complex increases labor productivity, frees up workers, and improves labor and production conditions.

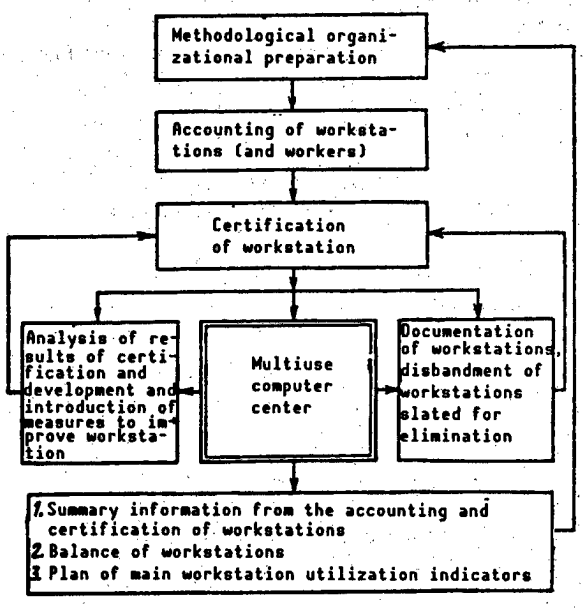

Figure 2.

Universal assembly retoolable attachments with magnetic clamps are being used successfully at the Tiraspol Casting Machine Plant imeni S. M. Kirov under conditions of multiproduct small-series and pilot-scale production in a finishing shop for assembly and welding operations. Thanks to their autonomous action, convenient and reliable operation, speed, and compactness, the attachment with its permanent magnets competes successfully with mechanical attachments equipped with pneumatic and hydraulic devices whose production requires significant expenditures of material and power. The economic impact for using the attachment in a boiler welding shop amounts to 1,500 rubles annually.

It is possible to use all possible tools including pneumatic and electric tools to machine components with no special problems on a toolmaker's workbench that is manufactured by the plant Yuvelirmashpribor (located in the city of Gorodok in the Lvov oblast). The workbench is designed with an allowance for ergonometric requirements. It has a larger tabletop, and unlike its analogues, it is equipped with a unit for preparing and controlling compressed air (0.1 to 0.6 MPa). The annual economic impact from the workbench's introduction is 200 rubles.

Auxiliary tables for installing a machine vice have been directly mounted to the machine tools at the mill operators' workstations at the Mogilev plant Strommashina imeni the 50th Anniversary of the Great October Revolution. The gear mill operators' and drill operators' workstations in the main shops are equipped with revolving racks for storing mandrels. A measuring tool is stored on special shelves that are mounted on the workstations to make workers' movements efficient. The toolmakers' workstations are equipped with special workbenches with a bottom locker. Their pull-out drawers are on rollers. The workbench's small cabinet is sunken in relative to the front surface, which makes it convenient for a worker to work while seated. The tool distribution warehouse shops are equipped with special racks and workbenches for storing tools and fittings, which makes the warehouse workers' jobs easier. These types of simple attachments do not require significant material expenditures; however, they reduce losses of work time substantially by better organizing the labor process and, consequently, increasing labor productivity. The labor productivity of toolmakers, for example, has increased between 8 and 10 percent thanks to an improvement in their workstations.

At the same plant, the production processes, equipment, tools, and attachments used were analyzed and the feasibility and necessity of changing them examined during the process of certifying and rationalizing workstations to improve the standardization of labor. In the machine shop, for example, a 36 x 6 thread on a shaft 900 mm long used to be cut with a thread cutter in 10 to 12 passes on a screw-cutting lathe. The lathing workstation is now equipped with a planetary head that the plant manufactured itself, and the thread is now cut by rotary cutters in one pass. This has made it possible to increase labor productivity and achieve a fivefold reduction in the labor intensity of manufacturing the shaft.

Dollies to transport components, assemblies, and products to be put into sets could be an excellent addition to the workstations in shops and sections. They could also be used as replenishment cells in workstations. The annual economic impact from their introduction amounts to 30,000 rubles.

Engineers and designers were not forgotten at the exhibition. Extensive work to improve the organization of the labor of engineering and technical personnel has been conducted at the Kiev Machine Tool Production Association where 82 percent of all workers are currently working at prototype workstations. The duty manuals and policies on subdivisions were updated, problems in storing documentation were solved, and racks and stands for storing sketches were manufactured. A great deal of attention is being paid to the interior of production areas, cleanliness, and personal conditions.

The Elektronika Central Scientific Research Institute exhibited a designer's workstation based on an MSO 585 personal computer complex. It is used in computer-aided design systems and is distinguished by its high technical characteristics, which correspond to those of the best foreign analogues.

An entire complex of workstations for directors and specialists, including the shop foreman, technical inspection department worker, technologist, time-and-cost clerk, and the state acceptance group, which has been formed as an individual glass-enclosed module, was exhibited by the specialized furniture production association Interyer (Moscow). This dismountable assembled module, which is furnished with desks equipped with card files and accessories, document shelves, and special portable pedestals, provides complete noise insulation and creates excellent comfort conditions for work. An air-conditioner may be installed in the module. The complex, which occupies a very small area, may be installed in plants' shops, a design office, or training and administrative areas. A complex costs between 1,000 and 2,000 rubles.

After becoming acquainted with the workstations presented at the exhibition it is not difficult to draw the unequivocal conclusion that a worker's labor productivity depends on the condition of his workstation. B. M. Batrakhanov, winner of the USSR State Prize, laureate of the Soviet Trade Unions Prize, Meritorious Efficiency Expert of the RSFSR, and Meritorious Inventor of the USSR, states, "I am deeply convinced that production conditions begin with a specific workstation. Not one

creative thought will come to a slovenly fitter or machine operator who works under conditions of clutter and who must search for the tool he needs before every production process." Boris Mikhaylovich was a participant in the exhibition. The three stands with inventions are only a small part of his contribution to improving a lathe operator's workstation. "The country's plants have a huge quantity of universal lathes," says B. M. Batrakhanov. "There are not enough workers' hands, and it has been difficult to find the labor to change over to two-shift operation. Nevertheless, numeric control machine tools and machining centers continue to be manufactured in small quantities. And it is far from everywhere that replacing universal machine tools with them is economically feasible. This means that there is one answer—to increase the productivity of lathes. And this is just what I am working on."

Boris Mikhaylovich is being modest. Indeed, when he says "I am working," he is referring to work that has been going on for more than four decades! The result of his labor and his talent as an innovator and inventor, i.e., a complex of high-speed universal lathing equipment, can, as they say, be touched at the exhibition. It consists of high-speed mechanical and mechanical-spring collet chucks; quick-change cassette tool posts; attachments for cutting threads in a stop with taps, threading dyes, and cutters; a high-speed tail spindle attachment; a set of attachments for mounting an indicator on the machine tool when machining high-precision components; a universal cassette with changeable inserts to mount a cutting tool; and attachments to cut outer and inner threads in a stop. All of these devices reduce the time required to adjust a machine tool, reduce the physical loads on the machine tool operator, and of course increase the operator's productivity. These are specific examples presented by B. M. Batrakhanov.

Attachments for cutting threads in a stop and at specified lengths by using taps and threading dyes while automatically switching off the feed and while achieving a specified thread length reduce the auxiliary time five- to sevenfold and increase the lathe operator's productivity two- to threefold. Quickly retoolable two- and multiposition tool posts with changeable cassettes make it possible to mount cutting tools into their working position (even at an angle) quickly (in 10 to 15 seconds) and precisely (a high degree of precision is ensured in the case of repeated installation). After having mounted two to four cutting tools in a tool post it is possible to immediately machine several surfaces from one base while maintaining the specified parameters with a high degree of precision. A cassette with a tool may be used multiple times. Using such a cassette makes it possible to retool a machine tool 10 to 15 times when compared with ordinary tool posts that have a set of fine adjustments. The lathe operators' productivity is increased 1.5 to 2-fold.

High-speed universal mechanical collet chucks make it possible to clamp components along their outer (1 to 110 mm) and inner (8 to 80 mm) diameters when machining in preliminary and finishing operations. A component is mounted in the collet with a precision of 0.01 to 0.02 mm in a total of 3 to 5 seconds without stopping the machine tool. Not much more (20 to 30 seconds) is required to replace the collet and slide blocks.

The advantages of B. M. Batrakhanov's inventions are convincing, but have they not been overtaken by the same sad fate of those domestic inventions that have been left to exist in a single specimen? "No," says Boris Mikhaylovich, "in our plant in Saratov where I continue to work as a retiree, there are 250 lathes equipped with more than 5,000 changeable cassettes. Virtually all of these machine tools occasionally lag a bit behind numeric control machine tools from the standpoint of productivity, but it is important to mention two forces here. Some leading lathe operators who are talented innovators have connected electronic attachments to the lathes, which makes it possible for them to service two machine tools simultaneously. The second point is that all of this equipment may also be mounted on numeric control machine tools. A number of other Saratov plants are also equipped with universal fittings. The following facts confirm its efficiency. The construction of a new shop with 80 to 90 universal machine tools had previously been slated at the Saratov Electrical Aggregate Production Association. However, thanks to the use of high-speed universal fittings, about 300 machine tools were outfitted and the plant decided not to construct the shop. Furthermore, this type of fitting can also be found at a number of plants in Michurinsk, Perm, Tartu, Ufa, Kiev, and Poltava."

"Does this mean that everything is in order?" we ask B. M. Batrakhanov. "Alas," replies the innovator, "judge for yourself. In the West and in Japan, machine tools with quick-change tool units were launched into production in 1965. And I made the first attachments back in 1947! To date, specialists in the aviation and electronics industries have expressed great interest in my inventions. And if things are really approached from an economic standpoint, then the matter should be taken up by the Ministry of the Machine Tool Industry. But I got the impression that they could care less whether a lathe based on universal machine tools would satisfy present-day needs."

"I am surprised," continues Boris Mikhaylovich with a hurt voice, "that the capitalists keep spies for stealing industrial secrets while I presented my inventions to our machine tool plants without any rights of authorship just so that a plant would manufacture a machine tool that is already equipped with the necessary attachments and fittings."

"You innovators go your own way while we are subordinate to our scientific organizations," was the reply given to B. M. Batrakhanov at the celebrated machine tool plant Red Proletariat imeni A. I. Yefremov.

Yes, it is surprising that the Ministry of the Machine Tool Industry has yet to express interest in B. M. Batrakhanov's inventions and continues to manufacture machine tools that are frequently not complete with the fittings and attachments that would increase productivity and improve working conditions for workers. Indeed, they continue to be manufactured by the very ones with the specialized plants and charts in their hands! And today it can also happen that enterprising cooperators who are full of initiative, having purchased a plant that is in ruins, will take up this matter that is, without a doubt, important and advantageous to the entire national economy!

During the exhibition, B. M. Batrakhanov not only presented his stand. He also gave a number of consultations, conducted a school on progressive experience and seminars at many Moscow enterprises, and accepted requests to manufacture sketches of the attachments.[2] His energies and firm belief in his own righteous cause are enviable. Boris Mikhaylovich has cause for optimism. Previously when he appeared before the specialists at enterprises, he seldom met their directors and he felt that, as a result, no one would lift a finger. Now, however, the directors themselves take part in Batrakhanov's schools with genuine interest. "If we do not lead full cost-accounting into a dead-end, the innovators and inventors will search for it and hold it in their hands. And if the directors do not turn their heads toward progressive experience, the restructuring in industry will die away!" says B. M. Batrakhanov. Not only are his words correct, his cause is also. His participation in the exhibition of enterprises' experience with respect to certifying and rationalizing workstations and the exhibition itself are directed toward disseminating the valuable progressive experience of the innovators and collectives of plants and organizations as widely as possible.

Footnotes

1. For information about the first exhibition, see MASHINOSTROITEL No 1, 1966, p 41.

2. The address for queries regarding sketches and information on the attachments and equipment developed by B. M. Batrakhanov is as follows: 410045, g. Saratov, ul. Zheleznodorozhnaya, 72. TsNTI.

UDC 621.9-82

Pneumatic and Hydraulic Drives for Priority Metalworking Machine Tools

18610158 Moscow VESTNIK MASHINOSTROYENIYA in Russian No 10, Oct 88 pp 11-13

[Article by G. M. Ivanov, candidate of technical sciences, and V. K. Sveshnikov, candidate of technical sciences]

[Text] The plans for development of the machine tool industry up to the year 2000 call for a substantial increase in manufacture of high performance automated equipment, GPM and GPS [flexible manufacturing machines (?) and flexible manufacturing systems]. This dictates the need for expanding the production of hydraulic and pneumatic drives. The influence of their technical level on the final indexes of the machine tools will increase drastically, and special attention should be given to improvements in machine tool assemblies with hydraulic and pneumatic drive, since their technical characteristics and reliability have direct impact on the technical level of the equipment assembled from them.

Although the needs for unified assemblies of hydraulic and pneumatic drives are being satisfied primarily by the specialized factories of the Ministry of the Machine Tool Industry, many complementary parts still do not meet the modern demands. A sufficient product mix of special machine tool assemblies has not been organized, and the volumes of supply of "same factory" assembled hydraulic drives are inadequate.

Based on analysis of the integrated technical requirements for development of a line of priority equipment that is to be commercially ready in the twelfth five year period, as well as the programs of improving the technical level of the entire product mix of metalworking equipment in the immediate future, a complex of research and development projects has been planned for creation of fundamentally new and upgrading of the series manufactured hydraulic, pneumatic, and lubrication equipment and lubricating-cooling systems for assembly of progressive metalworking machine tools, GPM, GPS and PR [work stations].

Modern hydraulic and pneumatic drives of lathe chucks with frequency of rotation up to 6000 rpm are being created. The drives contain a rotating cylinder for chuck or rod work (in the latter case, with an opening for the rod stock), a system of reliable pressure and path interlocks, and a control unit with direct-acting reduction valve, making it possible to monitor and regulate the clamping force in wide limits. Thanks to use of special devices to supply liquid lubricant in doses of 3 to 12 cm^3, power losses in the bearings of the high speed spindle assemblies are minimized and the process of lubrication is reliably monitored. Hydraulic drives for rotation of tool magazines, turret heads and indexing devices have been developed and are scheduled for series production. Thanks to the two-path throttling of the flow of oil supplied to the hydraulic motor in these, it will be possible to reduce the tool change time to several seconds with high accuracy of fixation, substantially reduce the overall size of the mechanisms, and improve their reliability.

The systems of hydraulic balancing of vertically positioned working elements based on adjustable vane pumps of type DG12-5 or throttle regulators, including such with separate regulation of the pressure in the up and the down stroke, and also those with proportional

electric control, are being further improved to allow almost total relief of the electric feed drives, essentially converting them from power drives into metering drives.

Working the straight end face of a part with the tailstock spindle retracted will be made possible by newly developed rests. Reduced power losses and better longevity of the spindle bearings will be assured by hydraulic regulators of the tension in the V-belts of the main motion drive. Factory-assembled systems for supply of oil for hydrostatic devices, including those based on multiple-flow gear pumps using a pump- pocket layout, will be created.

For drilling, milling and boring machines, hydraulic panels to change the speed of tool magazines, flow regulators with path control and possibility of regulating the back stroke speed, and flow regulators with reduction valve, which in certain cases permit great simplification of the hydraulic system, have been created. There are plans to develop functional assemblies to implement typified motion cycles of the working elements. For the actuators of clamping devices it is planned to create small sized pumping systems with up to 10 liter tank capacity and pressure of 14 MPa.

A large volume of work remains to be done in the field of hydraulic drives of grinding machines. Along with the development of volume- regulation hydraulic drives based on plate type or axial-piston adjustable pumps, including some with proportional electric control, fundamentally new linear motion drives for benches and feed drives based on the proportional electric control technique will be created, making it possible to program the motion of the working element, optimize the transitional processes, reduce the power losses, and significantly simplify the hydraulic drive. The control units will be both hydraulic distributors based on proportional electromagnets and numerical control machines (for example, electric step motors) with feedback in the movement of the terminal element, achieved by mechanical or electrical means.

The latter alternative is especially promising, since it opens the way to electrical correction of the quality of the dynamic processes in the drive, and also makes it possible to overcome the basic conflict between precision and maximum speed of movement of presently known step drives. It becomes possible to create the utmost in simple, cheap, and reliable electrohydraulic drives, providing a positioning accuracy in the range of several micrometers at movement speed up to 30-50 m/min, which is limited only by the ability of the pulsed feedback sensors to read the information (parameters which cannot be achieved with modern electromechanical drives). This same technique is being used to create electrohydraulic drives for superprecise equipment. A prototype of such drive which has undergone testing at the ENIMS has already achieved a resolving capacity of +0.08 mcm (given a maximum speed of 1.5 m/min), which is evidently not the limit of the physical capabilities of the hydraulic drive.

Of course, such problems must be tackled by the combined efforts of specialists in hydraulic actuation, electric actuation, metrology, and electronics. Commercial development of production of such drives with simple and reliable control systems costing in the range of 1000 rubles (for one coordinate) will allow substantial improvement in the quality and flexible control of grinding, honing, and other machine tools with actually no change in the existing design of the major assemblies. Other circumstances of no small moment are the compactness of the cylindrical electrohydraulic drive, its high operating reliability in reversal duties, and the prospect of eliminating the dc motors, the ball and screw transmissions, and the no-play reducers. Trial models of control units of type G69-44 with D_y and electric driving step motor will be produced by the Gidroprivod plant of Shilut in 1988, followed by a shakedown series in 1989. Thereafter, it is planned to develop modifications with D_y=10 and 16 mm, as well as hydraulic motor series coupled with high-resolution pulsed feedback sensors.

Soviet made machines for electric erosion machining presently make broad use of electrohydraulic tracking drives. Studies at the ENIMS have shown that ample reserves exist for their upgrading along lines of higher power and better quality of the dynamic processes. High speed correction devices have been developed, enabling an 8-10 fold increase in the static coefficient of amplification without loss of dynamic stability, which has a favorable impact on the rigidity of the drives, the accuracy of maintaining the regulated parameter, and increase in the instantaneous speed of movement of the electrode for the purpose of effective protection of the space between electrodes against slagging and reduction of the nonproductive working time spent on relaxation of the electrodes.

Electrohydraulic linear step drives have been developed with independent setter to monitor the actual displacement of the terminal member (bench, spindle, carriage, etc.), which has positive impact on the precision and rigidity. In our opinion, such drives may find application in heavy electric erosion cutting machines, milling machines with NPC, power benches of unitized machine tools and automatic flexible manufacturing lines, cutting-off machines and other machine tools. Since the productivity of electric erosion cutting machines depends substantially on the pressure of the water fed to the work zone, pneumohydraulic pumps are being created for pressure up to 4 MPa, while centrifugal electric pumps with increased submergence are being created to supply the process fluid to electric erosion duplicating push-broaching machines.

The equipment for hydrostatic relief, filtration and cooling of working fluid will be further developed as parts of gear cutting machines. Work is being done to create

linear hydraulic drives of reciprocating motion for gear shapers along lines of increasing the number of double strokes (hopefully up to 500 shaping strokes/min), reducing the power losses, and providing control flexibility.

The hydraulic cylindrical drive is particularly effective in broaching and cutting-off machines, as well as in equipment for the billeting shops which operates under a heavy dynamic load. On the basis of an investigation of the dynamic characteristics of the load-bearing system and the cutting processes, a cycle of projects is being carried out to upgrade the dynamic properties of machine tools, to make better use of them in high speed cutting regimes, and also to improve the metal and power requirement ratios. The hydraulic feed drives of cutting-off, milling and other machine tools will extensively employ adaptive control based on proportional hydraulic equipment and microprocessors, included such as are integrated directly in the frame elements of the hydraulic equipment (mechanotronics). The application of new hydraulic cascade layouts based on multiple flow pumps with significant reduction of the power losses in the hydraulic conduits is increasing.

New rotational electrohydraulic step drives of improved reliability, including models with selection of the spacings in the rack and pinion transmission, protection against inertial overloading, and interlocks preventing accident from the grip colliding with surrounding objects, as well as linear electrohydraulic step drives of type G28-2 with substantially simplified kinematics and reduced weight of the working elements, have been created for industrial robots.

Enhanced reliability and productivity of unitized machine tools and automatic lines is achieved by converting to mechanohydraulic path control. Toward this end, hydraulic path control panels of type PG36-1 and hydraulic control blocks G36-54, installed directly on the rear cover of the power cylinder, have been developed. Such design strategy makes it possible to produce compact hydromechanisms with specific mass of 2.1 x 10^{-2} kg/(MPa.l/min), which is lower by a factor of 1.5-2 than the best Western counterparts. Hydraulic drives of power benches based on proportional equipment, new group accumulating drives, functional assemblies, and hydrosystems of turntables and transportation equipment will be developed.

The creation and development of widespread production of flexibly retoolable metalworking equipment, able to work over a long interval of time without operator intervention, pushes to the forefront the problem of assuring reliable operation of highly automated layouts. Questions of cleaning (with a jet of air or cooling-lubricating fluid) of the base surfaces of the work and the tool, as well as the transport of the chip from the cutting zone, become especially acute. Systems for technical diagnostics of hydraulic drives are being intensively developed. The pump layouts (G48-1...6D) have already been created, outfitted with electrical pickups for the pressure, the amount of dirt on the filter (two levels), as well as the level and the temperature of working fluid in the reservoir. The commercial readying of new pickups, indicators, devices for analysis of the fluids, inspection (including incoming inspection) and maintenance stands for hydraulic systems, and stands for teaching the basics of design of hydraulic drives should be actively pursued.

In order to reduce power losses, more use should be made of adjustable plate-type pumps (including multisection ones) and the development of reliable pneumohydraulic accumulators with elastic separation of the media, charging and safety devices, and auxiliary gas cylinders should be accelerated. The creation of modern hydraulic drives is not possible without further improvement in the filters, packings, pipelines and their connections, and the devices for cooling of the working fluid.

A first priority of the research and development is analysis of the development trends of hydraulic and pneumatic equipment and formulation of a prospective product mix (especially in the area of special purpose machine tool elements), elaboration of the principles of technical diagnostics and the maintenance and repair procedures, investigation of new materials and coatings, development of methods for accelerated testing and equipment for assurance of industrial cleanliness, investigation of the mechanism of pressurization and means of noise abatement. In order to drastically reduce the product development cycle it is necessary to accelerate the development and adoption of CAD for hydraulic and pneumatic equipment, lubricating equipment, and engineering computation methods.

Successful solving of the complicated tasks confronting present day hydraulic drives of machine tools requires implementation of a number of technical organization measures. In our opinion, in order to implement a uniform technical policy in the sector, the coordination of special assemblies of hydraulic, pneumatic and lubricating equipment of machine tools should be done simultaneous with the coordination of the technical documentation for the machine as a whole, eliminating the need for an additional coordination with the VNII-Gidroprivod, which is responsible for the technical level of general machine products.

Evaluation of the technical level of factory-assembled parts should be based on the effectiveness of their use in the machine tools (the end result), and not on the specific parameters of weight and volume, which are aimed at an unwarranted increase in the operating pressure while at the same time increasing the weight and dimensions, which is contrary to the interests of machine tool design.

Assembly of competitive machine tools of a priority product mix requires creation of special hydraulic and pneumatic drive elements, the production lot of which, especially in the first years of commercial production, is extremely limited (5-100 pieces), which with the present

practices virtually excludes the possibility of their production at specialized plants. At the same time, the machine tool plants do not have the necessary production experience, equipment, or fixtures for a quality fabrication of these elements. To solve the problem at the specialized plants it is advisable to organize small-lot departments, as well as set temporary prices on a bilateral basis, assuring economic feasibility of the manufacture of the elements in a piece (or small lot) production setting.

Given the almost complete supply of Soviet made factory-assembled products and the presence in the Ministry of the Machine Tool Industry of a broad mix of hydraulic, pneumatic, and lubricating equipment elements of its own manufacture, it is advisable to expand the level of hydraulics of PNC machine tools of precision category N and P, machine tools of the billeting departments, machine tools with reciprocating motion of the working elements, GPM, GPS, PR, and other equipment, including such as operates in stressful dynamic regimes and in conditions of heavy dust load in the work zone. In order to increase the liability of the manufacturer and the quality of the products supplied, the volume of delivery of factory-assembled hydraulic drives to the machine tools plants should be sharply expanded.

UDC 621.9.06-133:658.527.011.56.061.3

Automated Rotary and Rotary-Conveyer Lines Discussed at All-Union Conference

18610120d Moscow
KUZNECHNO-SHTAMPOVOCHNOYE PROIZVODSTVO in Russian No 8, Aug 88 p 39

[Article by I. Z. Mansurov]

[Text] The USSR Ministry of the Machine Tool Industry and Rotor interbranch scientific-technical conference, which is based at the Moldavian production association Tochlitmash (located in Tiraspol) held an all-union scientific-practical conference of head organizations, scientific research institutes, and industrial enterprises in the machine building complex. The conference was devoted to the problems entailed in creating and introducing automated rotary lines and automated rotary-conveyer lines.

The results of work that was done in the machine building sector in 1986-1987 to create and introduce automated rotary lines and automated rotary-conveyer lines were presented. Also discussed were ways of further automating production processes by using the rotary principle for different production operations (in machining and assembly, special methods of casting metals, plastic metal working, processing plastics, and pressing powder materials).

The main efforts are being implemented in accordance with a program that encompasses a significant amount of experimental design work to create standard and specialized models of automated rotary lines and automated rotary-conveyer lines for various production processes in the machine building sector, including manufacturing products from plastics by casting and pressing, manufacturing metalware, machining and assembling, producing bush roller chains, thermochemical treatment, and casting production.

Introducing and using the specified types of automated rotary lines and automated rotary-conveyer lines will ensure the fulfillment of the quotas established by the USSR Council of Ministers with regard to manufacturing and introducing rotary lines in the machine building ministries during the 12th Five-Year-Plan and will create the process stock needed for the long-range period up to the year 2000.

To accelerate the production and increase the technical level and use of unified engineering decisions in automated rotary lines and automated rotary-conveyer lines, the USSR Ministry of the Machine Tool Industry, in conjunction with the machine building ministries, the Interdepartmental Coordination Council on the Production of Special Production Equipment, and the Rotor interbranch scientific-technical conference, is taking measures to organize the joint production of standardized assemblies in the machine building complex.

The design and production capabilities of the following standard automated rotary lines and automated rotary-conveyer lines created by the head organizations of the machine building sectors are being examined:

a range of automated rotary-conveyer lines for manufacturing plastic products with volumes ranging from 8 to 125 cm^3 at the Odessa production association Pressmash imeni the 60th Anniversary of October;

automated rotary lines for precision casting and for the production of ceramic molds at the Moldavian production association Tochlitmash;

rotary lines for machining railroad bearing rollers and tappets for valves and exhaust valves of automotive engines at the order of the GPZ-16, KamAZ, etc.;

standard designs of automated rotary-conveyer lines for plastic metal working—for stamping small components and mass producing components by the power metallurgy method;

automated rotary lines and automated rotary-conveyer lines for the following special purposes: heat treating, manufacturing products for medical technology and for the electrical engineering industry, producing bush roller chains and components for aerosol packages, etc.;

production complexes created by the USSR Ministry of Heavy Machine Building that make it possible to manufacture rollers for belt conveyers used in automated rotary-conveyer lines.

A great deal of attention was also devoted to examining the problems entailed in creating automated rotary lines and automated rotary-conveyer lines for automating production processes by using special casting methods.

The Moldavian Production Lines Special Design Office [SKB TL] has done a great deal of design work in the following areas: the branchwide and interbranch lists of casting products have been systematized; the production processes used in special-method casting have been analyzed to transfer them to the rotary principle of automation; a technical proposal for a standardized range of high-productivity automated rotary-conveyer lines for using special-method casting to manufacture cast blanks of ferrous and nonferrous alloys has been developed; and a new design for casting production has been developed. The new design is based on the creation of multiproduct automated systems that continuously perform the operations constituting the production cycle of manufacturing castings on rotary-conveyer lines.

The USSR Ministry of the Machine Tool Industry has developed a scientific-technical program called Rotolit that involves the creation and introduction into casting production of automated rotary lines and automated rotary-conveyer lines for special casting methods. The program includes basic theoretical, scientific research, experimental, and experimental design work to automate the special casting methods used in machine building. The Moldavian production association Tochlitmash is the head organization with respect to implementing the program.

G. P. Borisov, doctor of technical sciences and deputy department head at the Casting Problems Institute of the UkSSR Academy of Sciences, devoted his report to the technological bases of reproducing rotary casting principles in distributed pouring head systems (Raslit).

Ye. A. Letitskiy (from the all-union planning and technological institute Tyazhmash) spoke about the problems entailed in creating a production complex to produce rollers for belt conveyers.

E. I. Parfinovich, deputy chief technologist at the production association Latvbytkhim, spoke of the problems involved in creating integrated automated production to manufacture aerosol packages.

S. G. Gurvich, chief designer at the Odessa production association Pressmash imeni the 60th Anniversary of October, characterized the principal foundations of designing an array of automated rotary lines for processing plastics. He presented the characteristics of special rotary lines for medical technology. In his presentation, he paid special attention to further improving control systems for rotary lines by equipping them with electronic control systems, i.e., programmable controllers.

V. S. Sharshov, deputy chief director of the scientific production association ENIKmash, characterized the principal aspects of creating automated rotary lines and automated rotary-conveyer lines for plastic metal working. M. S. Fadeyev, deputy head of the automated rotary line department, devoted his presentation to the problems of developing standard metal-conserving finishing complexes of forging and pressing equipment in order to complete automated rotary lines and automated rotary-conveyer lines and for formulating integrated automated production based on rotary lines.

Yu. I. Tikhomirov, deputy general director of the Rotor interbranch scientific-technical conference, spoke of the tasks facing the Rotor interbranch scientific-technical conference under the conditions of restructuring.

The participants at the scientific practical conference adopted the following recommendations, which have great practical value:

the Rotor interbranch scientific-technical conference and USSR Ministry of the Machine Tool Industry should work jointly with the head organizations of the machine building complex to refine the machine building ministries's specialization with regard to creating automated rotary lines and automated rotary-conveyer lines. The plans developed should allow for further automating production processes in the chemical and forestry complex and manufacturing medical products and components belonging to other product lists;

the scientific production association ENIKmash should develop standard finishing complexes of forging and pressing equipment that would make it possible to organize integrated mechanized production including automated rotary lines and automated rotary-conveyer lines;

the scientific production association ENIKmash should work jointly with the head organizations of the machine building complex and, by using the module principle, specify fundamental configurational decisions for automated rotary lines and automated rotary-conveyer lines to be used in machining and assembling;

the Moldavian production association Tochlitmash should disseminate to the head organizations of the branches the experience that it has accrued with regard to organizing an automated data bank on the list of components subject to manufacture on automated rotary lines and automated rotary-conveyer lines;

the Rotor interbranch scientific-technical conference and USSR Ministry of the Machine Tool Industry should use the results from analyzing the developments

of the head organizations in the machine building complex to discover optimum size series and a standard for priority types of automated rotary lines and automated rotary-conveyer lines;

to further develop work in the area of standardizing automated rotary lines and automated rotary-conveyer lines based on an analysis of the rotary lines that have been created in the machine building sector, the Rotor interbranch scientific-technical conference and USSR Ministry of the Machine Tool Industry should work jointly with the head organizations of the machine building complex to work out the problems entailed in creating standardized arrays of rotary lines with a modular design; and

the Rotor interbranch scientific-technical conference and USSR Ministry of the Machine Tool Industry should, in 1988, develop proposals to refine the structure of the program to create automated rotary lines and automated rotary-conveyer lines. The proposals should allow for the formation of interbranch regional production and automated complexes for producing products intended for mass use.

UDC 621.733:621.365

Rotary Furnace for Tempering Springs

18610120c Moscow
KUZNECHNO-SHTAMPOVOCHNOYE PROIZVODSTVO in Russian No 8, Aug 88 p 37

[Article by O. A. Kulikov, Ye. V. Revin, and V. V. Gorin]

[Text] An electric rotary furnace for tempering springs has been installed and is successfully operating at the Volgograd Tractor Components and Standards Plant. The furnace differs from the existing designs in that has a sectional design. The springs being tempered are arranged along the periphery in a cyclically rotating rotor. The rotor is mounted on a shaft whose outer ends are located in rests that have been passed to the outside and are freely mounted on the foundation. This type of design makes it possible to automate the piece-by-piece loading and unloading of the springs, increase the furnace's productivity, disassemble the furnace (remove the cover, take off the rotor, etc.) quickly and easily, and conserve work space.

The furnace (Figure 1a) consists of a stationary frame (3), a removable cover (1) with lightweight thermal insulation, electric heaters (9), ventilators (6), a rotor (10) mounted on a shaft (8) that rests on bearings in rests that stand freely on pedestals (that have been concreted into the foundation), a transport bar (5) along which the springs (7) are transported to the furnace, and a feed mechanism (11). A tracing mechanism (4) turns the rotor by transmitting the rotary motion through a disk (2).

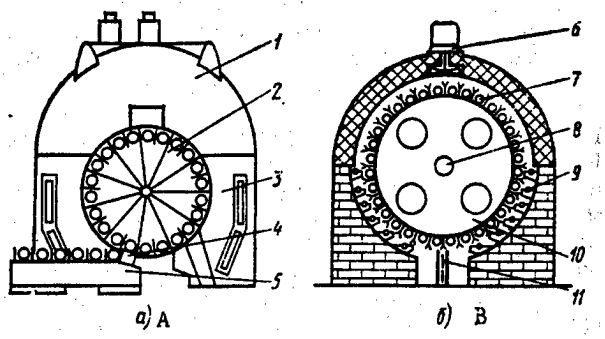

Figure 1. Diagram of the Rotary Furnace For Tempering Springs (a, overall view; b, cross section).

The furnace operates in the following manner. The springs (7) are fed along the transport bar (5) to the feed mechanism (11), which pushes them inside the furnace into the rotor housing (10). The rotor is turned to one position by a tracing mechanism (4). From this position, the heated springs (7) are pushed out of the housing by the same feed mechanism (11). The cycle is then repeated. The furnace's rotor is thus turned discretely one step.

Technical Data for the Furnace

Dimensions of the springs, mm:	
Length	500-750
Diameter	100-150
Bar diameter	20-80
Mass of springs, kg	22-30
No. positions	44
Time required to rotate to one position, s	15
Heating temperature, °C	420-500
Heat output, kW	480

The two furnaces that have been installed at the plant have operated without repair for 6 years.

The economic impact from introducing the furnaces has amounted to 20,000 rubles annually. Two additional furnaces have begun to be assembled.

UDC 621.771.013:669.018.8

Parameters of Cold Cross-Tapered Rolling of Corrosion-Resistant Steel

18610120a Moscow
KUZNECHNO-SHTAMPOVOCHNOYE PROIZVODSTVO in Russian No 8, Aug 88 pp 7-8

[Article by Yu. N. Mashnev]

[Text] Small (less than 12 mm in diameter and 80 mm in length) components such as multidiameter shafts, axes, and different pins account for a large number of the components manufactured at the enterprises of the Ministry of Chemical and Petroleum Machine Building, particularly at the Kislorodmash Scientific Production

Association in Odessa. From an economic standpoint, it is advisable to use cross-tapered rolling rather than machining when manufacturing such components.

Because the enterprises of the Ministry of Chemical and Petroleum Machine Building use a substantial quantity of bars made of corrosion-resistant and other high-alloy steels, the Kislorodmash Scientific Production Association studied the relationships between the limiting deformations during the cold cross-tapered rolling of products and the geometric parameters of the plane-tapered tool used and the reductions and mechanical properties of the blanks (made of these steels) that are being rolled.

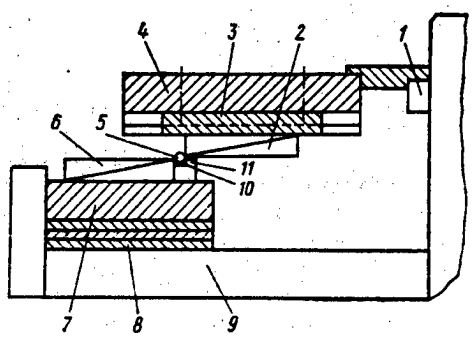

Figure 1. Diagram of Research Installation
Key: 1. Ram of cross-planer 2. Upper wedge 3. Upper plate 4. Slider 5. Blank 6. Lower wedge 7. Lower plate 8. Pad 9. Table of cross-planer 10. Pad 11. Prism

The process of cold cross-tapered rolling was researched on a laboratory installation for precision cross-tapered rolling (Figure 1). The installation for precision cross-tapered rolling was located on the table (9) of an updated cross planer (model no. 7310D) whose ram moves the upper plate (3) in a reciprocating motion. The upper plate (3) is connected with a plane tapered tool (2). The lower plate (7) with a tapered tool (6) is stationary and has different adjustments. The distance between the upper and lower plates is regulated by changing the thickness of the pads (8), and the height of the gauge is precisely adjusted by a special tapered mechanism located in the universal casing of the experimental tool. The design of the experimental fitting allows blanks to be rolled with different degrees of reduction. A tapered tool with a bilateral symmetrical wedge (with no constraints on radial rolling) (see Figure 2) was used during the research. The geometric parameters of the tapered tool on which the research was conducted are presented in Table 1.

Table 1.

β	α, degrees			
1°15'	20	30	40	50
1°30'	—	30	40	50
2°	—	30	40	50
2°30'	—	30	40	50

The maximum length of the tool (T) was 570 mm, the material used (5CrNiMo steel) had a hardness (HV) of 700, and the length of the rolled sections of the experimental specimens (L_{rolled}) ranged from 20 to 40 mm. The speed at which the upper plate moved was controlled within a range of 3 to 48 m/min. The tool had a surface roughness (Ra) of 1.25 mm. The major portion of the research was conducted on blanks that were 10 mm in diameter and 70 mm in length. They were made of the steels 10Cr17Ni13Mo2Ti, 08Cr13, and 12Cr18Ni9Ti.

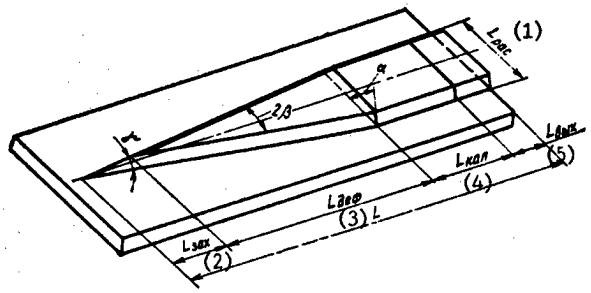

Figure 2. Geometric Parameters of Experimental Tool
Key: 1. $L_{distance}$ 2. L_{grasp} 3. $L_{deforming}$ 4. $L_{calibration}$ 5. L_{output}

The study examined single-pass cold cross-tapered rolling of blanks that had rigid ends and that were made of those corrosion-resistant steels that are most frequently used in chemical machine building.

The limiting deformations during cold cross-tapered rolling were determined experimentally by proceeding from the conditions of the absence of any slippage of blanks along the tool, the formation of microporosities (or the breakdown of the cavity) in the axial zone of the blank, and noncontact thinning deformation in the section of the blank being worked. The bounds of the stable occurrence of the process of cold cross-tapered rolling were established visually by proceeding from the conditions of the absence of any slippage of the blank and noncontact thinning deformation. Axial fracture was established by etching the plane of the cut blanks rolled on the wedges with the angle parameters specified in Table 1.

The degree of reduction was gradually increased until the blank began to slip (or until the noncontact thinning of that portion of the blank's surface being worked and its subsequent fracture). To make a more precise determination of the bounds of the stability of the process of cold cross-tapered rolling, three identical blanks were worked in each experiment (without changing any of the variable parameters in the given experiment). The tool's surface was degreased with acetone and wiped dry.

The research yielded relationships between the limiting deformations occurring during the cold cross-tapered rolling of corrosion-resistant steels, the geometric

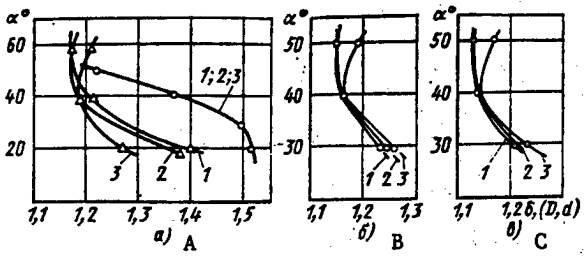

Figure 3. Allowable Reduction as a Function of the Angle for Three Types of Steel

Key: 1. 12Cr18Ni9Ti steel 2. O8Cr13 steel 3. 10Cr17Ni13Mo2Ti steel. Note: In A, open circles indicate $\beta = 1°15'$ and triangles indicate $\beta = 1°30'$; in B, $\beta = 2°$; in C, $\beta = 2°30'$.

parameters of the tool used, and the degree of reduction and the mechanical properties of the metals being worked (Figures 3 and 4). It follows from Figure 3 that the maximum degree of reduction in the steels studied is achieved when $\alpha = 30°$ and the minimum degree is achieved when $\alpha = 50°$. For angles α greater than 40°, the limiting reductions are restricted by the noncontact breakage deformation or slippage of the blanks. For angles α of less than 40°, it is limited by the axial fracture of the blanks. The areas located to the left of the curves obtained are characterized by the stable occurrence of the process of cold cross-tapered rolling (without axial fracture and other defects), and those areas located to the right of the curves are characterized by the breakdown of the process' stability. Using a tool with an angle α of 20° does not provide any significant increase in the degree of deformation since the deformation of the inner layers of metal along the blank's axis is reduced and the deformation of the metal in the tangential direction is increased (which facilitates the axial fracture of the blanks rolled).

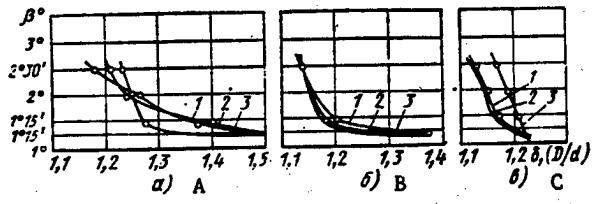

Figure 4. Allowable Reduction as a Function of the Angle for Three Types of Steel

Key: 1. 12Cr18Ni9Ti steel 2. O8Cr13 steel 3. 10Cr17Ni13Mo2Ti steel. Note: In A, $\alpha = 30°$; in B, $\alpha = 40°$; and in C, $\alpha = 50°$

It follows from Figure 4 that maximum deformations of $\delta = 1.5$ are reached when a tapered tool with an angle α of 30° and an angle β of 1°15' is used during the cold cross-tapered rolling of blanks. The maximum achievable degree of reduction during cold cross-tapered rolling with a tool having the angles $\beta = 2°30'$ and $\alpha = 30°$ amounts to $\delta = 1.18$ for O8Cr13 steel, $\delta = 1.23$ for 10Cr17Ni13Mo2T steel, and $\delta = 1.21$ for 12Cr18Ni9Ti steel. That is, it was established that as the angle β increases, the limiting degree of reduction decreases significantly. The difference between the values of the maximum deformations of the steels studied decreases as the angle β decreases. It was established that the limit achievable degree of compression decreases from $\delta = 1.5$ to $\delta = 1.22$ for one and the same angle $\beta = 1°15'$ as the angle α of the slope of the lateral face increases from 30 to 50°.

Conclusions

The cold cross-tapered rolling of the steels studied with a degree of compression of $\delta = 1.15$ (in a single pass without preliminary heat treatment) by using a plane tapered tool (see Figure 2) with angles $\beta = 1°15'$ and $\alpha = 30°$ was established as being technically possible.

When a degree of reduction δ of more than 1.5 must be obtained in the corrosion-resistant steels studied, preliminary or intermediate (in the case of cold cross-tapered rolling in two passes) heat treatment and a tapered tool with two sequentially located working wedges must be used.

The research conducted established that it is both possible and feasible to use a taped tool with the angles $\beta = 2°30'$ and $\alpha = 30°$ in the cold cross-tapered rolling of products made of the steels researched if the degree of reduction δ is less than or equal to 1.2.

The limiting conditions of the stable occurrence of the process of cold cross-tapered rolling as a function of the angles α and β, the degree of reduction δ, and the characteristics of the mechanical properties of the corrosion-resistant steel blanks being worked were discovered.

For the corrosion-resistant steels investigated, the optimum parameters of a tapered tool ensuring stable cold cross-tapered rolling were determined to be as follows: $\beta = 1°30'$ and $\alpha = 30°$.

The relationships between the limiting deformations and the tapered tool's geometric parameters and the degrees of compression and mechanical properties of the blanks being worked that were discovered during the research should be used in developing an industrial tool and technology for the cold cross-tapered rolling of products made of corrosion-resistant steels.

The precision of the dimensions of products that are made of corrosion-resistant steels and that are produced by using cold cross-tapered rolling correspond to class 3, and their surface roughness (Ra) ranges from 2.5 to 1.25 μm.

The results of research on the process of cold cross-tapered rolling as well as the extensive list of small corrosion-resistant steel components manufactured in

chemical machine building have made it both possible and economically feasible to use the process of cold cross-tapered rolling to manufacture the specified components.

The anticipated annual economic impact from introducing cold cross-tapered rolling in just six plants belonging to the Ministry of Chemical Machine Building amounts to 850,000 rubles. Introducing the process will also result in a savings of 750 tons of metal, a reduction of 156,000 norm-hours (i.e., 80 workers and 40 machine tools and production areas will be freed), and an increase in product quality and the quality of working conditions.[1,2]

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UDC 621.979.001.13

Classification of Forging Machines and Related Terminology (Discussion)

18610120b Moscow
KUZNECHNO-SHTAMPOVOCHNOYE PROIZVODSTVO in Russian No 8, Aug 88 pp 29-31

[Article by A. N. Banketov]

[Text] The increasing diversity of forging machines and the appearance of new terms have made it necessary to put them in some order and also to rename old machines in accordance with their purpose.

In the beginning of the 1950's there existed an All-Union State Standard [GOST] for crank hot-stamping presses in which these presses were termed "kovochno-shtampovochnyye" [forging and stamping] presses. This term, which is used in the GOST, was later replaced with the new term "pressy krivoshipnyye goryache-shtampovochnyye" [crank hot-stamping presses], which corresponded to their true function.

Professor A. I. Zimin[1], who made a number of terms more specific, has done a great deal of work to standardize the terminology. For example, the term "press mekhanicheskiy" [mechanical press] was replaced by the specific terms "krivoshipnyy press" [crank press] and "kolenorychazhnyy press" [toggle press]. M. V. Storozhev proposed replacing the term "ramnyye" [bed] frames with the terms "odnostoyechnyye" [single-arm] and "dvustoyechnyye" [double-arm] frames.

The term "kovochno-shtampovochnyye" [forging and stamping] machines, which was previously rejected, is now being used again (GOST 18323-86) along with the terms "kuznechno-shtampovochnyye" [forge and stamping] and "kuznechno-pressovyye" [forge and pressing]. Instead of these three names, it would be advisable to adopt the single name "kuznechnyye" machines for all documents.[2]

It would be advisable to link the examination of the terminology with the classification system for forging machines, as was proposed by Professor A. I. Zimin,[1] who divided the entire part of forging machines into four classes: hammers, presses, drive crank, and rotary machines. In one textbook,[3] this classification system was expanded into five classes: presses, hammers, rotary machines, pulse machines, and static-action machine (i.e., stats). Besides the nature of the change in the speed of the working pass of the main actuator, this classification system makes an allowance for its design and the nature of the transmission of the production force to the frame. The proposed classification system (see Figure 1) includes seven classes of forging machines. Two new classes are introduced. Shears are introduced because the dividing process is always accompanied by the breaking of the blank and by the occurrence of tensile forces in the connecting rod of the shearing beam.

New terms are also proposed in the classification system. Thus, it is recommended that hydraulic presses be subdivided into three groups: electric pump (presses with a purely pump drive), electric battery (with a battery-operated drive), and electric booster (with a booster drive). It is recommended that screw presses be subdivided into friction, electric and hydraulic screw, and geared hydraulic motor presses and presses that are driven directly by an electric motor.

The following are included among crank and cam presses: universal crank and hole-punching, broaching, bending, and straightening presses; sheet-stamping automatons; crank hot-stamping and toggle-crank coining presses; and automatons for cold die forging.

It is recommended that machines in which either the tool or the blank rotates around a mandrel be subdivided into four groups: roll and roller machines, rollers, and mills.

Roll rotary machines include roller sheet-straightening and sheet-bending machines. Roller rotary machines include roller bar-straightening and bar-bending machines as well as thread-cutting, profiling, and sheet-stamping rotary extruders.

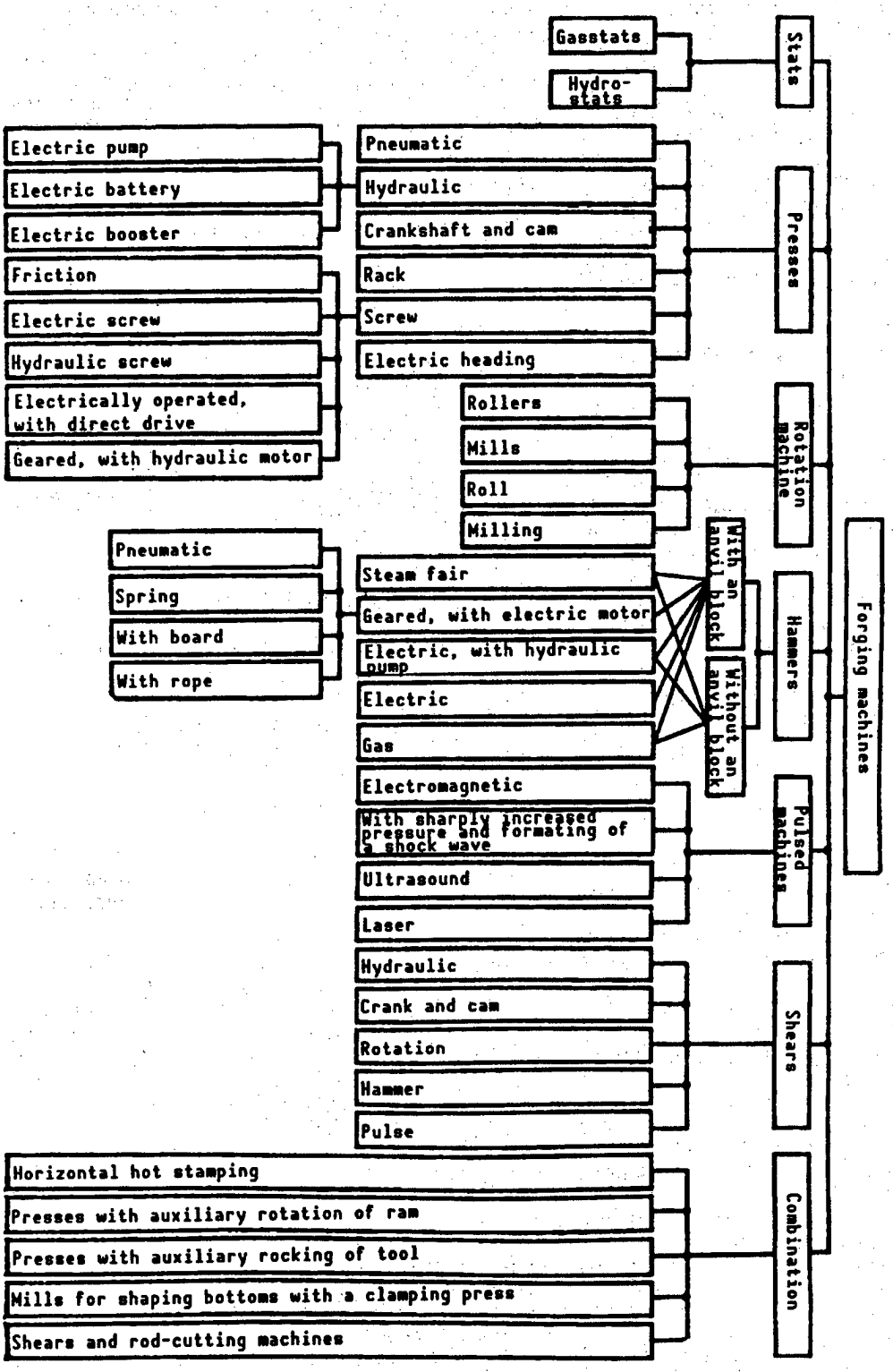
Gasstats
Hydro-stats
Stats
Electric pump
Electric battery
Electric booster
Friction
Electric screw
Hydraulic screw
Electrically operated, with direct drive
Geared, with hydraulic motor
Pneumatic
Hydraulic
Crankshaft and cam
Rack
Screw
Electric heading
Presses
Rollers
Mills
Roll
Milling
Rotation machine
Pneumatic
Spring
With board
With rope
Steam fair
Geared, with electric motor
Electric, with hydraulic pump
Electric
Gas
With an anvil block
Without an anvil block
Hammers
Forging machines
Electromagnetic
With sharply increased pressure and formating of a shock wave
Ultrasound
Laser
Pulsed machines
Hydraulic
Crank and cam
Rotation
Hammer
Pulse
Shears
Horizontal hot stamping
Presses with auxiliary rotation of ram
Presses with auxiliary rocking of tool
Mills for shaping bottoms with a clamping press
Shears and rod-cutting machines
Combination

Figure 1.

Rollers are subdivided into forging and stamping and single- and multicage rollers.

Mills include profiling mills, mills for rolling pinions and for uncoiling rings, and spring-coiling and splinting automatons.

Each of the aforementioned classes of forging machines includes machines for forging, hot die forging, and cold sheet stamping.

Shears are subdivided into crank, hydraulic, rotary, hammer, and pulse shears.

Crank shears include sheet shears with a sloping blade; downcut shears; and shears for cutting blanks, fittings, and scrap (alligator shears).

Rotary shears include two- and multidisk shears.

It has been proposed that a new class of forging machines, i.e., combined machines, be created in addition to shears. It would include machines with two working actuators or machines in which the tool of the main actuator has two motions. For example, in presses for spheroidal stamping the ram makes two motions, a forward motion and a rocking motion. It would be advisable to include a horizontal forging machine with two rams—clamping and header rams—in this class of combined machines. But the term "mashina gorizontalnaya goryacheshtampovochnaya" [horizontal hot-stamping machine] should be used instead of the obsolete term "gorizontalno-kovochnaya mashina" [horizontal forging machine], which does not correspond to the essence of its operation.

The following are included in this class of machines: a press for spheroidal stamping (which should be termed a "press with auxiliary rocking of the tool") and a press for twisting stamping (a press with auxiliary rotation of the ram).

The class of combined machines can also include a mill for shaping bottom that has a press for clamping blanks along with a shaping roller. This class also includes combined shears with sheet or bar cutters and press-shears with an auxiliary piercing ram.

GOST 18323-86, "Forging and Pressing Equipment. Terms and Definitions," actually reiterates (with slight additions) GOST 18323-73, which in its time was examined at the Technical Council of the TsBKM [not further identified; probably TsKBM, i.e., Central Design Office for Machine Building] and was rejected. Unfortunately, this standard was issued without revision anyway. Most authors of books on forging equipment and textbooks for a course in equipment to be taught at higher educational institutions, including L. I. Zhivov, A. G. Ovchinnikov, Ye. N. Lanskoy, A. N. Banketov, and Yu. A. Bocharov, have not adhered to the terminology proposed by the GOST. The Committee on Standards conducted a number of conferences at which GOST 18323-73 was sharply criticized. Unfortunately, no critical article devoted to this GOST has been published. It has only been mentioned in some works.[4,5] Thus, the absence of any discussion has resulted in a situation in which the errors of the old GOST 18323-73 have been duplicated in the new GOST 18323-86.

In our opinion, GOST 18323-86 has the following flaws:

1. It uses old, no-longer-used terms such as "kovochno-shtampovochnyy press" [forging and stamping press], "mekhanicheskiy press" [mechanical press], "ramnaya stanina" [bed frame], etc.

2. Its introduction of some new terms is not justified. In Section 69, for example, the new term "mnogudarnyy" [multihit] automaton is introduced instead of the generally used terms "dvukh-" [double] and "trekhudarnyy" [triple-hit] automaton.

3. A number of machines such as stamping hammers, rolling automatons, drawing and nail-making automatons, a press for spheroidal stamping, and briquetting and packaging presses are generally not mentioned.

4. Frequently, machines that are mentioned in the "General Information" section do not figure into the main text. These include pulse machines, thermoplast automatons, and reactive plastic automatons. On the other hand, several classes of machines that are mentioned in the general text are not included in the "Main Principles" section, for example, the forging and pressing stat and gas- and hydrostats (Sections 21 through 23).

5. There is no mention of what a horizontal-pressing machine should be called. It may be suggested that it corresponds to the term "gorizontalnyy kovochno-shtampovochnyy press" [horizontal forging and stamping press] (Section 18). However, this name does not correspond to the production operations performed on a horizontal forging and stamping machine.

6. The section "Drive Shears" (Sections 57 through 63), which includes crank and hydraulic shears, is inappropriately titled.

7. It would be better if the term "Stamping Press" (Section 16) were replaced by the term "sheet-stamping or hot-stamping press."

8. A radial blooming machine, which is a machine that belongs to the press class (to the crank machine group) is classified under rotary machines (Section 52).

9. Some definitions are not sufficiently distinct. For example, a rotary forging and pressing machine is defined as a forging and pressing machine on which the tool and/or blank makes a rotary motion when the production operation is performed (Section 6). If one concurs with the authors, then a hydraulic press equipped with a manipulator that rotates the blank is also a rotary machine.

10. The terms recommended in the GOST are inconsistent and incompatible with those examined in the appendixes. Thus, Appendix 1 uses the term "press krivoshipnyy goryacheshtampovochnyy" [crank hot-stamping press] while the main text contains the term "press kovochno-shtampovochnyy" [forging and stamping press], i.e., a term that has previously been rejected is used.

11. Why the terms "mechanical press" and "mechanical shears" are introduced in Sections 24, 28, 29, 30, and 57 when it was possible to avoid them (as in Sections 25, 26, 27, and 59) is incomprehensible.

12. Some terms presented in the alphabetical index of terms are also unacceptable: multihit forging and pressing automaton, multihit automaton, two-cage forging rolls, drive shears, and mechanical press.

13. The definitions in Sections 70, 71, 73, 80, and 84 are not sufficiently thought out. In our view, a machinery set for basic shaping and profiling of blanks should also be termed integrated equipment. A combined horizontal hot-stamping press that includes rolls is one such example. A forging section may consist of identical single-operation equipment, e.g., a section of die-forging hammers or a section of trimming presses (for cold trimming), as well as sections of two-hit automatons, trimming automatons, and rolling automatons, etc.

14. The diverse equipment for machining nonmetal products are virtually ignored by GOST 18323-86.

Adopting the classification system and terminology presented in Figure 1 will result in a well-designed system that can be used as a basis for revising GOST 18323-86. This system can then be used in developing a branchwide classification system and standardization.

Conclusions

1. The proposed classification system (see Figure 1) encompasses all classes of forging machines, and the recommended terminology corresponds to the essence of the operations implemented on one machine or another.

2. It is recommended that the Committee on Standards repeal GOST 18323-86, which is entitled "Forging and Pressing Equipment. Terms and Definitions" and issue a new GOST that makes allowances for the proposals put forth by the author of the present article, applying it solely to equipment used in plastic metal working.

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Kuybyshev Plenum Seeks Improvements in Engineering Design

18610124 Moscow TEKHNICHESKAYA ESTETIKA in Russian No 8, Aug 88 pp 1-2

[Article under the "In USSR Society of Designers" rubric: "Plenum Gives Assessment"; first paragraph is boldface TEKHNICHESKAYA ESTETIKA introduction]

[Text] The third out-of-town plenum of the board of the USSR Society of Designers was held on 17 May in Kuybyshev. The main topic discussed was the matter of improving the professional and creative level of designers working in industry.

I. A. Zaytsev, secretary of the USSR Society of Designers, presented a report on this topic at the plenum. He noted that the issues of the designer's position in industry, his working conditions, and the quality level and efficiency of his developments are becoming increasingly critical. The revolutionary transformations that are currently underway in all spheres of social life, the deep-seated changes in the management of the economy, and the increased attention that is being paid to the human factor cannot fail to have an effect on the field of design. Designers are being obliged to justify their calling and are actively being included in the process of accomplishing the tasks that have emerged during the course of restructuring. Included among these are the tasks of

sharply increasing the quality and competitiveness of Soviet industrial production, meeting consumer demand, and improving things in the residential, production, and social-cultural spheres. The well-known decree of the USSR Council of Ministers entitled "Measures for Further Development of Design..." is directed toward solving the principal problems facing design and taking the measures required to ensure its development.

Zaytsev also noted, however, that the true state of affairs in industrial design gives cause for alarm. The formal discussion of the policies of the aforementioned decree, the incompetent intervention of administrators in the creative process, and the bureaucratic and command style of management are all things that continue to be encountered in many sectors of industry and that demand activism, careful attention, and intervention by the USSR Society of Designers.

A careful analysis of the quantitative and qualitative makeup of the designers working in industry that was conducted during the induction of the USSR Society of Designers showed the heterogeneity of the distribution of design efforts, both from the standpoints of types of activities, sectors, and regions and from the standpoint of the effectiveness with which their creative potential is being utilized. Of the society's 1907 members, 115 (8.9 percent) work directly in industry. The largest numbers of designers work in Belorussia, Georgia, the Ukraine, Moscow, and Leningrad. Unfortunately, a real designer vacuum has been found in such large industrial centers as Kuybyshev, Gorkiy, Volgograd, Novosibirsk, Odessa, and Dnepropetrovsk. There is yet another telltale figure confirming the low professional level of engineering designers: they accounted for only 50 percent of inductees to the society.

What are the reasons for so unfavorable a situation? Zaytsev analyzed them. At the overwhelming majority of enterprises, conditions conducive for a decisive turning point in the use and introduction of design have yet to be created. The design services have not been staffed with qualified personnel, and they have been equipped with an extremely weak material and technical base. An acute lack of production areas is felt everywhere, and there is no normative documentation regulating the activity of engineering designers.

There are a number of sectors where designers' situations could be considered relatively fortunate, even though this good fortune is distributed very unevenly among the enterprises. These sectors include the automotive, instrument making, and agricultural machine building sectors. For example, the Ministry of the Automotive Industry issued a serious and thorough order dealing with developing the field of design in the sector. The order, which was issued to develop the well-known decree about design, specified present and long-range tasks and allocated staff, areas, and equipment for the development of design services. Standard structures and production equipment for design offices, departments, and centers were appended to this order. The ministry's plants are now issuing internal documents and implementing the policies stipulated in the ministry's order. But the absence of design services at such giants as BelavtoMAZ, the Kremenchug Automotive Plant, and the Plant imeni Uritskiy looks very strange against this background of "good fortune." Design is in a sad state in the bus and motorbike industries. The existing subdepartments are experiencing difficulties with their production areas and design personnel as well as in overcoming stagnation in both the technical and plant boards. Difficulties are also being encountered at the ministerial level. To date, this sector has lacked any coordination of designers' activities or any practice of exchanging experience. In this sense, each plant in a separate principality.

An in-depth analysis of the state of affairs in other sectors—in the machine tool building, communications equipment, aviation, and light industries—was also conducted. Their problems are similar and numerous. Of course, a great deal depends on the personality of the person in charge of the design service. Indeed, the design services headed by M. V. Demidovtsev and I. B. Golchinskiy (from the Ministry of the Automotive Industry), V. A. Kharkov and S. I. Passman (from the Ministry of the Machine Tool and Tool Building Industry), V. M. Atmorskiy (from the Berdsk Radio Plant), L. V. Tsekhanovich (from the BelOMO [not further identified], and I. Kyarmik (from the Mistra Production Association) were able to develop into creatively strong and nationally renowned collectives. It should, however, be stated that design has not generally become an organic component of the technical and economic policy of many sectors and that the attitude toward design in those sectors has been a formal one.

What can and should the USSR Society of Designers do to correct the situation that has evolved? What has the council's board done in the year of its existence? Zaytsev devoted a fairly large amount of attention to these questions, especially to the question of the status of the designer.

Letters were prepared and sent to the ministries explaining the need to introduce the job of "designer-artist" (designer) and its derivative jobs in accordance with the "Qualifications Manual on the Duties of Managers, Specialists, and White-Collar Employees" at enterprises and organizations. Twenty-six ministries confirmed that they would act on the document. And if this is not done at some enterprises, it must be. There are legal grounds. Technical administrative material on organizing a designer service is being prepared. It includes recommendations concerning the structures, size, and equipment of such services. Working jointly with the All-Union Engineering Aesthetics Scientific Research Institute, the USSR Society of Designers developed a new standard for the positions of designer, chief designer of an enterprise, chief project designer, and design council. These documents are recommendations. They are a

foundation for developing the respective positions at an enterprise and in a sector. The Law Governing the State Enterprise and the transition to full cost-accounting have given the collectives the right to decide such issues themselves. In a number of cases, it is more feasible (both economically and from the standpoint of existing conditions) to deal with a highly qualified design organization than to use an in-house department that does not have a full-capacity workload or that is performing nonspecialized assignments. It is obvious that the further development of design and its structure will be determined by economic factors. Zaytsev recalled taking part in the development of a number of legal documents that are now being jointly prepared by a working group from the All-Union Copyright Agency [VAAP] and representatives of the creative societies. Patenting should be also extended to the production of a design. A procedure for compensating authors for using (circulating) their design works is also being developed.

As far as helping to increase designers' professional creative level is concerned, a lot depends on the activity of the USSR Society of Designer's creative sections and its members. Zaytsev gave a critical assessment of the society's board and its secretariat and called attention to the slow start on work related to the plans that have been formulated. The creative sections' armament contains many organizational forms of communication among designers for increasing their craftsmanship and for developing their professional and civic activity. However, they are either not used or else little used. These organizational forms include seminars, exhibitions, competitions, roundtable meetings, club activities, and creative contacts with foreign countries. After analyzing the procedure of some past design competitions, Zaytsev discovered the reasons for their successes and failures. He also criticized the action of the USSR Design Fund, which has yet to solve many of the organizational problems that are crucial to the normal productive operation of design studios and individual designers who have expressed a desire to complete plans based on agreements reached through the fund. Zaytsev stressed the need for clear and unambiguous agreements between society members and the fund in all of the country's territories. In conclusion, he called upon the plenum participants to remember the creative essence of the USSR Society of Designers where bureaucratic operating methods are not tolerated and where a style corresponding to the spirit of restructuring, the spirit of social activism, democratization, glasnost, respect for the collective opinion, and objective assessment of each person's creative contribution should be celebrated. Observing these principles will make it possible for the USSR Society of Designers, as a society, to build a progressive creative intelligentsia.

Two additional reports were delivered as a supplement to the picture of the state of engineering design and the analysis of the board's activities over the past year and were presented in Zaytsev's report. A. G. Dlotovskiy, board chairman of the USSR Society of Designers, informed the plenum of a program to develop design in Belorussia that was developed by the republic council, and he described the course of its implementation. Proposals to create a republicwide design system and measures to develop it were developed in cooperation with the Belorussian branch of the All-Union Engineering Aesthetics Scientific Research Institute and were presented to the Commission of the Presidium of the BSSR Council of Ministers. These proposals were approved. Proposals related to art education that included a number of measures to improve designers' education were also prepared jointly with the BGKhTI [not further identified] and the republic Society of Artists and Architects. Work is underway to form specialized full cost-accounting subdepartments of the republic design fund.

M. V. Demidovtsev, first secretary of the board of the Kuybyshev oblast organization, presented a report that also dealt in detail with the problems in developing design that are characteristic of the oblast. He focused attention on the shortage of design personnel, on the lack of coordination of their creative activity, and on the poor extent to which they have been provided with materials and equipment. He noted that the first task in helping correct this situation is to re-create the society's oblast organization.

The debates on the reports were extremely interesting and critical. Many reports by board secretaries and members and the members of the revision commission contained practical and constructive suggestions. V. A. Sivkov (Omsk), A. K. Stapulenis (Vilnyus), R. A. Petrov, V. I. Pashko (Tolyatti), T. B. Suleymenov (Alma-Ata), N. V. Voronov, I. A. Andreyeva, V. F. Runge, V. K. Fedorov, A. K. Yuryatin (Moscow), O. V. Chernyshev, I. Ya. Gerasimenko (Minsk), and Ya. K. Antsitis (Riga) all spoke. M. V. Petrov, head of the department of light industry and consumer goods of the Kuybyshev CPSU obkom, took part in the plenum. He presented a report.

The plenum adopted a resolution calling for a number of measures to accomplish the critical tasks established by the USSR Society of Designers.

Armenian-Developed Sevan Laser Cutter Discussed

18610140 Yerevan KOMMUNIST in Russian
29 Oct 88 p 2

[Article by V. Sarkisov, winner of the State Prize of the Armenian SSR and the Prize of the USSR Council of Ministers in the area of science and technology, candidate of physical-mathematical sciences: "The 'Sevan' Laser Machine", with the subheading: "Striving for the State Prize of the Armenian SSR"]

[Excerpts][passage omitted] Armenian scientists and engineers working both in the system of the Armenian SSR Academy of Sciences, Yerevan State University,

and at industrial enterprises (the Kirovakan chemical plant, the APO "Safir") were among the first in the nation taking an active part in the creation of laser crystals and instruments. Their work has been commended with state prizes of the Armenian SSR and prizes of the USSR Council of Ministers in the field of science and technology. Over the past years, our republic has created a vast scientific and technical potential in laser science and engineering.[passage omitted]

The first step in the republic was taken by the Kirovakan "Avtogenmash" plant. For a number of years the enterprise had been organizing the industrial production of gas laser based machines for automatic cutting of thin metal plates. But gas laser machines are quite enormous and have poor efficiency, and their handling is rather inconvenient. However, they do not require an expensive outlay. It is therefore quite reasonable to resort to the more efficient and compact solid state lasers based on YAG garnet lasers with neodymium.

YAG crystal based lasers are universal. They operate easily in both a free generation mode, with modulated quality factor, and in a continuous generation mode. Having low thresholds of generation, a high coefficient of amplification, and a narrow emission line with quite large power, technological YAG-based laser machines are very compact, durable, and easy to control. They have a large power reserve and unlimited possibilities.

The creation and industrial manufacture of YAG crystal based technological laser machines of "Sevan" brand for automated cutting of thin sheet material by the "Avtogenmash" plan of Kirovakan is surely a major achievement for the republic. It is the outcome of the enormous contribution of the team of inventors: G. Gambaryan (project leader), S. Avakyan, E. Vartanyan, K. Grigoryan, A. Kalpakchyan, S. Safaryan, A. Tikhomirov, and G. Khachatryan.

Several dozen "Sevan" machines have already been released and they are in successful operation in many of the major sectors of the national economy. Work is being done to develop the next generation of more powerful machines.[passage omitted]

UDC 061.43:658.18

The Resursosberezheniye-88 Exhibit

18610166 Moscow VESTNIK MASHINOSTROYENIYA in Russian No 10, Oct 88 pp 75-77

[Article by Engineer L. I. Andreyeva; continued from issue No 9, 1988]

[Text] Various technologies and equipment for surface hardening, hard facing, and application of coatings were shown at the displays of the exhibit "Rational Use of Material Resources in the Economy."

The NNV-6.6-I2 layout with microprocessor system controlling the process is intended for application of wear-resistant coatings to metalworking tools by the method of condensation of material in vacuo with ion bombardment. The layout can be used to apply coatings on tools up to 200 mm in diameter and 250 mm long. The layout is characterized by high productivity and quality of applied coatings. In the working chamber of 600x600 mm cross section there are three electric arc evaporators. The pressure in the chamber is held in the range of 6.65×10^{-3} to 6.65×10^{-1} Pa, the rate of deposition of the coating (titanium nitride) is 5-40 mcm/h. The layout was developed by the VNIIETO (Moscow).

This same institute has created the LN-1.2NO-I1 "Pluton-1" laser technological layout for surface hardening, alloying, and plating of machine parts and tools. During the treatment, the surface of the workpiece is heated by the focused beam of a laser, moving at speeds up to 10 m/min. The laser heat treatment may increase the wear resistance of the products by a factor of 2-5.

The LTU-16 laser technological layout created by the Cherkassy NPO [scientific production association] "Rotor" is used for treatment of hard materials (silicon, ceramics) and metals, for fabrication of photographic templates, for marking out silicon structures, and so on. The layout is based on a coordinate table. High quality of treatment of the materials is assured by use of specially designed linear motors. The positioning system of the layout employs granite guideways and aerostatic supports, which eliminate friction and guarantee high quality, reliability, and stability of the parameters. The PNC system assures highly precise control of the operating duties of the laser and the process equipment. A television observation system guarantees the requisite precision of workmanship and work safety. Some specifications for the layout: wavelength of radiation 1.06 mcm; mean radiated power 16 W; speed of movement of table 15 m/min; positioning accuracy plus or minus 0.01 mm; dimension of laser light spot 0.02-0.2 mm. Outside dimensions of the layout: 1400x1000x1400 mm; weight 800 kg.

The ULG-2.02 laser technological layout with "Lantan-3" laser was shown by the VNIIESO (Leningrad). The layout is designed for welding metals, cutting metallic, dielectric and composite materials, heat treatment, and hard facing with powder materials. The layout includes a microprocessor system for automatic control of the laser. The layout can work in continuous and pulsed periodic duties. The following operations can be carried out: welding of metals and alloys with depth of fusion down to 5 mm and rate of 100-150 m/h; cutting of metal sheets up to 10 mm thick with cut width 0.3-1 mm at a rate of 2-5 mm/min; cutting of nonmetallic materials up to 20 mm thick; surface heat treatment; hard facing of powder metals on the surface of parts. Primary specifications of the layout: nominal radiated power in pulsed periodic duty (mean) 2 kW, in continuous duty 3 kW; maximum pulse frequency 500 Hz; diameter of light spot max. 40 mm; range of linear movement during processing 5-100 mm/s.

A new progressive technology for hard facing the worn tips of rails and crossings on the track without interrupting the train traffic is of interest. The hard facing work is carried out by means of specially developed equipment, including a mobile power station mounted on a caterpillar tractor, a lightweight semiautomatic hard facing unit, a grinder, an electric heating appliance for warming the rails prior to the hard facing, and a special measuring tool. The facing is done by using the manual electric arc and the semiautomatic methods. The technology was developed by the VNIIZhT MPS.

One of the advanced enterprises of the USSR Ministry of the Oceangoing Fleet, the Klaypeda experimental ship repair plant, organized in 1982 a basin laboratory for gas thermal coatings, the duties of which include development and introduction of advanced processes of gas thermal deposition. In the past three years, the laboratory has developed more than 30 technologies for restoration and hardening of parts. Thus, for example, the laboratory has developed a technology for restoration of the exhaust valves of internal combustion engines by application of wear and heat resistant coatings with fusion. The deposition makes use of the powder PGSR-2, produced by the NPO "Tulachermet." The work is done with the special torch GN-2. The hardness of the coating is 40 HRC. Paste is used to protect adjacent surfaces from the deposition. Heat treatment prevents the restoration process from affecting the structure of the workpiece. The technology is cost-effective for more than 30 pieces in a lot. The laboratory has also developed technological processes for restoration of cylinder bushings of ship internal combustion engines, propeller shaft facings, hydraulic cylinder rod facings, plasma powder hard facing to strengthen the half-bushings of the scoop of a dredger, and so on.

The VoroshilovgradPTImash has created technologies for brilliant two-layer nickel plating and brilliant zinc plating, providing excellent corrosion resistance and the requisite decorative qualities of the workpieces.

The two-layer nickel coating, applied by the new technology with no copper undercoat, is a substitute for four-layer protective-decorative coating, which results in a semi-shiny surface in need of polishing. The two-layer nickel plating process has been adopted by the PO [production association] "Voroshilovgradteplovoz" and the Southern Urals Machine Plant.

The brilliant zinc coating with colorless passivation replaces the protective-decorative nickel coating in the manufacture of certain items of domestic consumption. The coating has high elasticity and strength of adhesion with the base. The process of deposition of the zinc coatings has been adopted by the Irkutsk Heavy Machine Plant and the Staro-Kramatorsk Machine Plant.

The display booths also exhibited new materials, metal substitutes, and new metal-saving designs for parts.

The alloy 18KKh, developed by the TsNIIchermet and used in manufacture of magnetic circuits, has high (over 2 Tl) saturation induction, which makes it possible to construct electromagnetic systems with high specific power. The alloy 18KKh replaces the alloys 27KKh and 49K2F, thereby sparing cobalt, which is a scarce material. The production technology for the alloy has been introduced at a number of metallurgical plants.

A corrosion resisting structural composite has been developed by the VNIIK for protection of chemical equipment against corrosion and for fabrication of building structures and manufactured goods. The composite is based on a water glass bond, making use of wastes from the ferrovanadium industry. The coefficient of corrosion resistance of the composite in 40% HNO_3 is 0.84-1.34; in 40% H_2SO_4 0.98-1.28; in 40% NaOH, 0.92-0.95; the coefficient of water resistance is 0.92-0.98; the compressive strength is 20.5-24 MPa. Utilization of the wastes from the ferrovanadium industry makes it possible to improve the usage qualities of the material and lower the net costs, promotes rational use of natural resources, protection of the environment, and better working conditions.

The non-metallic, iron-replacing piston rings developed by the VNIIkholodmash are interesting. Sealing and oil-control rings are cast under pressure from the granulated fluoroplastic F40LD with glass fiber (8%) and graphite (4%) ballast. The cast rings require no machining. Thanks to replacing iron piston rings with nonmetallic ones the labor intensity of the ring manufacture is reduced by a factor of 3, the cylinder sleeves function with almost no abrasion, and the lifetime of the rings is extended three fold. Rings of fluoroplastic antifriction composite F40S8G4 can work in various environments, including ammonia and freons with refrigerating oils. The rings are made in diameters of 67.5, 76, and 115 mm. The lifetime of the rings is 15-18 thousand hours, the highest working temperature 180°C (brief temperature rise to 200°C is permissible). The manufacturer of the rings is the "Rigakhimmash" plant.

The VNIPTIkhimneftemash has developed graphite-bronze bushings, which are made by the method of powder metallurgy. The bushings are used as self-lubricating bearings in rubbing elements of petroleum drilling equipment—the submerged pumps and electric motors. Unlike their counterparts, the bushings withstand temperature up to 180-200°C. Development and introduction of the bushings makes it possible to raise the coefficient of utilization of nonferrous metals. The bushings are made by the "Borets" NPO.

The bimetallic compound piston for hydraulic equipment developed by the VNIIgidroprivod is a unit consisting of a steel body and an aluminum insert. The piston differs from its counterparts by the secure no-play fastening of the inserts in the bodies, so that the pistons can be used in high pressure pumps (32 MPa or more) and the noise level during operation of the pump is lessened. The manufacturing technology for the compound pistons increases the coefficient of metal utilization by a factor of 2, lowers the labor intensity of the machining by 30%, and improves the reliability and longevity of the pumps. The bimetallic pistons are made by the "Gidroprivod" plant of Shakhty.

The Kolomna Heavy Machine Tool Plant has introduced a technological process for manufacture of the guideways of machine tools from the epoxy compound UP-5-250. This polymer is used as an antifriction coating, providing good adhesion to the metal surface. Use of epoxy compounds for manufacture of the guideways entirely eliminates subsequent machining (including scraping), lowers the production costs, and saves on scarce materials (bronze and alloy TsAM-10-5). The guides of epoxy compound have high scratch resistance and make it possible to work with moderate abrasion in event of random interruptions in the supply of lubricating material. The procedure for application of the compound has been worked out by the ENIMS.

The NPO "RostNIITM" put on display stamped bodies of plain bearings making use of polymer materials. The body consists of two metallic stamped half-bodies, two flanges made from polyamide (in which a ball bearing is mounted), and two polyamide disks closing the bearing off at the outer end. Automatic adjustment of the unit is achieved by the turning of the flanges. The bearings are lubricated only once (lubricant is applied during assembly). Because of the presence of the polymer elements, the unit has good resistance to vibration. The allowable load on the bearing is 10 MPa, the frequency of shaft rotation up to 1500 rpm, the operating temperature from -40 to +70°C. Experience with the manufacture and use of the units shows that the design uses less metal than its counterparts, the manufacturing labor is less, and the ball bearing is reliably protected against abrasive particles. The bearing is intended for mounting the transmission shafts of farming and highway transport vehicles.

The TsNIImetallurgii i materialov (Sverdlovsk) put on display its new design of a metal-polymer bushing for the spindle joint of a rolling stand. The bushing, weighing

120 kg, is a steel skeleton with recesses accommodating polymer inserts which project beyond its surface. The wear resistance of the bushing is 2-3 times greater than that of bronze. The design of the bushing is protected by inventor's certificate 863035.

Technologies which make use of industrial wastes are of interest. Thus, the NPO "VNIIinstrument" has developed a method of fabrication of cutting tool blanks from fast-cutting steel scraps, using the powder metallurgy method. The technological process consists of the following steps: cleaning of the chips, fragmentation to produce the sintering powder, heat treatment of the powder, cold pressing, baking, hot pressing (extrusion), and one type of pressure working according to the required tool assortment. The technology for utilization of the fast-cutting steel scraps makes it possible to increase the coefficient of metal utilization and reduce the labor intensity of manufacture of the tools.

The ArmNIImash has developed the automated model ALBS-1 line for processing and briqueting of steel and cast iron cutting scraps. The line consists of a breaker layout, a crusher, a washing and drying unit, an elevator for transport of the chips, an accumulating hopper, a briquette press, a conveyor, and a cart for stacking the finished product. A distinguishing feature of the line, compared to its Soviet and Western counterparts, is the lack of a centrifuge. The cleaning of the chips takes place during the washing and drying steps. Thanks to the use of a special detergent, a film is produced on the fragmented chips, protecting the briquettes against corrosion. The line is attended by two men. The productivity of the line is 2.5-3 T/h, power consumption 190 kW, and weight of the finished briquette 13 kg.

The Gorkiy automotive plant has created a layout for waste-free decomposition of spent water-oil emulsions in a closed cycle. The technology is based on a reagent method of decomposing the spent emulsions which allows recycling of the organic and aqueous phases for production of cooling and lubricating fluids. The decomposition process is achieved by adding an aqueous solution of bactericide to the spent emulsion and treating the resulting pulp with a solution of calcined soda and polyacrylamide. The organic phase provides an emulsol of stable composition and properties, from which emulsion is prepared. The chief advantages of the technology are no pollution of the environment, reduced outlay of emulsol and water, extended lifetime of the emulsion. The method of producing the emulsol is protected by inventor's certificate 954417.

The college of machines and apparatus of the chemical industry at the Ufa Petroleum Institute has developed a compound method of biochemical cleaning of the waste waters of galvanic industries which permits deep cleansing of a number of contaminants at the same time: ions of heavy metals, organic substances, and sulfates. The cleaning is done with bacterial cultures resistant to the toxic effects of heavy metals (chromium, nickel, copper, cadmium, mercury, lead, bismuth, etc.), while also capable of altering the composition of the waste waters. The technology makes it possible to submit efflux water with overall content of heavy metal ions 200-400 mg/l for biochemical cleaning. An industrial layout has been created, after moving through which the purified water is recycled, while the dehydrated cakes are used as ballast in the production of construction materials. The Novocherkassk Design Development Institute "Giproelektro" has developed a design for a biochemical cleaning layout for the waste waters of the Perm Electrotechnical Plant with a capacity of 650 m^3 per day.

The corrosion indicator layout UK-1 is designed to determine the corrosivity of salt-bearing efflux waters from the oil drilling fields and to alter this by using various agents (temperature, rate of flow, pH, concentration of inhibitors, etc.). The layout can take a reading in the presence of hydrogen sulfide or other substances which form current-conducting sediments on the surface of solids. The corrosivity of the medium is evaluated in terms of the rate of corrosion of metal, which is measured by the method of polarization resistance. Besides the petroleum industry, the layout can be used in the machine industry and other sectors for determination of corrosivity of process environments similar in nature to the efflux water of the oil fields. The UK-1 layout was developed by the Kiev Polytechnical Institute.

The projects of the NPO "RostNIITM" in the area of economizing on paint and lacquer and rationalization of painting methods are of interest. This NPO has created process additives which are introduced into the paint prior to application, thus lowering the drying time and shortening the process. The expenditure of heat for heating the painted objects is also reduced, production floor space is freed up, and transportation costs are reduced. The process additives do not impair the properties of the paint and lacquer coatings.

The NPO has also created a low-waste technology of painting. The most common method of painting objects in the machine industry is pneumatic spraying, which wastes 25-55% of the paint and lacquer. The waste are mostly burned in special equipment or in simple bonfires, resulting in atmospheric pollution. It turns out that nearly half of the wasted paint and lacquer can be reprocessed to produce reconstituted enamel. The NPO has developed a technology for production of such enamels, which can be used in repair and construction jobs. The original paint and lacquer, with as much as 15% of the reconstituted enamel added, can be used to paint noncritical parts or to produce a temporary coating. Introduction of the technology for production of reconstituted enamel at the PO "Gomselmach" and the "Orselmash" plant has saved our economy more than 100 tons of paint and lacquer.

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