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USSR REPORT

ENGINEERING AND EQUIPMENT

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SURFACE TRANSPORTATION

PRODUCTION PLANS FOR NEW OFF-ROAD CARRIER NOTED

Moscow TRUD in Russian 20 Mar 86 p 1

[Article by Yu. Logachev]

[Excerpt] Tooling-up for the production of the first large industrial lot of "Ural-5920" vehicles has begun at the Ural Automotive plant. The "Ural-5920" is intended for transporting loads over snow and swampy terrain.

A map of Tyumen Oblast hangs in the office of A. Romanichenko, chief designer of the "Ural Automotive Plant" production association. Next to this map are drawings of motor vehicles intended for operation in areas of the Far North. Among them is the over-snow-and-swamp vehicle, test prototypes of which are already operating in Western Siberia.

"This is a vehicle with high off-road capability," related Aleksandr Alekseyevich. "It functions in any weather conditions and operates reliably."

An independent cab heating system was developed for the "Ural" vehicles. The range of 'duties' of the new motor vehicle is expanding. A fueling vehicle, a dump truck, and a passenger compartment have been designed on the basis of the over-snow-and-swamp vehicle.

Another valuable feature of these vehicles is their diesel engine, which has a capacity of 210 horsepower. Thanks to this, the "Ural" is not daunted by roadless terrain, swamps, forest-tundra, quicksand, dry riverbeds and other nearly impassable places.

Specialists of the plant and scientists of an industry institute have drafted a large-scale program for intensifying production. This program has been approved by the Chelyabinsk Oblast Communist Party Committee and the USSR Ministry of the Automotive Industry. In line with the program, 200 robot-equipped modules and complexes, more than 300 machine tools with numerical programmed control and 180 automatic production lines will go into operation in shops of the plant.

FTD/SNAP
/13046
CSO: 1861/365-E

NEW OFF-ROAD AIR-CUSHION VEHICLE DEVELOPED

Moscow IZVESTIYA in Russian 22 Mar 86 p 3

[Text] A cross-country air-cushion vehicle has been developed in the student design bureau of the Riga Institute of Civil-Aviation Engineers (RKIIGA).

Students from various member-countries of the Council for Mutual Economic Aid who are studying at this institute were brought closer together by work on the vehicle.

The RKIIGA bureau has concluded a contract with industrial enterprises. In accordance with drawings and designs of the cross-country vehicle, the first prototypes of a series-produced model will be built this year.

FTD/SNAP
/13046
CSO: 1861/365-E

NUCLEAR ENERGY

ATOMIC POWER STATIONS TO SUPPLY HEAT

Moscow TASS in English 9 Apr 86

[Text] Leningrad April 9 TASS--The 4 million KW Leningrad atomic power station, one of the largest in the world, will generate thermal as well as electric energy.

Station manager Anatoly Yeperin said that hot water supplied by the station will be absolutely safe. The first stage of the system is planned to generate 300 gigacalories of heat an hour, which is equivalent to an annual saving of 300,000 tons of fossil fuel.

The development of centralized heat supply based on atomic energy is a major aspect of the development program of Soviet power engineering. Under the resolutions of the 27th CPSU Congress, 75-90 million tons of reference fuel are going to be saved by the year 1990. The plan relies on sound scientific calculations and a technological base.

The first pilot station of this type with a capacity of 5,000 KW operates in Dimitrovgrad in the Volga area. The Bilibino atomic power station in the Chukchi peninsula generates heat as well as electricity. Reactors with an aggregate capacity of 2,000,000 KW are going to be installed at the Odessa atomic heat supply plant now under construction. Similar construction projects have been launched in Volgograd, Kharkov and Gorky.

/13046
CSO: 1861/369-E

NON-NUCLEAR ENERGY

PROBLEMS OF PRICING OIL FIELD EQUIPMENT

Baku NARODNOYE KHOZYAYSTVO AZERBAYDZHANA in Russian No 11, Nov 85 pp 41-43

[Article by A.M. Rzayev and N.B. Beyukkishiyev, All-Union Scientific Research, Planning and Technological Institute of Petroleum Machinery]

[Abstract] The problem of proper establishment of prices for new equipment has become particularly important since the machine building industry was shifted to a broad-scale economic experiment on 1 January 1985. There are three stages in determination of costs for new oil field equipment: determination of the limiting (projected) cost; the costs for experimental models; and the costs for series produced products. The major problem of cost determination for new products is to establish proportional distribution of the effects of new equipment among producers and consumers. Proper determination of the level of cost for experimental models is also important. Analysis of the practice of cost determination for experimental models in this branch of industry has shown that it has certain shortcomings and contradictions. Artificially elevated costs for new products without proper economic justification does not stimulate industry. One of the major sources of generation of funds for economic stimulus, however, consists in the profit added to the costs of new equipment. The system for determining costs of new equipment should be improved, a matter which deserves the attention of production workers, ministry employees, scientific research and design-technological organizations.

6508/13046
CSO: 1861/241

UDC 622.7-52.004

IMPROVING MAINTENANCE, REPAIR IN AUTOMATED COAL-CLEANING PLANTS

Kiev UGOL UKRAINY in Russian No 3, Mar 86 pp 41-42

[Article by D.N. Kopanitsa, candidate of technical sciences, N.S. Serdyuk, candidate of technical sciences, and A.S. Nesnov, engineer, Voroshilovgrad Branch, State Institute for Automation Development in the Coal Industry]

[Text] During the 11th Five-Year Plan period, integrated automation equipment began to be manufactured and is being introduced into operation at coal cleaning plants to handle most of the production processes: at the preparation stage for coal cleaning -- equipment operating the hopper loading process AZB-1; for heavy-media separation -- equipment for automating heavy-medium plants RUTA; for jigging machines--equipment for comprehensive automation of cleaning processes OKA-1; for flotation--the equipment for automated control of flotation and filtration processes SARS-3; and for water-slurry management, the equipment for automation of processes and installation of the water-slurry system AVS-1.

The automation equipment is built as a sophisticated multifunctional complex which includes data inputs, a keyboard, and executing devices. In addition to process parameter stabilization, signalling and blocking, OKA-1 equipment controls the process by end-product quality and optimizes the processes according to a preset criterion. Similar equipment is being developed for optimizing heavy-medium concentration processes and flotation.

A comprehensive ASUTP [production process automated management system] has been introduced at the Sverdlovskaya cleaning plant (Antratsitugleobogashcheniye Enterprises) producing a return of 630,000 rubles per year. An ASUTP is to be installed at the cleaning plant of the Neryungrin section (Yakutugol Enterprises) and the Sibir cleaning plant (Kuzbassugleobogashcheniye Enterprises). The coal cleaning plants are thus being equipped with sophisticated up-to-date means of automation; the servicing of this equipment has to be performed by skilled automation and electronics professionals.

At 62 of 150 coal cleaning plants within the purview of the Ministry of the Coal Industry of the USSR, we have units servicing control and measurement instruments and automation [KIPiA] with a staff of from two to 10 persons. A detailed study of the services has been conducted at a sample of plants belonging to Voroshilovgradugleobogashcheniye Enterprises, mainly equipped with state-of-the-art automation facilities. Of 11 plants here, only one (Voroshilovgradskaya plant) has a KIPiA service with sufficient staff (25 employees), qualifications (three college graduates and four employees with special secondary vocational education in the field), as well as with a sufficient control and measurement instrument base to service and repair the automation equipment at the plant. At the other plants, these services have just one specialist in the field with a college degree and lack the necessary control and measurement instrumentation. The situation is similar at other production associations.

The Ministry of the Coal Industry of the USSR has up to 10 plants where the KIPiA service is capable of providing adequate maintenance of automation facilities. The coal concentration plants do not have specialized laboratories or facilities for testing and adjusting equipment modules.

In order to improve the maintenance and repair services for the automation equipment, the Ministry of the Coal Industry of the USSR has developed a comprehensive program. A list of organizations has been issued charged with the maintenance and current repair of safety devices, equipment for automation of processes and control systems, as well as a list of mine automation equipment recommended for priority servicing by the maintenance system (this includes the automation equipment for coal concentration plants). In 1983 the State Institute for Automation in the Coal Industry developed and the Ministry of the Coal Industry of the USSR approved the "Statute for the Organization of Technical Services (Testing and Adjustment) of Mine Automation Equipment," which specifies the distribution of responsibilities and regulates the interrelationships between manufacturers, assembly and adjustment organizations (maintenance and repair services), the production associations, mines and scientific research institutes.

The Voroshilovgrad Branch of the State Institute of Automation in the Coal Industry in 1984 developed the "Normative Materials for Technical Maintenance and Repair of Automation Equipment at Coal Cleaning and Briquette Plants." The document has been approved by the Ministry of the Coal Industry. The estimates are based on data supplied by component unit manufacturers; operation experience with automation equipment at coal concentration plants and surveys among KIPiA staff; the results of studies of reliability of equipment used for the automation of production processes and management; service life rates for spare parts; and actual data on the reliability and overhaul capability of automation equipment at plants.

The normative materials specify the basic characteristics of maintenance (types of jobs, their periodicity, itemized operations and time and labor rates), the product mix and rates of consumption of spare parts. As experience with maintenance and repair of automation equipment is accumulated,

the normative documents will be revised periodically at least every five years. The "Normative Materials for Technical Maintenance and Repair of Automation Equipment for Coal Concentration and Briquette Plants" were circulated in 1985 to all concerned organizations and enterprises.

The introduction in the industry of a system of maintenance and repair of mine automation equipment is expected to generate substantial savings. For example, maintaining in constant serviceability the automation equipment complexes AZB-1, RUTA, OKA-1, SARF-3 and AVS-1 at a coal concentration plant with an output of 3 to 4 million tons per year would produce an annual savings of up to 1 million rubles.

Currently, the system of maintenance and repair for automation equipment of concentration plants is passing through the stage of initial development The specialized installation and adjustment organizations should typically set up maintenance and repair services with the appropriate personnel, material and technical basis, transportation vehicles, etc. The production associations operating the coal mining and cleaning enterprises should sign contracts for maintenance service and repair of automation facilities with the installation and adjustment organizations. Arrangements should be made for the manufacture of spare components and supply of these components to installation and adjustment services. Major organizational efforts will be required to secure the efficient functioning of the system of maintenance and repair services for the automation equipment at cleaning plants.

9922
CSO: 1861/255

UDC 620.4

RESEARCH FOR LONG-RANGE DEVELOPMENTS IN POWER ENGINEERING

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 4, Apr 86 pp 46-54

[Article by academician M.A. Styrikovich and Yu.V. Sinyak, doctor of economic sciences]

[Abstract] Long-range planning of energy policy in the USSR covers a period of 50-70 years, possibly longer than that. It is done by the Working and Advisory Group established in 1977 by the Presidium of the USSR Academy of Sciences for this purpose, under the leadership of academicians M.A. Styrikovich and N.D. Fedorenko. Studies made by this group so far indicate several trends in energy development and management in the USSR. Expansion of the national economy will continue to be based on the use of domestic energy sources, without cutback in their export. The demand for primary energy sources will steadily increase, owing to population growth and economic growth, but at a decreasing rate made possible by energy conservation measures. Efficiently transported energy, namely electric energy, will play an increasingly dominant role in the overall nation-wide energy balance, with corresponding cutback first in natural gas and then also in nuclear fuel as well as in low-grade coal. This trend is stimulated by the relatively much more stable cost of electric energy and by the favorable effect of electrification on production output. There will develop a wider gap between the costs of base power, peak-load power, and slack-load power so that means will have to be found and widely implemented to meet the daily, weekly, and seasonally fluctuating demand for energy. In heating systems the trend will continue toward centralized heating, while electricity as well as nuclear fuel will replace first oil and then natural gas. Developments in the use of atomic energy will accelerate, while economic use of renewable energy sources such as water, wind, solar radiation, and geothermals will also increase. The energy utilization factor will improve on account of more efficient production equipment and appliances, also because of a more extensive use of secondary energy sources. Energy production will become more concentrated and energy distribution will become more centralized, while ground transportation will have to be improved for better coping with the uneven territorial distribution of natural resources. There will be more stringent requirements for protecting the environment and maintaining the ecological balance. Specific items tackled by the Working and Advisory Group include development of the coal industry, more capital investment being recommended for the Kuznetsk basin than for the less profitable Donetsk basin, infusion of new

energy sources and raw materials into the chemical and petrochemical industries, and conversion of biomass (industrial or animal and human waste) into fuel by fermentation. The thermophilic process at 55°C temperature has been found to be most suitable for the USSR. Other items are year-round air conditioning with heat pumps and conversion to hybrid solar-conventional home heating. For some time the Working and Advisory Group has also been studying world markets for energy sources, natural gas being of special interest to the USSR as major supplier. Recommendations are being developed concerning the long-range strategy of the USSR with regard to this commodity. References 3: 2 Russian, 1 Western.

2415/13046
CSO: 1861/354

UDC 622.691.4.01:628.517.4

MULTIPLE PULSE-BOTTLE ARRANGEMENTS FOR GAS COMPRESSORS

Moscow GAZOVAYA PROMYSHLENNOST in Russian No 3, Mar 86 pp 21-22

[Article by G. P. Bosnyatskiy, Yu. N. Vasilyev and V. S. Kashirov, VNIIgaz and Mosavtogaz, under the "Recommended for Implementation" rubric]

[Text] The proposed designs for multiple pulse bottles in the connecting piping of reciprocating-piston GCU's [gas compressor units] are compact, economical and convenient to operate. When installed on compressors, they reduce the power consumed for gas compression.

The Vuktyl GPU [Gas-Field Administration] reported that the implementation of a double pulse bottle on the refrigeration station of UKPG-1 [Integrated Gas-Preparation Installation] reduced the gas-pressure pulsations and eliminated vibration in the connecting piping of a 10GKN compressor. In sum, the high-pressure process lines for formation gas injection operated reliably.

In the last 20 years in the oil, gas, petrochemical and chemical industries, a large amount of theoretical and practical experience has been obtained in solving problems of pipe vibration. In the gas industry, developments in this area by MINKhIGP imeni I. M. Gubkina [Moscow Institute of the Petrochemical and Gas Industries] and VNIIgaz [All-Union Scientific-Research Institute of Natural Gases] have been successfully implemented at a number of existing compressor stations [CS's].

Standard solutions have been proposed for pulse bottles in new CS's equipped with various versions of 10GK, MK-8 and DR-12 compressors. However, none of these solutions took into account how the pulsating-flow characteristics influenced the compressor's indicator diagram, since these solutions were developed for emergency situations involving dangerous pipe vibrations during compressor startup.

The works of I. M. Frenkel, S. A. Khachaturyan, A. A. Kozobkov, A. P. Vladislavlev, V. M. Pisarevskiy and others provide convincing, experimentally proven data which show that the power consumption for gas compression is 8-10 percent higher when the cylinder operates on a line with unfavorable pulsating-gas-flow dynamic characteristics.

In practice, the type and location of pulse bottles in existing CS's were determined mainly on the basis of minimum expenditures for reconstruction of the existing connecting piping. Solutions for new CS's were based on a number of recommendations.

For example, for new CS's with 10GK and MK-8 compressors with suction pressures of less than 5.5 MPa, computer calculations led to the adoption of a header 400 mm in diameter and 5-6 m long as the pulse bottle. This pulse bottle performed well in CS's with the standard connecting piping, with relatively short lines between the compressor and the 700- to 1000-mm-diameter collecting header, the latter being an additional means for damping pressure waves.

In gas-engine compressors [GEC's], the pulse-damping header is installed right by the cylinders and is connected to them by short pipes. With this arrangement, cylinder operation still significantly influences the amount of pressure differential in the short connecting pipes between the cylinders and the pulse-damping header. The pressure differential in this case greatly exceeds the permissible values and causes unfavorable changes in the compressor-cylinder indicator diagrams.

Thus, when a pulse-damping header (a 400-mm pipe) is installed on a 10GKN GEC, the gas pressure differential near the cylinders (in connecting pipes) reaches 4 percent of the static pressure in the pipeline (5.5 MPa), while during high-pressure operation of cylinders (up to 12.5 MPa), the value of this indicator in the section between the cylinder and the pulse bottle increases to 6.6 percent (Table 1).

Table 1. Pressure Differential in Connecting Pipes of Cylinders and in the Discharge Line of a 10GKN GEC at n = 6 s^{-1}, percent

(1) Тип гасителя	(2) В патрубках между цилиндром и гасителем	(3) В линии нагнетания за гасителем (усредненное значение)
4) Труба-гаситель 400 мм ($p_{вс}$=2,5 МПа, $p_{н}$=5,5 МПа)	4,0	2,0
5) Труба-гаситель 400 мм ($p_{вс}$=5,5 МПа, $p_{н}$=12,5 МПа)	6,6	6,8
6) Пакетный из двух труб с попарным разделением цилиндров ($p_{вс}$=5,5 МПа, $p_{н}$=12,5 МПа)	1,8	2,3

Key:

1. Type of pulse bottle
2. In connections between the cylinder and pulse bottle
3. In the discharge line downstream of the pulse bottle (average value)
4. Single pulse bottle, 400 mm (p_{su} = 2.5 MPa, p_{d} = 5.5 MPa)
5. Single pulse bottle, 400 mm (p_{su} = 2.5 MPa, p_{d} = 12.5 MPa)
6. Double pulse bottle with two cylinders connected to each bottle (p_{su} = 2.5 MPa, p_{d} = 12.5 MPa)

Pulse bottles with acoustic separation of the cylinders (a buffer tank) are not widely used for GEC's with parallel operating cylinders or for balanced-opposed compressors. The reason is that, although the buffer tank is an effective means of damping pressure waves, its use on the above-mentioned compressors involves design problems and greater expense. Also, the buffer tanks must still be certified for high-pressure operation. The installation of a buffer tank outside the CS building (for example, at the Kazakh CS)--especially for a compressor with several parallel-operating cylinders--is not always a positive factor in matching gas-flow dynamic characteristics in the cylinder-line system. "Floating" of the GEC shaft rotating speed and changes in the gas properties and temperature conditions also lead to a mismatch of the acoustic characteristics in the cylinder-line system.

In addition, the installation of a buffer tank on the section between the CS building and the header (at existing CS's) is complicated by the presence of bypass lines, service areas and pipe supports.

When converting to GEC operation at a discharge pressure greater than 5.5 MPa, dangerous vibrations occur in the connecting piping (SP-3, Vuktyl). In this case, the use of a common pulse-damping header (400-mm pipe) for all cylinders is ineffective. Firstly, the header must be replaced, because it must be made of thick-walled pipe. Secondly, the header operating conditions are worsened, because the header is still connected to the cylinders in the same way (see Table 1).

In recent years, new versions of reciprocating-piston compressors have been developed in the sector for pressures of 10 MPa and higher for use in pipeline main compressor stations [DKS's], natural-gas compressor stations for filling motor-vehicle fuel tanks [AGNKS's] and in cycling processes. This requires the development of connecting-pipe arrangements using high-pressure pipes, valves and process devices. In this case, the acoustic characteristics in these connecting pipes change greatly. An increase in the pressure differential between cylinders leads to an increase in the energy consumption for compression, and also causes intense vibration of pipes and equipment, as occurs at present in new AGNKS's.

For such connecting pipes operating under high gas pressure, VNIIgaz has developed a multiple pulse bottle made of two small-diameter pipes (159 mm. dia. x 14 mm wall thickness) with two cylinders connected to each pipe. It was implemented at SP-1 (Vuktyl) for a 10GKN GEC with a discharge pressure of 12.5 MPa. As a result, vibration was prevented in the connecting process piping for formation gas injection.

We note that when using this multiple pulse bottle, the pressure differential is reduced directly in the cylinder connections and in the line to about one-fourth compared with the operation of four cylinders on one 400-mm-diameter pulse bottle (see Table 1). The effectiveness of pulse damping will be even higher if four pipes, each connected to one cylinder, are used.

There are various possible arrangements of multiple pulse bottles (Fig 1). In particular, they can be used also for 2GM-4-1.3/12-290 compressors in AGNKS's. When multiple-pipe pulse bottles are used on reciprocating-piston compressors with basement foundations (at gas and oil refineries), less floor space is needed for the compressors, the connecting piping is more durable and repair and maintenance are simplified.

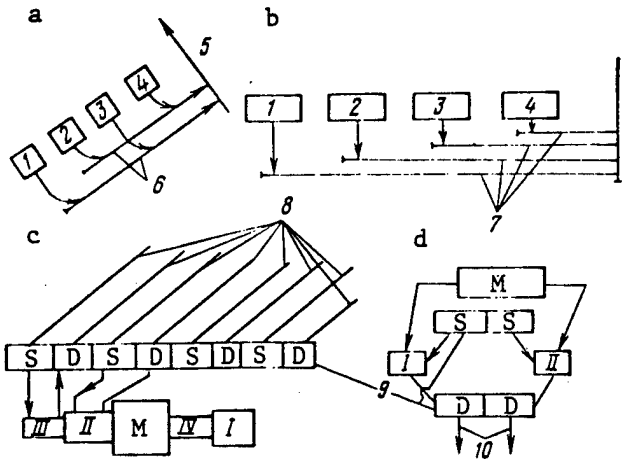


Figure 1. Diagrams of Multiple Pulse Bottles: for a Compressor with Parallel Operating Cylinders, with Two Pipes (a) and with Four Pipes (b); for a Balanced-Opposed Compressor (c) and for a Two-Row Compressor (d):

M. motor
S. suction
D. discharge
I-IV. compression stages
1-4. cylinders
5. discharge line
6. two pulse bottles
7. four pulse bottles
8. connecting pipes
9. pipes with baffles
10. discharge pipes

The main advantage of multiple pulse bottles is that they reduce the power consumption for gas compression by 2-3 percent for each reciprocating-piston compressor. For the sector overall, this will provide great economic savings.

12595
CSO: 1861/283

MODERNIZATION OF OIL DRILLING ENGINEERING INSTITUTE'S R & D SECTION VIEWED

Moscow NEFTYANIK in Russian No 3, Nov 86 pp 2-3, 9

[Article by B. Levin, Minnefteprom press-center reporter, under the rubric "Course of Accelerating Scientific and Technical Progress": "On the Path to Improvement"

[Text] A meeting with Vladimir Mikhaylovich Belousov,director of the experimental plant of the All-Union Scientific and Research Institute of Oil Drilling Engineering [VNIIBT], took place in the machine and assembly shop. That day all newspapers had published the draft of the new version of the CPSU Program, and the director decided to share with workers his thoughts, induced by his first reading of the document.

V.M. Belousov has been the director of the experimental plant a little bit over three years. He came here on the recommendation of the Lyuberetskiy party gorkom, which he had been a bureau member of for five years. He is a candidate of technical sciences, author of 31 inventions, and bearer of the Order of October Revolution and Order of Labor Red Banner. He was a delegate to the 15th VLKSM Congress. Besides his direct duties as a director, Vladimir Mikhaylovich takes upon himself the same responsibility for a lot of social duties, such as a member of the party gorkom inspection committee, deputy of the Lyuberetskiy City Council, member of the plant's party bureau and chairman of the city management board of the "Znaniye" [knowledge] society. And, in one way or another, all these duties are related to the needs and interests of development of the plant and the plant's employees.

By modern standards, the experimental plant is not a large one, at least compared to the Moscow oblast industrial giants. But it faces the same problems as the entire industry: shifting to principally new manufacturing processes that provide multifold increase in productivity and manufacturing efficiency. So much so that the development and implementation of new techniques for the oil producing industry depends a lot on the plant.

The VNIIBT experimental plant, which was awarded the "Enterprise of High Production Culture and Labor Organization " title in 1975, successfully solves problems of drilling intensification. Per drawings developed by the leading institute, the plant's professionals build prototypes and pilot lots of rock crushing tools, downhole motors and other unique equipment.

To be able to manufacture a broad product mix of rock crushing machines with high precision and efficiency, 58 out of 218 machine tools in the plant should be replaced; this was the well-reasoned program the director presented at the meeting of the insitute's scientific council where the Minnefteprom managers were present, and he was given an approval to modernize.

"Our plant's course is toward increase of organizational and technological flexibility of production, implementation of automated systems, and fast and economical reaarangement of technological cycles", Belousov says.

The objective is clear, but to implement it, a long and complicated road has to be traveled.

"Once I went to Kuybyshev", says Belousov. "I was intertested by the fact that in hard alloys surfacing, professionals there performed the preheat using r.f. currents, whereas in our plant this operation was performed using scarce and expensive acetylene. I decided to implement this method in our plant. The implementation d r a g g e d for an inordinately long time: eight months. Sometimes it is difficult, you know, to overcome the inertia, habitual stereotypes, unwillingness to create extra troubles for oneself. I had to show my character then. After the innovation had been implemented, the plant's acetylene consumption decreased by 40 %. But this is just a particular case, so to speak."

The plant's technical policy for a long-range prospective has been determined by the Minnefteprom order of 20 February 1984 "On Development and Organization of Production of New types of Effective Drilling Bits". The order made it incumbent to accomplish necessary preparation for manufacturing of bits equipped with diamond and hard alloy plates. To do this, it was necessary to add a bay to the existing shop block, and this was not a simple task.

The work began with a detailed analysis of available options. Thorough calculations showed that it was possible to get by without the additional bay, and thus without huge expenses and time losses. Instead, it was possible to use existing basic assets provided some production lines were modernized and additional equipment installed. This decision is now being implemented; it became a basis for the program of plant's technical rearmament and further development.

So far technical innovations go a very long way from the experimental to series production.

Back in 1979 the State commission recommended for series production a TRM gearbox turbodrill, prototypes of which had been manufactured by the plant. Testing under the severe geological conditions of Western Siberia had demonstrated that the new machine designed by the VNIIBT professionals makes it possible to increase footage per drill by a factor of 2.5, to reduce the cost of drilling by 20 % and electrical power consumption by 15 %. The

turbodrill can withstand a well temperature up to 250° C. The fact that the Kola superdeep well exceeded the 12 km depth mark is to a large extent due to the new turbodrill.

Says Belousov: "Minkhimmash was charged with the organization of series production of the turbodrill, but the production has not been started yet. In the meantime, our small experimental plant is still getting dozens of orders for manufacturing of this machine, which is needed in Tyumen, Bashkiriya, Tatariya, Azerbaydzhan and Ukraine. We are trying to help the drilling enterprises as much as possible, but in doing this we are diverting our resources from meeting the plant's main planned goals".

"Today a director or any executive must not only put his own plant in order, but also try to uproot those 'external causes' that hinder progress. For instance, let us consider the notorious problem of supplies for experimental enterprises", Vladimir Mikhaylovich thinks.

"The existing system, which is the same for both experimental and serial plants, does not suit us anymore. Say, a plant needs several grades, types and sizes of steel, several hundreds kilograms of it. But the minimum order quantity now is several tons. Therefore the plant has to buy extra metal that is needed somewhere by somebody. Such organization of supplies only impedes the cause.

"It is in the interest of the rational metal consumption to organize a special purpose system of supplying experimental enterprises with a wide range of types, grades and sizes of materials, so that it would be possible to get exactly what is necessary, and at any time at that.

"Yes, specific decisions are needed today, that are formalized in appropriate codes and specify the speed and the sequence of development and implementation of new technology. For this plant, as well as for other similar plants, and there are quite a few of them in the country, approving an "Experimental Enterprise Statute" becomes a matter of utmost importance. The statute should provide for the supply system, as well as for the system of implementing approved newest technology, and specify relationships with the leading institute and the Ministry. A lot is also in limbo as far as financing and settling with customers and suppliers is concerned. That is why a broad-based interagency act is needed."

And the immediate problem that the director must solve together with the plant employees is to create a businesslike, highly demanding, yet congenial atmosphere at the plant.

12770

CSO: 1861/252B

EXPERIENCE WITH SVD-VTI-YuTE FLY-ASH COLLECTORS

Moscow ENERGETIKA in Russian No 4, Apr 86 pp 14-15

[Article by Doctor of Technical Sciences L.I. Kropp, Candidate of Technical Sciences M.S. Kharkovskiy, and G.A. Konshin, Ye.T. Darovskiy and Ya.D. Vasylyna, engineers, VTI [All-Union Heat Engineering Institute] imeni F.E. Dzerzhinskiy, Yuzhtekhenergo]

[Text] The entry into effect of norms for maximum permissible and time-coordinated effluents of harmful substances into the atmosphere, as well as the conversion of the GZU [hydraulic ash disposal] systems of electric power stations to a circulating water supply have imposed heightened requirements on the operating reliability of fly-ash collectors and their gas-scrubbing efficiency.

These requirements are especially topical for power generating units with an output of 150 to 200 MW, equipped with fly-ash scrubbers with high productivity per unit for the purpose of cleaning finely dispersed ash in high concentrations from flue gases.

Ash of this sort is formed in burning Donetsk and Lvov-Volynsk coal, crushed in ball-tube mills. The effectiveness of its removal in standard MV [molecular weight] and MS [molecular sieve] scrubbers is not higher than 95 percent.

Besides, in burning coal distinguished by a high ash and sulfur content, intense abrasive-corrosive wear of the walls of coagulators and of the inlet sections of the bodies of fly-ash scrubbers is observed.

These problems were solved in the development of the SVD-VTI-YuTE fly-ash scrubber, in which were used the results of research and development by VTI imeni F.E. Dzershinskiy and Yuzhtekhenergo.

The SVD-VTI-YuTE unit (cf. fig 1) consists of, set at a certain pitch, a two-stage Venturi coagulator (VC) with a rectangular cross section, and a drip pan, 1. The first stage, 3, of the VC is two-sectioned. Four atomizers of Yuzhtekhenergo's design are installed in the gas conduit in front of it. The exit cone, 4, of the second stage of the VC is connected to the drip pan by means of an inlet scroll-type connection, 2. The side walls of the

coagulators are made out of acid-resistant brick. The design is sufficiently compact for installation in power generating units in the modernization of fly-ash collectors.

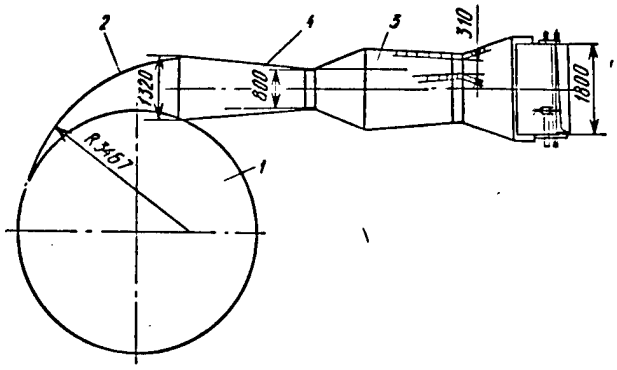


Figure 1. SVD-VTI-YuTE Fly-Ash Scrubber with Two-Stage Venturi Coagulator

SVD-VTI-YuTE units were used in three 200-MW power generating units of the Moldavian GRES. The first models of these units were introduced at the GRES in May 1982. The experience of using them demonstrated that the use of acid-resistant brick in making them made it possible to reduce considerably the cost of routine repairs. There is every reason to assume that this kind of protection will make possible the reliable operation of fly-ash collectors in the period between overhauls of boilers.

The walls of the modernized fly-ash collectors, in spite of operation of the GZU system entirely in a closed circuit (as the result of this the clarified circulating water from the Moldavian GRES's ash dump is supersaturated with calcium sulfate), were not overgrown with deposits of gypsum ($CaSO_4 \cdot 2H_2O$). This is explained by the fact that about 20-percent service water was mixed with the circulating water used to spray the fly-ash collectors, as recommended by VTI and Yuzhtekhenergo. Since approximately the same percentage of water was evaporated in the fly-ash collectors, mixing did not result in the appearance in the ash dump of excess amounts of clarified water, which would have to be dumped into natural water reservoirs.

Acceptance tests were made of SVD-VTI-YuTE units in October 1984 in a power generating unit, of station No 5, of the Moldavian GRES. The principal results of the tests are presented below:

Fuel	Mixture of Donetsk coal
Steam-generating capacity of boiler, t/h	608-612
Reduced ash content of fuel, %/ /(MJ/kg)	1.3-1.45

[Continued on following page]

Suction of air into fly-ash collectors	0.027-0.047
Exhaust gas temperature, °C:	
Before fly-ash collectors	155-162
After fly-ash collectors	67-69
Volume flow rate of flue gases to one fly-ash collector, thousand m^3/h	To 280
Total pressure loss of fly-ash collecting unit, Pa	1430-1550*
Degree of cleaning of flue gases, %	97.3-97.7
Specific weight flow rate of water for cleaning gases (under normal conditions), kg/m^3	0.189-0.229
Specific consumption of electric power for cleaning flue gases (under normal conditions), kWh/1000 m^3	0.813-0.846

*The elevated pressure loss of SVD-VTI-YuTE units in this power generating unit as compared with other power generating units is due to increased suction of air into the boiler and flue gas flow rates of up to 280,000 m^3/h instead of 240,000 to 250,000.

With spraying water flow rates making possible a degree of cleaning of gases of approximately 97.5 percent, flue gases are cooled in the unit by 90 °C on average. As tests have demonstrated, this cooling can be reduced to 75 °C by reducing the flow rate of the water for spraying but then the degree of cleaning of gases drops below 97 percent.

The permissible temperature of cleaned gases in burning Donetsk coal equals 65 to 70 °C; therefore it is recommended that the new units be used in boilers with exhaust gas temperatures less than 150°C. With lower temperatures like this, it is advisable to heat the cleaned gases to approximately 70 °C (e.g., the heating of cooled gases to a temperature of not less than 72 °C before discharging into the atmosphere at a TES [steam power plant] is regulated by legislation in the FRG).

A saving of 57,000 rubles per year was gained in each power generating unit of the Moldavian GRES just on account of a reduction of the cost of repairing the linings of fly-ash collectors.

Conclusions

1. As the result of the development and lengthy testing of the new fly-ash collectors in the process of stand tests, industrial tests and the mastery of the units at the Moldavian GRES, their technical and economic indicators were confirmed and a determination was made of their recommendable area of application.

2. The SVD-VTI-YuTE units should be used for the re-equipping of electric power plants, primarily for 150- to 200-MW power generating units burning high-ash and -sulfur coal (Donetsk and Lvov-Volynsk), as well as the tailings

from cleaning them. For the more complete realization of the advantages of these units they should be used at exhaust gas temperatures of higher than 140 °C. With lower temperatures, the use of these units is feasible upon the condition that the cleaned gases are heated, e.g., by mixing with them five to six percent of the excess hot air from the boiler.

3. Optimization of the efficient conditions for the circulating water supply for the new units when the GZU system operates in a no-discharge circuit makes it possible to solve in an integrated manner questions relating to improving the reliability and efficiency of fly-ash scrubbing.

CSO: 1861/349

UDC 622.692.4.07:69.057

MODULAR CONSTRUCTION OF COMPRESSOR STATIONS DESCRIBED

Moscow GAZOVAYA PROMYSHLENNOST in Russian No 3, Mar 86 pp 12-13

[Article by I. I. Klyukach, M. P. Linchevskiy, V. I. Kostyuchenko and N. A. Glikman, Soyuzgazproyekt: "Supermodular Compressor Station"]

[Text] The industrial integrated module method of building compressor stations [CS's] out of supermodules ensures high quality and reduces the labor content and volumes of on-site construction-installation work. The area of the CS itself is reduced and the construction period shortened by about a year.

The economic savings from the implementation of the industrial integrated module construction method for one supermodular CS total about 4 million rubles.

Soyuzgazproyekt, together with other organizations, has developed a modular compressor station [CS] made of mobile supermodules which are completely factory manufactured. The CS's are designed for main gas pipelines. These CS's are to be built for gas pipelines in northern Tyumen Oblast.

The diagram of a supermodular CS is shown in Fig 1.

Technical Description of the Modular CS

Capacity, billion m^3/yr	30-32
Number of GCU supermodules	6
Pressure, MPa,	
at CS inlet	5-5.5
at CS outlet	7.5
CS outlet temperature, ^{o}C	40
Installed capacity, thous. kW	96
Number of GP and APE supermodules	1
Number of PA supermodules	1

The general plan of the supermodular CS was based on the following requirements: 1) maximum modularity of the CS units, 2) zoned areas at the station site for production and auxiliary facilities and 3) maximal use of space, with allowance for contamination- and fire-safety.

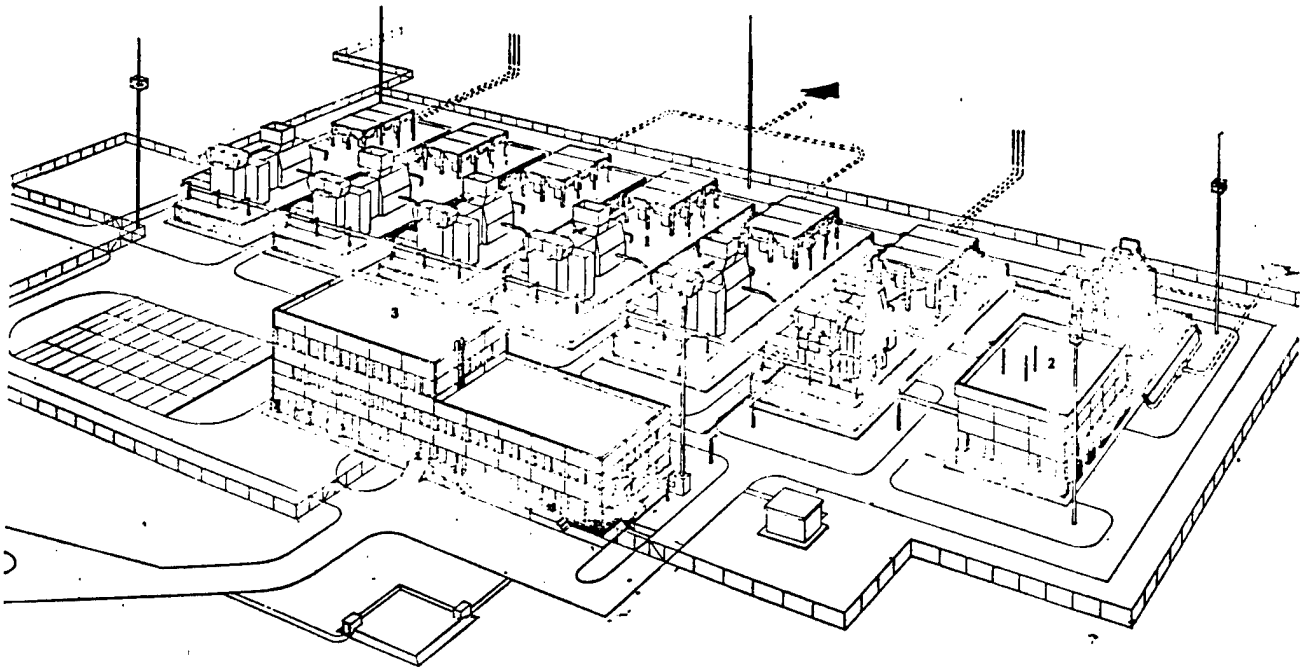


Figure 1. Diagram of a Modular CS Consisting of Mobile Supermodules:

1. gas-compressor units [GCU's]
2. gas-purification [GP] and auxiliary process equipment [APE] supermodules
3. production-administration supermodule [PAS]

The supermodules are located in two zones on the CS site: the main production zone and the service-production complex.

The design solutions for the on-site roads, sites, walkways, water drainage, vertical layout and site enclosures for the supermodular CS are similar to those for a traditional CS.

The CS utility lines for the supermodules are laid above- or underground, depending on the type of line and the engineering-geological conditions at the station.

The thermal lines on the CS site are above ground on metal supports off of the supermodule support structures.

The CS water lines are located alongside the thermal lines, with common insulation. The electrical and communications cables are in trenches, while the cables for automatic equipment are in cable channels.

Table 1 gives the technico-economic indicators for the general layouts of supermodular and traditional CS's.

Table 1.

(1) Показатели	(2) КС в традиционном исполнении	(3) КС из суперблоков
(4) Площадь в ограде, га	5,48	2,99
(5) Площадь застройки, м²	22 030	12 280
(6) Коэффициент застройки	40,2	41
(7) Покрытие дорог, площадок, тротуаров, м²	9300	6100
(8) Коэффициент использования территории	57,2	61,5

Key:

1. Indicator
2. Traditional CS
3. Supermodular CS
4. Enclosed area, ha
5. Building area, m^2
6. Building coefficient
7. Paving of roads, sites, walkways, m^2
8. Area-utilization coefficient

The process circuit of the GPA-Ts-16 gas-compressor unit includes gas compression and cooling. In addition, this circuit contains the auxiliary systems necessary for normal operation of the main process equipment: fuel and startup gas purification; lubrication, protection regulation and control of the GCU; monitoring and measurement instruments and automatic control for the GCU etc.

The distinguishing features of the process circuit of the GPA-Ts-16 supermodule are:

capability of using the GCU on the startup loop, the gas in which constantly passes through the AVO [air cooler]. This makes it possible to maintain a low gas temperature in the loop and provide for long-time operation of the unit on the startup loop;

full autonomy of the supermodule's oil supply by locating the oil storage and drain tanks directly in the floating base.

The floating base of the supermodule is a steel, flat-bottomed, water-proof housing with dimensions of 18 x 60 x 1.8 m. The housing design makes the supermodule strong and unsinkable, and also allows it to be transported on an air cushion or pneumatic rollers over dry land.

Because of the engineering-geological conditions of the CS site and the small ($p \leqslant 10$ kPa) specific pressure of the supermodule bottom on the ground, no foundations are provided for the supermodules: they are installed on packed sand. A 10-cm-thick layer of the sand is treated with petroleum products to prevent corrosion to the supermodule bottom.

Around the perimeter of the supermodules are pre-cast reinforced-concrete road slabs to ensure the precise construction elevations, as well as to locate the supermodules in their proper positions. The protruding part of the slabs serves as a blind area.

The bottom of the floating base, reinforced with metal beams, serves as the GCU foundation.

Reliable operation is ensured by: 1) the large weight of the supermodule, 2) the design of the floating-base bottom, which takes into account the distribution of dynamic loads and 3) proper centering of the supermodule weight.

The metal structures of the supermodules are corrosion-proofed with paints or lacquers.

Heat supply for the modular CS is provided by UT-9.2 waste heat exchangers mounted on the outlet ducts of the GPA-Ts-16 units. The GCU's are factory-equipped with these heat exchangers.

The supermodules arrive at the CS construction site ready for operation, with equipment, process piping and all utility lines installed. After the supermodules are installed, the external utility connections are made.

The supermodular CS design ensures high-quality construction-installation work, while completely eliminating foundation construction. This improves the degree of industrialization and makes possible faster CS startup.

12595
CSO: 1861/260

SPREADING BUILDING

Moscow IZOBRETATEL I RATSIONALIZATOR in Russian No 12, Dec 85 p 19

[Article by Engineer A. Vikulina: "Spreading Building: The Basic Elements of the Building, Columns and Ceilings, Are Spread on the Ground and When Connected Together, They Are Fixed at Once in the Design Position"]

[Text] Even in the construction of a single-story home, the rafters are made on the ground so the unworked lumber is not lifted into place. It is inconvenient to work up off the ground. And the higher the house, the greater the difficulties and inconvenience.

For a long time, builders have tried to do as much work as possible on the ground. Panels, blocks, toilet facilities, prefabricated stairways, and other reinforcements of the structure are the result of precisely this effort. And in Yerevan it has gone even farther. Here the design position of a column is fixed, and the ceiling is assembled on the ground and raised; the next higher floor is manufactured, raised, and suspended from the columns; then the next floor, and so forth ("Inclined Floors," IZOBRETATEL I RATSIONALIZATOR, No 7, 1983, p 24). However, everywhere (including Yerevan) the columns themselves are placed as before, each individually. And the ceiling over them must be fastened as previously, from above.

But what if everything is raised simultaneously: the columns, trusses, ceiling, roof? The idea is not new. Twelve years ago the authors of invention No 387 109 thought of laying the columns out on the ground and securing their bases to the foundations with hinges. The ceiling components are also secured with hinges to the column heads and attached to the roof; then, all the columns are raised simultaneously to a vertical position.

In principle, the procedure is feasible; however, a number of difficulties arise. In order to simultaneously raise columns lying on the ground to a vertical position, it would be necessary to erect a complicated rigging and to literally enmesh each column with rope, diverting blocks, and tackle blocks. At the same time, synchronizing the lifting would be extremely difficult. It is obvious why the procedure is not practically applicable. In any case, it is not mentioned in the special literature of recent years.

However, good ideas are tenacious. And the inventors M.A. Korshunov, I.F. Balenko, and V.K. Fedorenko (Poltava Civil Engineering Institute) couldn't find any peace until they conceived a way to simultaneously raise an entire structure, pulling the first series of columns literally by a thread (Certificate No 1 126 678). The first series of columns is fastened by their

bases not on the foundations intended for them but rather to trolleys, but also using hinges. Before the lifting begins, the trolleys are arranged so that the bases of the first series of columns are as close to the bases of the latter as possible. The rest is clear from the Figure.

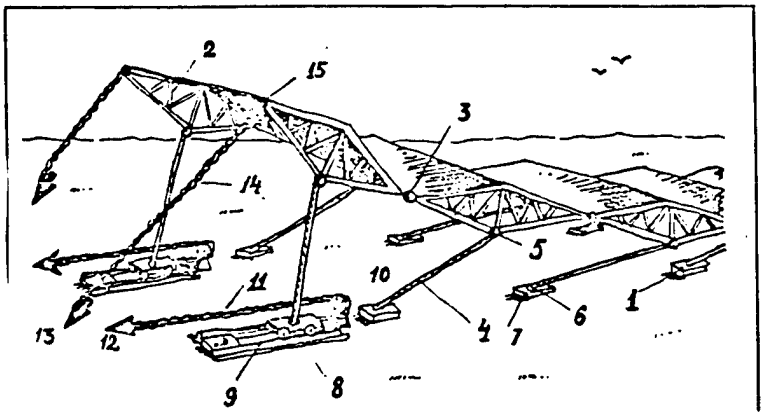


Figure. The elements, for example the ceiling trusses 2, are spread out at the construction site with the prepared foundations 1 under the building, and they are connected by hinges 3. Next, the columns 4 are spread out and are connected by hinges 5 with the ceiling elements and by hinges 6 with the supports 7 on the foundations 1; and the columns in the series that is first from the point of view of the raising are connected by hinges to trolleys 8, which are arranged along guides 9. Then, the pull ropes 11 are thrown through the diverting blocks 10 and fastened to the trolleys 8. The winch 12 is turned on and the hoisting begins. The ropes 11, which are taken up on the winch drums, pull the trolleys toward the foundations of the second series. Immediately thereafter, the ropes 14, which are connected at points 15 with the ceiling elements 2, are taken up onto the winch drums 13. Rotating around hinges 5 and 6 and relative to one another, the columns of the first series gradually assume the position shown in the Figure and become similar to tower cranes. From that moment, they act like cranes. At the same time, the winches 13 take up the ropes 14 onto their drums, and the winches 12 set the ropes 11 into flight. Now the columns of the first series creep to the left, approaching their foundations 1 and gradually assuming a vertical position; following after them, the remaining series of columns turn around the hinges 6 and are raised to the design position. All that is left is to fasten the building by stays 16 and tension members 17.

Such a procedure for erecting the frame and ceiling of buildings is very effective inasmuch as tower cranes, assembly cradles, and scaffolds are not necessary and all the basic operations are done on the ground. The columns themselves are used as auxiliary assembly booms for turning the columns around the hinges and raising them to the vertical.

The authors believe that this procedure will find wide use, especially in rural construction when erecting storehouses, livestock facilities, and other single-story buildings.

12794
CSO: 1861/107

INDUSTRIAL TECHNOLOGY

PROGRESS IN DEVELOPMENT OF SUPERCONDUCTIVE TURBOGENERATORS DESCRIBED

Moscow ZNANIYE-SILA in Russian No 2, Feb 86 pp 2-3

[Article by I.A. Glebov, academician, chairman of the Presidium of the Leningrad Scientific Center, director of the USSR Academy of Sciences' All-Union Research Institute for Electrical Machine-Building; under the rubric "Toward the 27th CPSU Congress:" "Scientific-Technical Progress: Ways To Accelerate It;" paragraphs 1 and 2 are a quote from the plan for "Basic Directions in the Economic and Social Development of the USSR for 1986-1990 and for the Period up to 1990;" paragraph 3, an editor's note; text in slantlines printed boldface]

[Text] /"To ensure all-out acceleration of scientific-technical progress, universal application of its results in production, management, services, and daily life./

/"To push the national economy to the frontiers of science, technology, and engineering. To make more efficient use of uniquely socialist forms and methods of achieving scientific-technical progress. To strengthen integration of science and production, improve organization, and reduce the time needed to develop and assimilate scientific discoveries, technical innovations, and inventions into the national economy."/

/We are continuing a series of articles begun in the previous issue, in which leading Soviet scientists answer questions from the editor and describe achievements in individual fields of science and future plans closely related with the task of accelerating scientific-technical progress./

[Questions] 1. In your opinion, what are the most significant achievements in your field in the last several years?

2. What is the possible contribution of your field to solving the urgent problems of accelerating scientific-technical progress?

3. What trends in research, development, ideas, and designs do you think are the most promising?

/"Essentially New Engineering Approaches"/

[Answer] Let me immediately answer the editor's three questions. My colleagues and I believe that the future of electrical machine-building lies in the creation of essentially new power machinery using superconductivity, cryogenic turbogenerators. The world's first prototype of such a turbogenerator has already been field tested. It is supposed to be connected to Leningrad's power supply network to reduce power losses and to improve the quality of electricity.

Well-founded predictions for development of power engineering until the end of this century state that a significant increase in turbogenerator capacity will be required. The limit capacities of bipolar machines are still no more than 2500 MW. Further progress is hindered by the insufficient mechanical strength in steel rotors, problems eliminating machinery vibration, and, finally, the limitations of rail transport.

Therefore, it was necessary to find basically new engineering approaches. The idea of using superconductivity suggested itself. The fact is that the capacity of superconductor turbogenerators may be two to three times that of ordinary equipment of the same size. Such a rapid increase in productivity rarely occurs in technology.

There have been more than a few roadblocks on the way to actual, practical application of superconductivity. Alloys of niobium with titanium and tin were produced only as of the 60's. Their unique feature is that they become ideal conductors in liquid helium and maintain this conductivity in the powerful magnetic field which develops in a working generator.

A large group of Leningrad scientists did basic research in thermodynamics, thermal physics, mechanics, physical metallurgy, and other sciences. Without them, success would have been impossible. Of course, they approached the construction of the machinery itself in a new way. A rotor with the finest filaments made of ultrapure niobium-titanium alloy was submerged in liquid helium at 4.5 K (-269°C), which is quite close to absolute zero. Rotor speed was 3000 rpm. And there were no losses due to heating in the rotor winding.

Externally, the turbogenerator differs little from its counterparts. It is only a little smaller, and along the slip rings there is a slightly frost-covered device for introducing liquid helium. The helium itself is contained in silvered tanks lined up in a row. A high-power compressor liquefies the helium, converting it into the ideal coolant.

The machinery's efficiency rose, though its weight was nearly halved. The rotor became five times lighter. This paradox is a unique phenomenon in technology.

I must add that helium consumption is only 3 grams per second. Losses of this extremely expensive gas are negligible, since it circulates in a closed space.

The cryogenic generator has one more positive feature: A new stator winding design makes it possible to produce 110 or more kilovolts--six times the

voltage ordinarily generated by modern thermal and nuclear power plants. This means that step-up transformers become unnecessary.

The first production prototype's capacity was limited to 20,000 kV. But manufacture of a much more powerful generator--300,000 kV--has begun. It will be assembled and delivered for testing by the 27th CPSU Congress.

The All-Union Research Institute for Electrical Machine-Building has begun work on design of a 1200-MW turbogenerator with a superconductive excitation winding.

We can confidently say that the prospects for widespread use of superconducting machinery is intimately connected to progress in cryogenic technology. The desirability of using superconductor generators in the country's power supply system is determined on the one hand by their unquestionable advantages and on the other by the high operating reliability of power units with these generators.

I suggest that superconductor turbogenerators with capacities of 3, 5, and more kilovolts will be a reality in the beginning of the 21st century. And it is possible that these giants will not need helium: Superconductivity will be achieved at much higher temperatures.

Introduction of superconductor turbogenerators with high unit capacity is impossible without continued basic research. First, superconductors with higher critical parameters must be developed, and the low-temperature properties of basic construction and insulation materials must be studied in greater depth. We must solve heat exchange and thermodynamics problems in the new machinery. In a word, we must do serious research in various fields of science and practice.

I have to say that use of superconductivity in power engineering is not limited to turbogenerators. There already exist plans for superconducting inductance energy storage to create reserve capacities suitable for nation-wide power supply systems.

We must develop cryogenic AC and DC power transmission lines. Their advantage is that there is virtually no energy loss in ultra-pure niobium cables cooled to helium temperatures.

It is anticipated that motors with superconducting excitation windings will be widely used in ship electric motor systems and in mill drives. The first Soviet-built 100- and 200-kV motors have been created by the USSR Academy of Sciences' Physico-Technical Institute for Low Temperatures. Cryogenic magnetic systems can be used to create magnetically suspended high-speed transport and in many other branches of technology and science.

12809/13046
CSO: 1861/293

UDC 621:65.011.56;621.791.945.55

AUTOMATION OF PREPARATION OF PLASMA CUTTING PROGRAMS

Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 2, Feb 86 pp 19-20

[Article by engineer V. V. Solomyanikova]

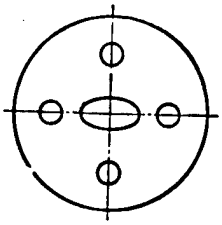
[Text] The need to automate preparation of control programs for plasma cutting machines has increased recently.

The TEKhTRAN system, which permits one to automate preparation of control programs for plasma cutting of blanks using a computer, has given a good account of itself under small-series production conditions.

Until recently, the control programs were developed manually and by using the Lana computer-aided programming system (SAP). The Lana computer-aided programming system did not take into account all methods of assigning a point, straight line and curve and was used to compile control programs for individual parts. Introduction of the TEKhTRAN system at the enterprise made it possible to produce a finished papertape on the computer and to program the entire cutting flow chart.

Taking the multiply repeating contours of the parts to be cut out into account, a classifier was developed in which the geometric parameters of the parts are assigned variable values.

A program (macroinstruction) was worked out for each conditional part with regard to the requirements of OST [Sector Standard] 9526-77.



Model of Part

A code, consisting of a letter notation and ordinal number of the macroinstruction, was assigned to each macroinstruction. The letters characterize the configuration of the outer and inner contours. They are all reduced to a table for the programmer technician to find the necessary macroinstruction rapidly.

Several macroinstructions can be used to cut out a single complex part. Thus, three macorinstructions can be used to cut out a part (see figure): Otv 7--for cutting out an ellipse; Otv 11--for cutting out holes (with any given number of holes); and KA1--for cutting out the outer disk.

The same macroinstructions can be used to cut out parts of similar configurations.

Any part can be located in the cutting flow chart in six typical positions, without regard to rotation by an angle that is not a multiple of 90°.

Moreover, there is a minimum of at least one macroinstruction, conducive to each set of positions, for each part. This combination of measures permits one to arrange the parts in any position, with any direction of passing around the contour and the part to be cut out will be cut from the sheet by the last cut.

There is always the capability of selecting the macroinstruction so that the plasmatron move toward the operator or aside rather than from them. This measure protects the plasma machine operator from sparks, which are especially discernible if the metal is very thick.

The macroinstruction makes it possible to burn through from the edge of the sheet and this is very important if the thickness of the sheet is more than 40 mm. The use of macroinstructions considerably increases labor productivity when working out the control programs and improves the quality of the parts to be cut out.

Introduction of the macroinstruction system made it possible to increase the labor productivity of developers and to reduce the laboriousness of working out control programs by 25-30 percent.

6521
CSO: 1861/222

UDC 658.286

SELF-CONTROLLED CONVEYOR SYSTEM

Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 2, Feb 86 pp 16-18

[Article by Candidate of Technical Sciences A. Yu. Kerpauskas]

[Excerpts] A modular integrated coordinate conveyor system with logic-program self-control of movable objects in a large modern shop with any number of spans (see figure) has been designed and developed at the Kaunass Polytechnical Institute imeni Antanas Snechkus. Freight from an automated overhead inter-operations warehouse is transported through the shop on one track and is removed from the shop along another track by large-capacity freight carriers. The chain elevator of the freight carrier automatically distributes the freight to the production machines, for example, to the looms. Both tracks are arranged parallel to each other in opposite sections of the shop and consist of a monorail, fixed catwalks and auxiliary (movable) span bridges. There are one auxiliary bridge and a main bridge--common for both tracks, in each span of track. The main and auxiliary bridges move along crane tracks, can change position and are fastened by a special device. The auxiliary bridge for moving mainly along the given track can be moved away from this track a short distance and the auxiliary bridge is returned to the track and fastened upon dispatch of the main bridge and the bridges are then automatically disconnected. The main bridge moves the freight carrier along one track to the shop span and then, after distributing the load to the given complex of machines, transports it further and transfers it to another track, while it itself returns to the former track. Thus, the freight carrier moves along one track--to the left--and along another track--to the right--in this transport system and the freight carrier is transported by the main bridge from one track to another in the given span.

The movements of the freight carrier and of the main bridge are independent of each other and their tracks are perpendicular and intersect. The freight carrier cannot be on the auxiliary bridge when the main bridge changes places with the auxiliary bridge. Therefore, logic-program self-control has been developed to control the moving freight carrier and main bridge approaching it. Logic switching units (microprocessors) are used for program self-control of the freight carrier and main bridge when transporting freight carriers to the shop along one track and from the shop along another track. The microprocessors cannot be used according to program in the shop span during distribution of

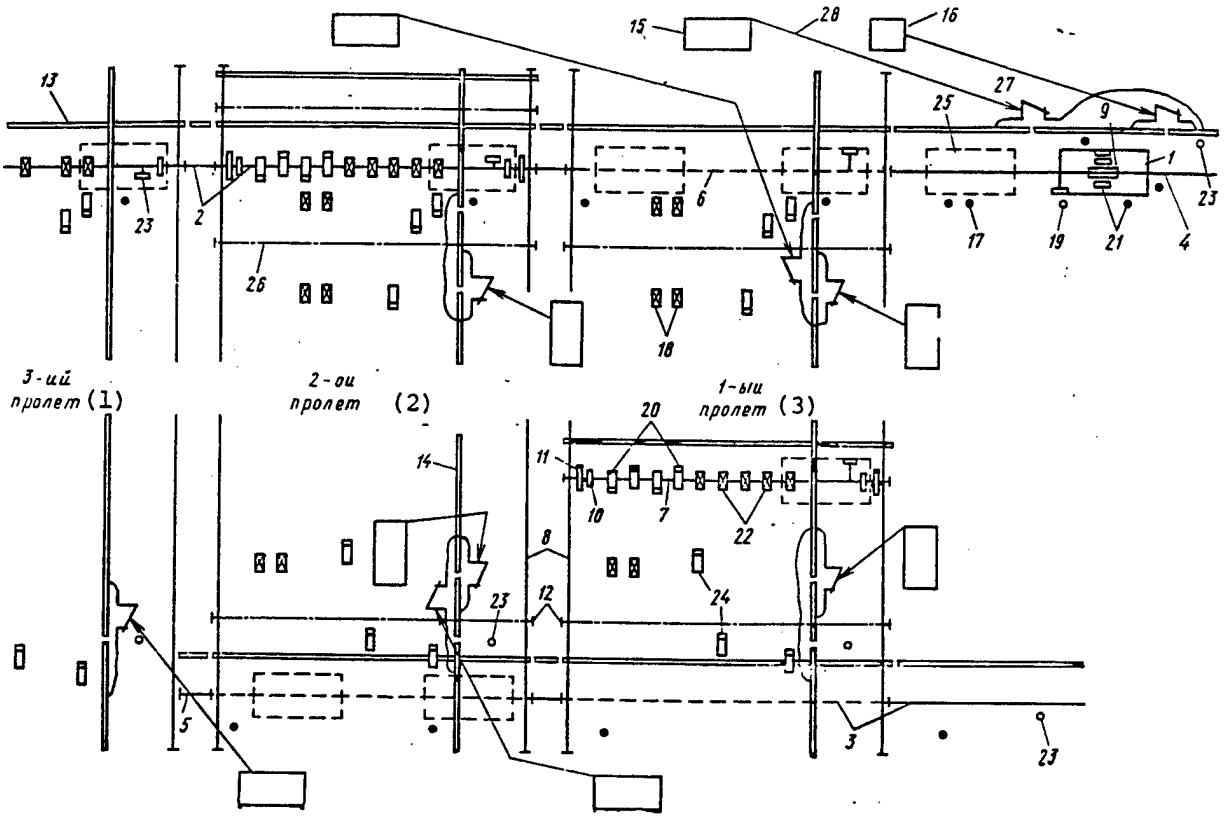


Figure 1. Diagram of Self-Controlling Conveyor: 1--freight carrier; 2, 3--first and second tracks; 4--monorail; 5--fixed catwalk; 6, 7--auxiliary and main bridges; 8--subcrane track; 9, 10--fastening devices of freight carrier and of main bridge; 11--device for changing position of bridges; 12--devices for closing-opening joints; 13, 14--sectioned trolleys for control of freight carrier and main bridge; 15--logic switching unit; 16--switching unit for power supply of trolley section of freight carrier; 17, 18--position sensors for freight carrier and main bridge; 19, 20--position sensor address units of freight carrier and of main bridge; 21, 22--sensors of change of motion of freight carrier and of main bridge; 23, 24--sensor address units for change of motion of freight carrier and of main bridge; 25, 26--standby stops of freight carriers and of main bridge; 27--controlled power supply contact of trolley section to be switched; 28--output signal

KEY:

1. Third span
2. Second span
3. First span

freight to the machine tools. Accordingly, microprocessors are used to control some movable objects, operating simultaneously in the system or in a part of it and not connected to each other. The paths of motion of the objects intersect in this case.

Few means and methods of control are used to form the logic-program self-control system perpendicular to moving objects, besides many newly developed mechanical automation devices. The drive of each movable object is temporarily converted to automatic self-control in the track zone to control the movement of the freight carrier and of the main bridge. Moreover, sectional control trolleys with switching section power supply are used. Position sensors for movable objects, located on the path of their motion, are used to switch the power supply of the trolley sections and the signals coming from the sensors are processed by using microprocessors.

Devices that permit movable vehicles to be fastened automatically, that permit the main and auxiliary bridge to exchange places in the track, that open and close the joints of movable tracks and so on are used in this system. Moreover, large-capacity automatic freight carriers, which can transport freight in large quantities and can distribute it automatically without reloading to the production machines, for example, to looms located in the shop, are also used in this conveyor system. Large production complexes with new progressive technology have a large production and economic effect; therefore, these complexes should be designed and developed.

Computer hardware is used to process the signals. Due to the fact that the transport system is subjected to the effects of impacts, dust, moisture and other harmful phenomena, while high speed is not required, as in computers, since the number of operations is small, their reliability is estimated primarily under production conditions when selecting the necessary logic self-control devices.

A great deal of attention is also devoted to selection of sensors operating under severe conditions. The sensors for determining the position of movable objects and for changing the mode of their movement and also the trolley control sections form the receiving system.

The logic freight-carrier self-control system, designed for compilation of them one after the other and for maneuvering on the track in front of the arrival of the freight carrier to the first shop span, the logic self-control system for movable objects in zones of intersection of the tracks and the program self-control system for movable objects during distribution of freight to production machines form the integrated conveyor system. Moreover, this entire system is interconnected to the self-control systems for movable objects of an overhead warehouse.

When executing the rigid control algorithm, the movable objects make specific motions and when executing the logic self-control algorithm, the movable objects intercoordinate their movements according to established situationss. Program control of movable objects is used in the simplest cases, while logic control is used in more complicated cases.

One freight carrier must wait until it completes it operations and is returned upon being sent to a transport system with program control and only then can it send the next freight carrier. This conveyor system for a large modern plant is insufficiently productive, i.e., it is unsuitable. Freight carriers are sent directly one after the other in a conveyor system with logic self-control of movable objects, they complete logical movements and are returned after executing the program. Therefore, the performance and throughput of the conveyor system are increased when using logic self-control of movable objects. Technical progress inevitably results in design and development of integrated logic self-control systems for movable objects that more fully automate production.

A coordinate conveyor system with logic self-control of independently moving objects can be used, for example, in a large modern textile shop, in which there are located up to 3,000 looms, for transport of all types of freight, including equipment of this shop. This transport helps to increase considerably the zone serviced by robots and manipulators and also their utilization factor.

6521
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TENSOMETRIC VOLUMETRIC-WEIGHT LOW-LOAD PROPORTIONING DEVICE FOR BULK MATERIAL

Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 2, Feb 86 pp 24-26

[Article by engineer G. A. Bystrova, engineer T. S. Kuznetsova, engineer V. G. Urakov, engineer Yu. N. Fufayev, Candidate of Technical Sciences V. D. Galchenko, Candidate of Technical Sciences Yu. L. Polunov and Candidate of Technical Sciences R. I. Yanbulatov]

[Text] One of the timely problems for some sectors of industry is that of design and development of proportioning devices for bulk materials that provide proportions of tens and hundreds of grams in mass with accuracy of 0.2-0.3 percent and with performance of 300-600 proportions/hr. The indicated specifications should be maintained with bulk density of the material in the range of ±20 percent with respect to its rated value. The volumetric method of proportioning does not provide the required accuracy under these conditions and weight proportioning is characterized by comparatively low performance. Therefore, an iterative algorithm for volumetric-weight proportioning was selected to develop the proportioning device.

Let us consider a multichamber feed unit filled with bulk material from a general delivery hopper. Without losing generality of the arguments, let us assume that the number of chambers is equal to three and their volumes are selected from the relation

$$V_i = 10^{2-i}/\rho_{max}, \quad i = 1, 2, 3 \ldots, \tag{1}$$

where ρ_{max} is the maximum possible bulk density of the material.

A code that determines the number of unloadings of the material from each chamber, required to assemble a proportion of mass $M_Д$, is established by the proportioning device controller (UU). Since the actual value of the bulk density $\rho_Ф \leq \rho_{max}$, the received mass of material M_1 will be less than the required mass of the portion after the chambers are emptied. The value of "underportion" ($\Delta_1 = M_Д - M_1$) is calculated in the controller and the code of the number of unloadings of the material is automatically established on the second step of the algorithm. The received mass ($M_1 + M_2$) is again measured, $\Delta_2 = M_Д - (M_1 + M_2)$ is determined and so on. The proportioning process is completed when the following condition is fulfilled

$$\Delta_i = M_д - \sum_{i=1}^{k} M_i \leqslant \Delta_{доп},$$

where $\Delta_{доп}$ is the given tolerance per portion.

The necessary number of steps (iterations) is determined from the expression

$$k = [\log \varepsilon (\Delta_{доп}/M_д)],$$

where $\varepsilon = \Delta\rho_{max}/\rho_{max}$; $\Delta\rho_{max} = \rho_{max} - \rho_{min}$ and ρ_{min} is the minimum possible bulk density.

Let us determine the number of feed chambers at given values of $M_Д$ and ρ_{min} and the volumes of the smallest chamber V_1, which determines the accuracy of proportioning.

Let us select the maximum possible number of multiple unloadings and the ratios of the closest volumes of the chambers as identical:

$$V_2/V_1 = V_3/V_2 = \ldots = V_R/V_{R-1} = n,$$

where R is the total number of chambers.

Then

$$(\rho_{min} V_1 n + \rho_{max} V_2 n + \ldots + \rho_{min} V_R n) \geqslant M_д$$

or

$$\rho_{min} V_1 (n + n^2 + \ldots + n^R) \geqslant M_д. \qquad (2)$$

Since the expression in parentheses in (2) is a geometric progression, the sum of the terms of which is equal to

$$S_R = n (R^R - 1)/(n - 1), \qquad (3)$$

we find, by substituting (3) into (2),

$$[(n-1)/n] (M_д/\rho_{min} V_1) \leqslant n^R - 1,$$

hence,

$$R \geqslant \log_n [(M_д/\rho_{min} V_1)((n-1)/n) + 1].$$

If the achieved proportioning does not satisfy the given requirements, a modified version of the algorithm can be used, according to which the first portion is selected as described above and the following actions are performed to find the second, third and additional portions.

A code corresponding to the total number of unloadings of material from each chamber during assembly of the first portion is stored in the controller. The second portion is selected purely by the volumetric method according to this code (without intermediate measurements of the mass M_i and without determinations of Δ_i). The mass is weighed and its conformity to the given tolerance field is checked. If it is greater than the upper bound of tolerance, the portion is rejected and a new cycle of the iterative algorithm is begun. If the mass of the portion is less than the lower bound of the tolerance, the material is poured from the necesssary chambers and the code, corrected according to this filling, is stored in the controller. The code is also corrected if the mass of the portion is in the range of the tolerance, but differs from its rated value. The third portion is initially selected in the latter two cases by the volumetric method, it is then weighed, checked and so on.

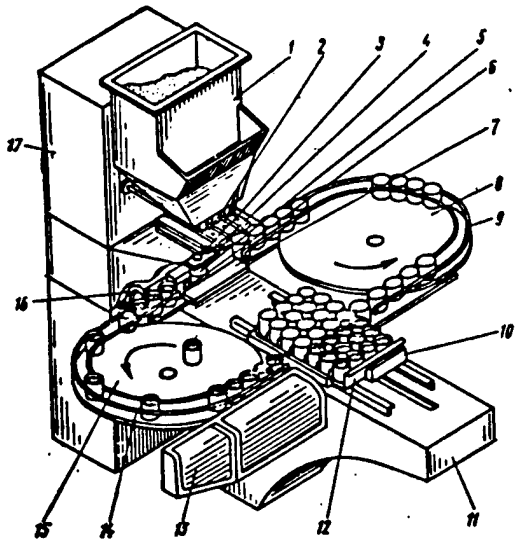

Figure 1. Diagram of Volumetric-Weight Proportioning Device: 1--hopper; 2--slide valves; 3--intermediate container; 4--gate; 5--cups; 6--load receptacle (GU); 7--individual cup delivery mechanism; 8, 15--rotating disks; 9, 14--guides; 10--trays; 11--transport-makeup device; 12--plateholder; 13--mechanism for group delivery of cups; 16--mechanism for removal of rejects; 17--proportioning unit (DU)

The developed proportioning unit (Figure 1) has a modular design and consists of the following units: proportioning (DU), conveyor-makeup (TKU), load-receiving unit (GU), which includes a force-transmitting assembly (SPU) and

tensometric force sensor (TDS), digital measuring-control unit (TsIUU) and control console (the latter two units are not shown in Figure 1).

The conveyor-makeup unit is used to deliver the package (cups) to the portioning position (the receiving surface of the load-receiving unit) and for automatic setting of the filled cuts into a cartridge, which is a tray separated by baffles into six channels. The conveyor-makeup unit is made in the form of two disks 8 and 15, which rotate in the same direction and which are equipped with guides 9 and 14, individual and group cup delivery mechanisms 7 and 13, respectively, a reject removal mechanism 16 and also a movable plate 10 having a step drive.

The proportioning unit (Figure 2) includes a delivery hopper filled with material upon a signal of a level sensor (not shown in the figure), a feed unit, made in the form of three slide valves, in each of which there are two each chambers of identical volume (the volumes of the chambers of adjacent slide valves are selected from relation (1)), an intermediate container and a gate. The slide valves and gate are supplied with individual pneumatic drives to which control signals are fed from the digital measuring-control unit.

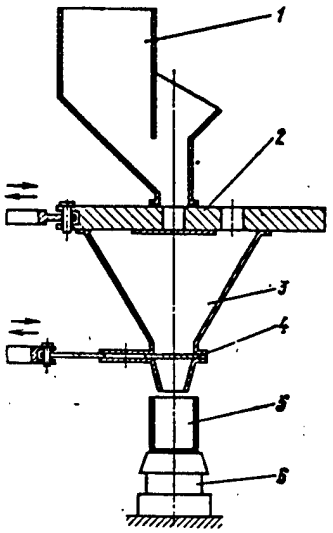

Figure 2. Diagram of Proportioning Unit: 1--hopper; 2--slide valve; 3--intermediate container; 4--gate; 5--cup; 6--load-receiving (GU)

The proportioning unit operates in the following manner (see Figure 1). The holder 11 with empty cups 5 is installed on the tray 10 by a manipulator (not shown in Figure 1). Upon a signal from the control console, the tray is moved to the initial position, at which the extreme right channel of the holder coincides with the line of motion of the cups in the guide 9. The group cup delivery mechanism 13 pushes the cups of the first channel onto the rotating disk 8, which delivers them to the individual feed mechanism 7. The latter, upon instructions from the digital measuring-control unit, sequentially sets each cup on the receiving surface of the load-receiving unit. After the cup is

installed, the "zeroing" operation of the mass-measuring system, consisting of the force-transmitting assembly, tensometric force sensor and digital measuring-control unit, is executed. This permits one to use cups of different mass and eliminates the additive measurement error.

The modified iterative proportioning algorithm, described above, is executed in the proportioning unit. An intermediate container 3 is introduced into the proportioning unit to increase the performance of the unit and two identical chambers are made in each of the delivery slide valves, so that the second chamber is emptied into container 3 or cup 5 when the first chamber is being filled with material from the delivery hopper 1. When the first portion is selected, the material is delivered from the chambers directly to the container through an open gate 4. The portion is then selected and its mass is checked, the gate is closed, mechanism 7 pushes the cup with the material to guide 14 and an empty cup is installed to the proportioning position. The material is unloaded from the chambers to container 3 upon instructions from the digital measuring-control unit during execution of these transport operations and "zeroing" of the mass-measuring system for the second cup. The gate is then opened and the material falls into cup 5, after which the next steps of the algorithm are executed. If filling is necessary, it is achieved through the open gate directly into the cup. If the mass of the portion does not correspond to the given tolerance field, the cup is pushed by mechanism 16 to the inner surface of disk 15 upon instruction from the digital measuring-control unit. The third, fourth and other portions are formulated in similar fashion.

Cups with suitable portions are transported by disk 5 to mechanism 13. A total of four filled cups will then be accumulated in its effective zone, they are transported by the mechanism to the first channel of the tray, the latter is moved one step to the right, a group of four empty cups from the second channel is delivered to the disk 8 and so on. After the tray is filled with full cups, it is moved by a maniulator to a conveyor that delivers the tray to the production equipment.

An SA-P sensor, produced by the Kiev PO [production association] Veda, is used as the tensometric force sensor in the proportioning unit. The output signals are converted to digital code in the digital measuring-control unit by the double integration method, which makes it possible to achieve high resolution of measurement (1:50,000) and good noise protection of the mass-measuring system.

Specifications of Proportioning Unit

Range of proportioning, g	20-300
Reduced error of proportioning in range of 20-100, 100-200 and 200-300 g, percent, nor more than ..	0.3
Performance of proportioning unit, portions/hr ...	300-600
Length of tensometric force sensor-digital measuring-control unit communication line, m, not more than	150

There is a built-in vacuum cleaner to clean the proportioning unit of dust.

The proportioning unit has been introduced at one of the enterprises of the sector with saving of 16,000 rubles.

6521
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WHICH BelAZ [DUMP TRUCK] TO BUY

Minsk NARODNOYE KHOZYAYSTVO BELORUSSII in Russian No 2, Feb 86 pp 33-34

[Article by Li Son So, graduate student, Economics Institute of the Belorussian SSR Academy of Sciences]

[Text] We are usually not stingy in handing out praise when talking about Zhodino dump trucks. In doing so, we generally cite their excellent performance. But even the giant among giants--the 300-ton truck which workers in Zhodino are working on--is above all, a commercial product. This means it will be sold and purchased. And the mechanism behind how the price of this type of equipment is determined is by far not the least important of the factors which determine how efficiently it is used.

An analysis of ferrous and nonferrous ore and coal open-pit mining operations that process construction and other types of material demonstrated that growth in the volume of production may be achieved by increasing either the number of transportation units or the load-carrying capacity of open-pit mining dump trucks such as the 75-, 110-, and 180-ton BelAZ trucks. The second alternative would be the most productive. Taking into account the manpower shortage in the north and in the almost inaccessible mountainous regions in which the BelAZ trucks are used, the second method is without a doubt the better one.

Statistics bear this out as well: Other conditions being equal, the average annual productivity of a 40-ton BelAZ-548 A dump truck is 2.2 times less than that of the 75-ton BelAZ-549 dump truck, 4.5 times less that of a 110-ton BelAz, and 5.6 times less than a 180-ton BelAZ. But here again we are talking about technical indices. What about the economic indices?

Accelerating scientific and technological progress requires decreasing expenditures per unit of the net effect of new production. To this end, the wholesale prices for new and improved products should be determined based on well-founded costs of production, taking into account the technical and economic parameters as well as how efficiently they are put to use. When it comes to actual management, however, the economic interests of enterprises which develop new equipment frequently do not coincide with those of the state as a whole.

A manufacturing enterprise which is switching over to a new line of goods generally finds itself in a no-win situation: Output volume (and therefore profit margin) decreases, which in turn has a considerable impact on the funds available for economic incentive. This is why the manufacturer tries to jack up the outlays needed for manufacturing new products while determining the cost of production already in the planning stage. This makes it possible to lower production cost quite easily at a later point in time. This subsequently slows the rate at which new equipment is introduced and retards scientific and technological progress.

Currently, operating BelAZ open-pit mining dump trucks becomes more expensive as their load-carrying capacity increases. An analysis of data garnered from 223 enterprises under the jurisdiction of ministries of ferrous and nonferrous metallurgy, the mining industry, construction materials, and others showed that the average production cost of transporting 1 ton over a 1 kilometer distance using BelAZ trucks with a load-carrying capacity of 27, 40, 75, 110, and 180 tons was 10.1, 11.5, 13.2, 11.0, and 15.0 kopeks, respectively. The jump in cost for every unit of work accomplished is mainly attributable to the high wholesale prices on new truck models. The prices for 75- and 180-ton trucks were 30.7 percent times higher than the level at which their operation would be efficient for consumers and 12.6 percent higher in terms of the national economy as a whole.

The high wholesale price for a BelAZ truck can be explained by the cost of its component parts. The cost of tires, the engine, and electrical equipment (which are supplied by cooperatives) makes up from 60 to 67 percent of the total cost of a BelAZ dump truck. Hence, just buying these three parts consumes over two-thirds of all expenses. All told, the item "Finished parts and purchased semifinished components" makes up over 70 percent of the cost for producing open-pit mining dump trucks.

It so happens that the subcontractor is in no way responsible for the high price of the article as a whole, since the goods manufactured by it do not represent the final product. Having provided himself with a "safety factor," he takes his own sweet time fulfilling the plan for reducing the production costs, totally disregarding the interests of the principal contractor. Considering the fact that 40 to 60 subcontractors usually participate in the process of manufacturing a truck, the principal contractor can do absolutely nothing on his part to lower the cost of production to a standard level, no matter how rationally he sets up the production process.

In order to resolve this problem, it is necessary to establish centralized control over reducing the cost of production. One way would be to standardize the costs for producing the primary units and assemblies.

Another factor involved in the high cost of operating open-pit dump trucks has to do with the idle time which is associated with their incomplete use. While the amount of debris transported by 75-ton capacity dump trucks has risen by a factor of 2.4 since 1980, the recommendation to serially produce EKG-20 excavators having a bucket capacity of 20 cubic meters did not come until 1984. This is why low-power excavators having a bucket capacity of 5 or 8 cubic meters predominate at open-pit mines.

The improvement and modernization of dump trucks, the development of industrial production bases at motor pools, the renovation of highways, as well as the improvement of the way transportation is organized, must all go hand in hand with accelerating the development of new improved, productive, and efficient trucks. As our experience in operating these trucks has shown, it is most important to increase the service life of engines, the mean-time-between-failures, the reliability of the hydro-pneumatic suspension, and the reduction gear for the engine-wheel system as well as the strength of the frame and chassis.

Work is currently underway at the Byelorussian Plant to lay the foundation for developing 230- to 280-ton capacity open-pit mine dump trucks. These giants will be put to work in the upper tiers of open-pit mines for transporting the stripped rock which will be cleared by the power shovels of EKG-30 and EKG-40 excavators. Optimal transportation distances can here reach 5 to 6 km due to the remoteness of the dumps. Primarily 110- to 120-ton dump trucks will be used at the lower levels of surface mines, where the area is limited, the truck routes difficult and transportation distances short (1.5 to 2 km). One hundred fifty- to 180-ton models will be employed here as well, but much less frequently.

Developing new trucks of exceptionally high capacity will therefore continue to be a very important direction in truck manufacturing in the future. In light of the trend towards the stabilization of expenditures for transportation and roads, however, attention must be focused on making the "purchase" and operation of these trucks beneficial even now.

/13046
CSO: 1861/281

BRIEFS

HELP FOR FOUNDRYMEN--A set of equipment for automating pressure die casting machinery was developed by specialists in the design office for casting equipment at the Pinsk Production Association of Forging-Pressing and Automatic Casting Lines. The set consists of a device which monitors the draw of the casting, a manipulator for moving this device, manipulators for lubricating and pouring, an electronic control unit, and a communications device with the object. Using this set eliminates the difficult and monotonous work of foundrymen, greatly increases labor productivity, and also reduces defective output and the cost of casting. [Text] [Minsk NARODNOYE KHOZYAYSTVO BELORUSSII in Russian No 2, Feb 86 p 3] /13046

MACHINE TOOL FOR BENDING TUBES--The Minsk Motorcycle Plant developed and assimilated a machine tool for bending thin-walled tubes by using a burnisher to roll the tubes. The new machine tool is reliable, easily adjusted, and convenient to service. The device has been recommended for low-scale serial production at machine building plants. [Text] [Minsk NARODNOYE KHOZYAYSTVO BELORUSSII in Russian No 2, Feb 86 p 3] /13046

INTRODUCING "MASLYANIT"--A Minsk automatic lines plant has replaced the needle bearing the feed-gear box of a vertical milling machine with slip supports--sleeves made from antifriction and self-lubricating composite "maslyanit" material. This material was developed at a materials science laboratory in the Novocherkassk Polytechnical Institute. Prolonged use of these supports confirmed their durability. "Maslyanit" may be used in place of expensive ferrous metals and their alloys in manufacturing heavily-loaded slip supports which are used at moderate speed. Using "maslyanit" eliminates the necessity for feeding a lubricant into the friction zone, which in turn greatly simplifies the design of the unit and machine in general, thereby increasing its reliability. Another advantage of "maslyanit" supports lies in their high damping capacity and smooth operation in aggressive environments. The operating temperature range is -20°C to +180°C. Individual brands of "maslyanit" have an even wider range. [Text] [Minsk NARODNOYE KHOZYAYSTVO BELORUSSII in Russian No 2, Feb 86 p 26] /13046

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UDC 681.518.54:621.9.06-529 621.906-529.004.69

NC SYSTEMS DIAGNOSIS AND MODERNIZATION DEVICES

Moscow MASHINOSTROITEL in Russian No 12, Dec 85 pp 32-33

[Article by Ye. D. Kaminskiy, candidate of engineering: "Means of Diagnosing and Modernizing NC Systems"]

[Text] Industry is serially producing servicing and diagnostic equipment and gear which ensure effective operation of a sector park of NC systems. The servicing equipment includes mobile work stations, test units, simulators, trainers, comprehensive monitoring and measuring devices, etc. The manufacture of diagnostic devices such as signature analyzers, which use micro-computer for automated localization of faults in electronic units, etc., has been organized since 1984. NC machine tools are being modernized by replacing obsolete monitoring systems with processor systems (developed by the sector). With respect to this, series production of NC gear required for equipment operation, input-output devices, simulators, diagnostic equipment and grouped SPT&A [kits of spare parts, tools and accessories] is being organized . Here are some of these developments.

SMALL-SCALE ELECTRIC SIGNAL ANALYZER SET (KMAES) is designed to measure the parameters of electric signals in NC systems and electrical equipment of metal cutting machine tools under shop conditions. It can be used to measure the parameters of electrical signals in electronic gear and general-purpose electrical equipment. It is a multi-function, digital electrical measuring device built on the principle of transforming the measured parameter into a time interval, which is then filled with counting pulses. The power consumed from a circuit of 220 (± 22) volts and 50 (± 1) Hz is 35 voltamperes.

The KMAES comes in two units: the measuring instrument (MAES) proper and a specialized power pack (IP MAES), which are connected electrically (by a unit-to-unit plug and socket) and mechanically (by easily detachable clamps). The IP MAES can be used by itself as a laboratory power pack.

MOBILE WORKPLACE FOR THE ELECTRICAL TROUBLE-SHOOTER (PRM NE) makes it possible to improve the conditions and increase the effectiveness of the work of electronic equipment trouble-shooters under shop conditions. A C1-55 oscillograph and KMAES, used during repair of NC systems, transistor and thyristor drives and the electrical power part of programmed technological

equipment, are attached to a small mobile hand cart. A folding table top and boxes are designed for storing the SPT&A, technical documentation, instruments and accessories. In the transport position the boxes are locked, the instruments are secured and the table tops are also closed and locked. It has a built-in 36 volt power unit. Power from the circuit is 220 volts; it draws no more than 300 voltamperes.

STEP-TYPE SYSTEM TEST UNIT (SShS) is designed to simulate the work of electromechanical devices of machine tools with step-type electro-hydraulic drives, controlled by N22-1M and N33-1M NC units. It can be used: by NC apparatus trouble-shooters for comprehensive testing of the proper functioning and tuning of NC devices; by technicians and repair personnel to detect errors in control programs; for training purposes as test units for training specialists to service metal-cutting machine tool control systems (operators, trouble-shooters, technicians, repair personnel). The test unit is a coordinatograph equipped with simulators of technological commands, which ensure the generation of feedback signals in the NC apparatus for advancing the control program. ShD-5D1M step-type motors are used as the recording unit drive.

MODEL I6211 SIGNATURE ANALYZER is used for quick diagnosis of digital systems by measuring signatures (down to 16 places) at separate points of the circuit and comparing them with the expected values. The power from the voltage source is 5 volts (± 5 percent). It draws 8 volts.

The use in the analyzer of a built-in PR sequence generator allows it to be used not only in a set with an device which ensures the generation of stimulant actions, but also as an independent diagnostic device. It is made from K155 series microcircuits. The analyzer makes it possible to reduce the time required to search for faults and does not require highly skilled service personnel.

MODEL I6231 PROGRAMMED DIAGNOSTIC TEST UNIT (SPD) for automatic fault localization in digital units and apparatus, ensures reduced labor intensity and better-quality repair and debugging of microprocessor devices, by shortening the search time and increasing the reliability of fault localization. There are 128 monitored channels (input - output). The test unit accomplishes monitoring: functional, algorithmic, test, signature and parametric (threshold monitoring of the duration of pulse edges; sampled signal propagation time; level of logical signals).

MODEL I3901 NC MICROPROCESSOR APPARATUS is used to replace obsolete SP22-1M, BM-769 and Luch-22 type systems on the Model OF-72 drill press, which is used in the manufacture of printed circuit boards. It consists of three units: the NC apparatus itself with operating controls (computer), set on a rotatable support, the base of which is affixed to the power unit; the power supply unit and interface for hooking up to the machine tool (power unit), built into its base; and the circuit filter, fastened within the base. It draws no more than 150 watts.

MODEL I1101 PHOTO-READER (FSU) serves to equip the branch Model OF-72SI1 drill press with the Model I3901 NC apparatus, and can be used to input information

into any apparatus having an asynchronous channel with TTL [transistor-transistor logic] levels. The FSU is a small portable apparatus and can service a machine tool section. A program from the FSU is input in approximately one minute. The FSU employs a manual drive (the operator turns a guide roller with the aid of a handle). It has no electric motor or tape-winding mechanism, which are, along with the complex optical system, the weakest and least reliable link in known FSUs. Input is accomplished at a wide range of speeds (up to 2,000 lines per second); speed changes are permitted (up to full stop). An electronic device located on a 75 x 170 mm printed circuit board receives, processes and shapes signals from the photo-detector head, and outputs them to the channel of communication with the numerical control device . Voltage power is +5 volts (± 5 percent). It draws no more than 0.5 amperes.

9069
CSO: 1861/0100

DECENTRALIZATION OF ASUTP SYSTEMS PLANNED FOR GAS INDUSTRY

Moscow GAZOVAYA PROMYSHLENNOST in Russian No 3, Mar 86 p 14

[Interview with N.I. Gorelikov, chief, Scientific Research Administration, Ministry of Instrument Making: "A Current Interview: Toward Unmanned Control of Industrial Object Operation"; date and place not specified; the first paragraph is an introduction]

[Text] A major contribution to implementing a large-scale program of automation of the industrial objects in the gas industry, particularly in West Siberia, is being made by the organizations of the Ministry of Instrument Making. They have taken a course toward developing and introducing broadly the means and systems of automatic control based on microprocessor technology for operations at gas and gas condensate extraction enterprises, major pipelines and gas processing plants. Important tasks in promoting the automated control of enterprises in the gas industry are facing the instrument makers under the 12th Five-Year Plan. This was the topic of our interview with Nikolay Ivanovich Gorelikov, the chief of Scientific Research Administration of the Ministry of Instrument Making.

[Question] Nikolay Ivanovich, what is your appraisal of the five years of experience of cooperation between the organizations of the Ministry of Instrument Making and Ministry of Gas Industry in the development and practical introduction of the technological facilities for automation of enterprises in the gas industry?

[Answer] During the 11th Five-Year Plan period, close businesslike relationships developed between the organizations of the Ministry of Instrument Making and Ministry of the Gas Industry. Virtually all of the undertakings planned for that period have been carried into effect. The organizations and enterprises subordinated to the Ministry of Instrument Making concentrated their efforts in automation of the industrial objects in the gas industry on the development of pilot models of automated control systems of a new generation, largely based on the use of microprocessor technology and also on the development of specialized hardware and software, including primary measurement equipment.

Our organizations have taken an active part in the development of control systems at all levels in the extraction and transportation of gas. These

systems include the system of automatic control of gas pumping plants (GPP); ASUTP [automatic system of industrial process management] of installations for complex gas preparation (ICGP), compressor stations, gas extraction sites and gas pipelines; an automated computerized system of production management activities (PMA) at the level of regional groups of industry. The first pilot ASUTP for ICGP have been introduced at the Urengoy deposit. At Syzran compressor station and Urengoy deposit, the new hardware and software complexes will be tested.

An automated management system for PMA of production associations Urengoygazdobycha and Tyumentransgaz has been put into operation. The ASUTP for Yamburelets gas pipeline is being prepared to be launched. The development of an automated management system for PMA of Tyumengazprom, the largest gas industry association in the USSR, is being developed with direct participation of organizations of the Ministry of Instrument Making.

As a basis for the functioning of these automated management systems, the organizations and enterprises of the Ministry of Instrument Making have developed specialized sets of hardware, including the controlling computer. remote mechanization complexes for monitoring and controlling production facilities, the systems for control of GPP based on microprocessors, information-control complexes for automating ICGP, compressor sections and stations, and production associations.

Progress has also been made in developing primary measurement equipment such as gas pressure sensors manufactured in explosion-proof and vibration-resistant versions, the means of GPP monitoring and protection, and tachometric instruments. Work is under way to develop devices for gas inventory control.

The technologies and control systems that have been developed will provide the basis for automation of industrial objects under the 12th Five-Year Plan and the creation of remote-controlled automated production complexes and plants.

[Question] A number of ministries, including the Ministry of Instrument Making, have been charged with tasks in providing a higher scientific and technological level of projects in Western Siberia and large-scale introduction of progressive methods of work management, so as to make a transition during the 12th Five-Year Plan period to unmanned operation. What qualitative shifts do you see in the contribution of the Ministry of Instrument Making to the development of the gas industry in Western Siberia in the coming years?

[Answer] A gradual transition to automated production complexes with unmanned operation and periodic maintenance services involves not only modernization of technological facilities but also of the organizational, procedural and programming components of automated management systems.

Under the 12th Five-Year Plan, we envisage substantial reductions of the metal-intensity of products and upgraded reliability of controlling computer complexes. In addition, it is necessary to raise drastically the failsafe operation of multilevel ASUTP by choosing efficient system structures, i.e., by decentralizing control and bringing the data processing closer to the site of data origination, as well as by using redundancies in system hardware and functioning.

Emphasis is placed on standardizing the technological concepts on the basis of large-scale use of modular technology when designing hardware and software for automated management systems. This will reduce system development time and also allow putting together the design components of automated management systems, as determined by the complexity of the industrial object and the required functional and informational coverage.

In selecting the hardware for the automated management systems, the designers will use units lending themselves to easy combination, which will facilitate the compliance with the principles of enhanced system reliability mentioned earlier. Special attention would be paid to expanding the self-diagnostic functions of microprocesor equipment, which will greatly improve the reliability of hardware-software configurations.

[Question] What difficulties does the Ministry of Instrument Making face at the initial stage of the five-year plan?

[Answer] One of the crucial problems calling for an urgent solution is improving the quality and expanding the product mix of primary measurement instruments taking into consideration the particular conditions of their use. We must increase the output of sensors in cold-resistant modifications with the requisite precision and reliability characteristics and organize the production of flow-measurement equipment. Our specialists have started active work to solve these problems. We will spare no effort to provide the gas industry of Western Siberia in the current five-year plan period with the necessary software and hardware facilities for the automated production complexes in gas extraction, storage and transportation.

The absence of regional centers for service maintenance of software and hardware supplied by the ministry to the enterprises of Western Siberian gas industry is a cause of serious concern at present. Neither we as developers of the equipment nor the operation services of the Ministry of the Gas Industry can be satisfied with this situation. Under the joint plan of organizational-technical activities in upgrading the automation of the gas industry enterprises in Western Siberia, we have passed a resolution to organize such centers.

A successful solution of the problems confronting us calls for drastically raising the productivity and efficiency of work by organizations of the ministries of Instrument Making and Gas Industry. This will be a reliable safeguard that the program for improvement of automated management systems in the gas industry will be implemented.

9922
CSO: 1861/258

TACTILE SENSOR BASED ON QUARTZ CRYSTAL ADAPTED TO ROBOT

Moscow TASS INTERNATIONAL SERVICE in Russian 1200 GMT 21 Apr 86

[Text] Moscow, 21 April (TASS)--Use of high-speed scales, as proposed by Soviet scientists, allows robots to be endowed with touch. They need less than a millionth of a second to weigh any object.

"Nature suggested the principle of such scales," Mikhail Gerts, research assistant of the Moscow Mechanical Engineering Institute of the USSR Academy of Sciences said to a TASS correspondent. "Scientists have remarked that before throwing a stone, for example, man usually first tosses it up on his hand. Having thus assessed the weight of the stone, it can be thrown more accurately. But why do people in such circumstances toss the stone, instead of simply holding it in their hand?"

Research in the field of resonance theory has helped answer this question. It turned out that man intuitively compares the movement of the hand with the stone to the resonant frequency of the hand alone.

The working medium of new scales is quartz. A crystal, 1.5 cm in size, replaces the spring system, the weights and weigh beam of traditional scales. Because of natural laws, the quartz vibrates continually, oscillating at a definite frequency.

Scientists consider that the new scales may be used successfully in production-line manufacture, for example, in pharmacology, where thousands of tablets, moving rapidly along a conveyor belt, have to be weighed in a matter of seconds. High-speed scales will be used in one of the robots being manufactured by the "Krasnyy Proletariy" factory in Moscow. Equipped with such a sensor, the mechanical arm will acquire the capacity to "touch" objects, accurately assessing their weight.

/13046
CSO: 1861/367-F

UDC 629.11.012.572-771

MECHANIZED STATION FOR INSTALLATION OF CATERPILLAR TRACKS

Moscow TEKHNIKA V SELSKOM KHOZYAYSTVE in Russian No 3, Mar 86 p 48

[Article by A.A. Golovin]

[Text] One of the complicated technological operations during the repair of tractors involves the installation of caterpillar tracks on the running gear.

The methods for installing caterpillar tracks practiced in repair shops--manual and mechanized with the use of OR-9416 and OR-25441 stations--is labor-intensive. Twenty to 30 minutes are needed to install caterpillar tracks. The stations are of a complicated design and are very metal-intensive.

A principally new method for installing caterpillar tracks on the carriage and the mechanized OPR-13451 station for this purpose have been developed.

The station consists of support surfaces (1, 8) [figure not reproduced], the guide (7) and two industrial [heavy-gauge roller] chains (6).

Both support surfaces are installed level with the shop floor on anchor bolts. Concrete is poured over them and they do not impede the movement of mobile shop transportation means. The support surface (1) is conveniently made from discarded caterpillar tracks. The caterpillar track flanges (2) in this case will serve as the guide when the tractor is moved on a carrier. This surface is simultaneously one of the working stations of the assembly lines. The support surface (8) is welded together from a steel sheet (10) 10 millimeters thick and two No 14 channel beams (11) flat side up, forming a rectangular groove (9) for the industrial chains. The guides (7) are made from rolled steel angle irons welded to the channel beams. The industrial chains are made from strips or sheets that are 5 millimeters thick and rods having a diameter of 22 millimeters. The pitch is equal to the pitch of the caterpillar tracks (170 millimeters). At the starting position they lie in the grooves (9) and are connected to the support surface (1) with the help of a pin.

The installation of caterpillar tracks is implemented in the following manner. The tractor (5) on a carrier is moved along the support surface (1) with the help of a pull chain or winch to the place where the industrial chain is attached.

Rolls of left- and right-side tracks are positioned to the rear with the help of the shop hoisting-transportation equipment (13). The ends of the rolls must be on top and directed toward the tractor. The industrial chains are thrown over one by one through the tractor carriage above the guide wheel, support rollers and the star wheel and joined to the ends of the rolls of track. Then the winch drive is inserted. Here the guide wheel of the tractor tightens the industrial chains which in turn unroll the tracks and slip them onto the running gear. After the tracks are fully installed, they are joined at the ends by pins and the tension is adjusted. The time it takes to install the track unit is 10 minutes. The dimensions of the station are 8800 x 1780 x 88 millimeters. One person can service it.

Such stations have been introduced in the Tsivilskoye and Cheboksarskoye installation enterprises of the Chuvash ASSR. The design of the station is simple; it does not require expensive materials or materials in short supply. It can be constructed under any shop conditions in 4-5 days.

Write the Chuvash affiliate of TsKTB [Central Design Technical Office] at the following address to request technical documentation: 429500, ChASSR, Chebokarskiy Rayon, Kugesi.

8228/13046
CSO: 1861/279

NEW TECHNOLOGY FOR DEGASSING STEEL

Moscow MOSKOVSKAYA PRAVDA in Russian 9 Mar 86 p 1

[Article by G. Digtyarenko: "According to the New Technology"]

[Text] The scientists of the Institute of Metallurgy imeni A. A. Baykov of the USSR Academy of Sciences have perfected the technology of degassing liquid steel.

After the heated metal turns into a liquid mass it is necessary to remove gasses from it. Degassing chambers exist for this purpose. With the subsequent casting of the metal into slabs up to 20 percent of the steel is wasted. The institute's scientists, together with innovators of the Novolipetsk Metallurgy Combine, were successful for the first time in combining degassing with the uninterrupted casting of steel. This enables us to decrease waste to a minimum. The metal itself becomes more plastic. As a result, the automobile industry, for example, was given the opportunity to utilize domestic steel, which is not inferior to imported steel in quality.

A resolution of the 27th CPSU Congress states that the congress is setting the goal of implementing an energetic turnaround of science toward the needs of technically reequipping the national economy and toward production.

The processing of wastes is one of the basic tasks which the institute deals with jointly with producers. In this area an elaboration that is being introduced in Norilsk is interesting. The necessary iron is brought here from afar. When transports are of long duration the iron is oxidized and loses its quality. At the same time the enterprises in Norilsk have a great deal of this metal in their waste products. It cannot be utilized without processing. But the national property should also not be allowed to be wasted. The institute's scientists proposed oxidation-reduction baking, as a result of which a ferrous nonoxidizable product is produced.

The institute's laboratory of plastic deformation is also carrying out elaborations in the area of waste utilization. Together with innovators of the GPZ-1 production association scientists are working on a technology for processing shavings into powder, which can be used in particular when producing non-rusting and electrotechnical steel. The production of components from powder obtained from wastes makes them 15 times less costly.

Here it is not necessary to build metallurgical plants for trapping wastes. All that is needed is the already-existing equipment plus inexpensive specialized equipment.

Close scientific contacts are maintained by the institute with the Cherepovetskiy Metallurgy Combine. Recently a technology for an asymmetric rolling of sheet steel has been introduced here; it has yielded a savings of over 1 million rubles per year. A method for surfacing rollers, which protects costly equipment, has been tested; equipment which raises the durability of bearings has been introduced.

8228
CSO: 1861/279

FOR THE OIL WELLS OF SIBERIA

Tbilisi ZARYA VOSTOKA in Russian 31 Jan 86 p 1

[Article by Sergey Murguliya, director, Kutai Electromechanical Plant, All-Union Scientific Production Association, "Potentsial"]

[Abstract] In this article, Murguliya answers three questions posed by the publication: How is your group to achieve a significant increase in the rates of development of production in 1986? To what extent has the need to accelerate scientific and technical progress been considered in the plans of your workers? How would the volume of production be maximized by conservation of resources? The answers: The enterprise is now the major producer of electric motors for oil wells in the nation, having produced 7,500 last year. Some 30 percent of all oil produced in the country is pumped from the ground using electric motors from the author's plant. The central task for today is modernization of all types of products produced at the plant. During the past 5-year plan, automatic equipment, NC machine tools, and more than 80 nonstandardized and specialized items of technological equipment were introduced at the enterprise. the economic effect achieved by modernization in the past 5 years was 180 million rubles. By the end of the present 5-year plan, over 18,000 immersible electric motors will be produced, 12,000 due to modernization of the plant. Increases in production will not require an increase in personnel. Increased technological levels will be achieved by introducing a flexible manufacturing system, two automated sections for mechanical working of parts, mechanized assembly lines, and much more. The overall output of the plant has increased by a factor of 2.5 during the past 5 years, with an increase in consumption of rolled ferrous metal products by only 10 percent, of pipes by only 14 percent.

6508/13046
CSO: 1861/244

TURBINE AND ENGINE DESIGN

DISCOVERY DOUBLES JET ENGINE THRUST IN EXPERIMENTS

Moscow VECHERNYAYA MOSKVA in Russian 20 Mar 86 p 1

[Text] A major scientific discovery in the field of mechanics was entered in the USSR State Register of Discoveries today.

This discovery was made by doctors of technical sciences O. Kudrin and A. Kvasnikov and academician V. Chelomey at the Aviation Institute imeni Ordzhonikidze.

They discovered that increase of reactive force is unusually high when atmospheric air is displaced by a fluctuating active jet. This phenomenon was previously unknown. The thrust horsepower of engines was increased by 2.0-2.5 times in experiments.

The Moscow scientists' work is of great practical significance. This discovery makes it possible to heighten substantially the efficiency of jet engines, gas-turbine units, and other technology.

FTD/SNAP
/13046
CSO: 1823/248

NEW CAMERA BASED ON LASER RADIATION DEVELOPED

Moscow TASS INTERNATIONAL SERVICE in Russian 1103 GMT 28 Feb 86

[Text] A film camera to register rapidly occurring processes in invisible ranges of laser radiation has been created in the Moscow Scientific Research Institute of optico-physical measurements. There have not been such cameras in the world up to now.

The exposure takes micro seconds, the whole process of the laser flash is fixed on film, which is processed in the normal way, and the invisible becomes visible. The complex spatial structure of laser radiation forms a fantastic picture on the film. The film is put into a projector and the nature of laser radiation is studied. At the same time the instrument is able to give numerical values, which are entered into a computer.

Formerly it was necessary just to guess how a rapidly occurring process in the ultraviolet or infrared ranges of the spectrum, which are invisible to the eye, actually take place. Now accurate reports have been obtained for the first time. It is possible to control the work of lasers and to chose favorable conditions for their work. This is necessary for the accurate tuning of lasers used, for example, for unique eye operations or operations using a laser scalpel.

/13046
CSO: 1861/229-F

SELECTED SYNOPSES OF ARTICLES IN TRUDY AKADEMII NAUK LITOVSKOY SSR, SERIYA B: KHIMIYA, TEKHNIKA, FIZICHESKAYA GEOGRAFIYA, JANUARY 1986

Vilnius TRUDY AKADEMII NAUK LITOVSKOY SSR, SERIYA B: KHIMIYA, TEKHNIKA, FIZICHESKAYA GEOGRAFIYA in Russian No 1, Jan 86, pp 69, 75, 92

UDC 532.517

LIQUID TURBULENT FLOW STRUCTURE IN WAKE OF CIRCULAR CYLINDER

[Synopsis of article by P. M. Daujotas, V. P. Širka, and A. A. Žukauskas, pp 63-69]

[Text] The longitudinal and transverse components of the average and the pulsating velocity where $Re=3.7\cdot10^4$ were investigated with a two-component laser Doppler anemometer. The measurements were made in the area of the near two-dimensional wake of a circular cylinder up to seven calibers [diameters]. From the measured components of average velocity the vector pattern was established for the average flow past the cylinder. With the aid of an electrically heated cylinder its streamlining characteristics were determined. The experimental data base provided the convection and generation terms of the equation of the transfer of turbulent energy. The contribution of these terms in the transfer of it is significant only in the area of the shear layer at a distance less than two calibers. It is apparent from the vector pattern that in the wake there are zones of flow separation, of large velocity gradients, and of large velocities, which rapidly even out as a result of strong turbulent motion. The profile of average velocity at a distance of seven calibers was no different from the profile of turbulent flow in the channel. Measurements of pulsation showed that at the beginning of the critical phase of flow around the cylinder maximum pulsations were observed in the area of the shear layer and amounted to 55-60 percent of the velocity of the approach stream. Five illustrations and seven references.

UDC 536.24

PECULIARITIES OF HEAT TRANSFER IN STAGGERED TUBE BANK IN CROSSFLOW OF AIR WITH TEMPERATURE DIFFERENCES

[Synopsis of article by A. A. Žukauskas and R. I. Jankauskas, pp 70-75]

[Text] Investigates local and average heat transfer of tube of deep (VI)layer of a tube bank with aXb=1.25X1.25 for values T_w/T_f up to 3.2 in the range $Re_\psi=(0.96\text{-}65)\cdot10^4$. The experiments were conducted in a high-pressure closed aerodynamic loop by the local modelling method, where q_w=const. The natural turbulence of the approach stream was 3 percent. It was experimentally established that in any part of the tube in the zone before the entry of the laminar boundary layer into the turbulent layer, with increase in T_w/T_f heat transfer is less, but the nature of the flowpast of this zone does not change, and the transition point remains in a fixed position. Increasing T_w/T_f from 1.2 to 1.3 shifts the shear point of the boundary layer approximately 10° against the flow, and increasing the shear zone also increases the local heat transfer ratios at the front end of the tube. The average heat transfer of a tube in the deep layer of a staggered bank does not depend on T_w/T_f, since a decrease in heat transfer in any part of a tube with a laminar boundary layer is compensated by an increase in heat transfer in the zone with a vortical current. In the Re interval investigated the relative non-uniformity of heat transfer a_{max}/a_{min} decreased with growth of the temperature factor, and where $T_w/T_f\approx3.2$, it was within the limits of 1.5 to 1.75. Five illustrations and seven references.

UDC 536.244

HEAT TRANSFER IN TURBULENT FLOW OF HIGH TEMPERATURE GASES IN ANNULAR CHANNEL WITH COLD WALL

[Synopsis of article by S. K. Karčiauskas, P. Yu. Valatkevičius, and A. B. Ambrazevičius, pp 87-92]

[Text] Describes the experimental setup and presents the research results of and the data processing methods for heat transfer in short annular channels with a turbulent current in the flow of high temperature gases. Average air temperature was 3200, and wall temperature was 300 to 350 K. Re varied in the interval from $3.5\cdot10^3$ to $7\cdot10^4$. It was established by investigating the effect of the height of the annular opening on heat exchange that heat transfer to the inside and outside walls of an annular channel varies, and in a short annular channel Nu_1 may be either less or more than Nu_2. When employing the proposed method of data collation, i. e., by the average-mass temperature of the flow, no effect of the temperature factor on heat transfer in annular channels was observed where $T_f/T_w<10$. Generalized relationships were obtained that make it possible to calculate the heat transfer to the wall of an annular channel. The relationships are valid where $0.48<d_1/d_2<0.8$, and $0.4<x/d_e<45$. Five illustrations and 14 references.

12697
CSO: 1861/265

UDC 539.3

MATHEMATICAL MODEL OF A FIBER-STRUCTURE COMPOSITE MATERIAL

Tbilisi SOOBSHCHENIYA AKADEMII NAUK GRUZINSKOY SSR in Russian Vol 120, No 3, 1985 (manuscript received 21 Jun 84) pp 501-504

[Article by R.P. Mainya, I.N. Preobrazhenskiy, P.I. Preobrazhenskiy and G.N. Khashba, Georgian Subtropical Studies Institute]

[Abstract] A mathematical model of a fiber-based composite material is presented, based on analysis of oriented reinforced composite materials as macroscopically homogeneous media consisting of a multitude of small diameter fibers uniformly distributed in a matrix. It is assumed that the composite material operates elastically over broad limits. The purpose of the model is to establish the interrelationship of the physical and mechanical characteristics of the composite material as a function of the elastic characteristics of its components and their volumetric and spatial arrangement. The theory presented in this article is based on elements of structural analysis and a superposition of the theory of unidirectional reinforced materials with the theory of elasticity of macroheterogeneous bodies. Initial assumptions include that the unidirectional reinforced material is a continuous macroscopically homogeneous monotropic, transversely isotropic body; the binding and reinforcing materials are linearly elastic, isotropic, and homogeneous; full bonding obtains between the materials; transversely directed stresses are negligible; and stresses in the binder and reinforcing material are identical upon loading of the specimens transverse to the direction of the reinforcement. Figures 2, references: 2 Russian.

6508/13046
CSO: 1861/242

UDC 62.215

DESIGN OF PREFABRICATED CYLINDRICAL RESERVOIRS DEFORMED IN AN ELASTIC MEDIUM

Tbilisi SOOBSHCHENIYA AKADEMII NAUK GRUZINSKOY SSR in Russian Vol 120, No 3, 1985 (manuscript received 19 Apri 84) pp 581-584

[Article by D.V. Tavatadze, Tbilisi Institute of Mathematics imeni A.M. Razmadze, Georgian Academy of Sciences]

[Abstract] A study is made of a prefabricated cylindrical reservoir covered with a hemispherical dome, assuming the individual circular elements of the reservoir to be interconnected by circular joints. The walls of the reservoir are exposed to internal hydrostatic pressure, transverse and normal forces from the dome, and the elastic reaction of the medium. Optimal design of the cylindrical reservoir wall refers to selection of the unknown strength of the structure such that certain conditions of strength and rigidity are achieved. Design of the reservoir is reduced to integration of a differential equation. The existence of the elastic medium decreases the thickness of the envelope required. Figures 2, references: 4 Russian.

6508/13046
CSO: 1861/242

LARGE-AREA CdTe/Al_2O_3 EPITAXIAL FILMS

Kishinev IZVESTIYA AKADEMII NAUK MOLDAVSKOY SSR: SERIYA FIZIKO-TEKHNICHESKIKH I MATEMATICHESKIKH NAUK in Russian No 3, Sep-Dec 85 (manuscript received 21 Nov 85) pp 67-69

[Article by E.A. Senokosov, K.D. Sushkevich, A.N. Usatyy, and V.M. Federov]

[Text] In the group of $A^{II}B^{VI}$ wide band-gap semiconductor compounds, cadmium telluride is one of the most promising materials for converting solar energy into electricity. Up to now, photocells with an efficiency factor of $\cong$10% have been manufactured from CdTe crystals [1]. The wide practical use of CdTe for photoconverters has been restricted primarily by difficulties in growing high-quality crystals with a large working surface area. The efficiency factor of polycrystalline film photocells does not exceed 5%. The search for and development of an effective technology for growing monocrystalline layers of CdTe having a large area with specified physical properties is one of the important directions in improving the operational characteristics of photocells.

This work discusses the production, study of the structure and emissive properties of epitaxial n-CdTe/Al_2O_3 films with an area of $\cong$20 cm^2 (Figure 1A).

Films with a thickness of 10 to 50 μm, which were grown in a quasiclosed container under conditions close to thermal equilibrium, were investigated [2]. n-CdTe crystals with a specific resistance of 10^5 to 10^6 ohms x cm were used for deposition. Sapphire wafers (α-Al_2O_3) with a thickness of 300 to 500 μm and a diameter of 60 mm that were oriented in a plane (0001) were used as substrates. A correlation between the type and resistance of the films and the parent material was discovered.

Alloying the films with indium decreased the resistance from 10^5 to $10 - 10^2$ ohms · cm. In the process, the Hall mobility μ_H fell from 300 to 100 $cm^2/(V \times s)$. Annealing the alloyed films in cadmium vapors resulted in a decrease in their resistance to 1 ohm cm and an increase in μ_H to 700 $cm^2/(V \cdot s)$.

The surface structure of the films was investigated electrographically by the reflection method (EG-100 electronograph) and the phase composition by the x-ray method (DRON-UM 1 diffractometer).

Luminescence [LM] was excited by an LGI-21 argon laser ($\hbar\omega_{exc}$ = 3.68 eV) with a pulse repetition frequency of 100 Hz and duration of 8 ns. The maximal excitation level was $I_0 = 3 \times 10^{23}$ phot/($cm^2 \cdot$ s).

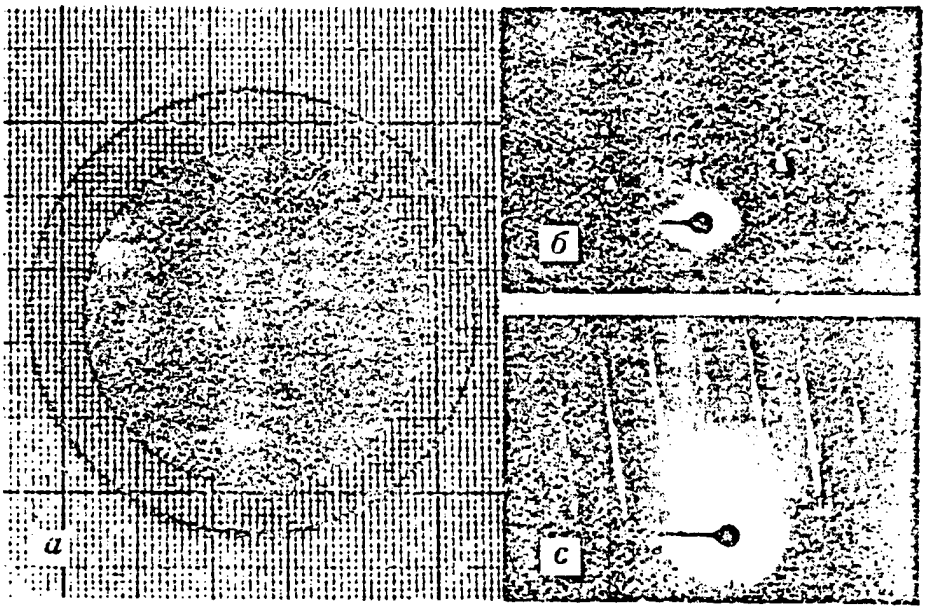

Figure 1. General view of a CdTe epitaxial film on a sapphire substrate (a); electronograms from the surface (111) layer of CdTe along direction [112] (b) and [110] (c)

The reflection electronograms of the n-CdTe/Al_2O_3 film that were taken along direction [112] (Figure 1B) consist of a regular (square) lattice of point relfexes that are accompanied by satellites in the form of tails, which are characteristic for crystals with regular faceting [3]. The electronograms along [110] (Figure 1C) contain bars that are symmetrical relative to the central electron beam, which degenerate into a kicking-line, attesting to the monocrystallinity and high structural perfection of the condensate. The layers had a single-phase cubic structure and were oriented in a plane (111), CdTe||(0001) Al_2O_3.

Figure 2 presents the spectra of the recombination radiation [RR] of the parent crystal (curve 1) and the n-CdTe/Al_2O_3 films (curves 2 to 6), which were taken at 77 K and different levels of excitation. It is evident that the LM of the films is completely determined by the emissive properties of the parent material. In both cases, the spectra of fringe radiation consist of two bands, a fundamental band at 1.574 eV and a wide, structureless band with a maximum of 1.43 eV.

The nature of the electron transitions that are responsible for the short-wave line in the RR of the n-CdTe films has been explained by using mechanisms connected with the presence of a great density of excitons or nonequilibrious charge carriers in the nonalloyed semiconductors under conditions of high-level excitation. On the basis of such an analysis, it has been suggested that inelastic exciton-exciton type [4] interactions play a basic role in the formation of the band:

$$(E_K^{1S}, E_{K'}^{1S}) \longrightarrow (\hbar\omega, E_{K''}^{1S}). \qquad (1)$$

In such a process, two 1S-excitons interact with the wave vectors K and K', as a result of which one of the 1S-excitons acquires the momentum K'' and the other emissively recombines with an energy

$$\hbar\omega = E_g - E_{1s} - 2k_0T. \qquad (2)$$

where E_g = 1.597 eV is the width of the band gap of the CdTe at 77 K; E_{1S} = 10 MeV is the energy of the exciton bond in the 1S-state; k_0 is the Boltzmann constant; and T is the lattice temperature. The following band properties confirm such an RR mechanism:

--the spectral position of its peak (1.574 eV) coincides well with the value $\hbar\omega$ = 1.574 eV computed by formula (2);

--the band possesses a weak asymmetry with a steeper long-wave fall. Of all the types of P-bands, such a form is only characteristic for the LM P_1-band [5];

--the quadratic relation of the radiation intensity to the excitation level (Figure 2B, curve 2).

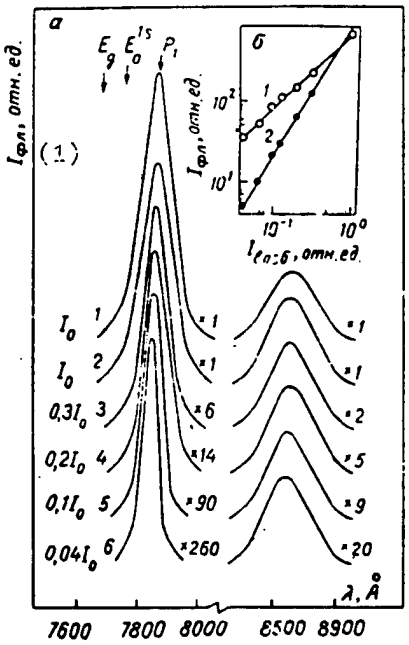

Figure 2. Spectral photoluminescence distribution at 77 K of the parent material n-CdTe (1) and n-CdTe/Al_2O_3 films at different excitation levels (2 to 6)

Key: 1. $I_{photoluminescence}$, relative units

The 1.43 eV band in CdTe is ascribed to the donor-acceptor recombination mechanism [7]. In the process, excess cadmium atoms with an ionization energy of E_{CD} = 0.015 eV [8] or the impurity atoms In, Al, Br, and I with E_{CD} = 0.011 to 0.022 eV [9] can serve as donors. The physicochemical nature of the acceptors in CdTe, as in other $A^{II}B^{VI}$ compounds, has not been determined unambiguously. Obviously, natural defects or complexes formed on their basis are the donors in the films under investigation. The growth in the intensity of the 1.43 eV band with an increase in the concentration of excess cadmium points to this. In this respect, our conclusions agree with the results of work [8] in which it

was established that in CdTe crystals with excess cadmium atoms the 1.43 eV band occurs as the result of the radiative transitions of electrons from a small Cd donor with E_{CD} = 0.015 eV to an acceptor with E_{VA} = 0.15 eV. An uncontrollable impurity or a complex including a natural defect and impurity atom may correspond to the acceptor.

Data on the change in the emissive properties according to the thickness of the layer were investigated in order to estimate the extension of the transition layer formed in the CdTe at the interface with the substrate. The thickness of the transitional layer was 3 to 4 μm. The radiation turned out to be rather homogeneous throughout the entire area of the films, which is a characteristic trait of layers grown in a quasiclosed container.

The authors are grateful to P.I. Khadzhi for reviewing the experimental results.

BIBLIOGRAPHY

1. Rodot, M., REV. PHYS. APPL., Vol 12, No 2, 1977, pp 411-416.

2. Vinogradov, V.Ye., Senokosov, E.A., and Fedorov, V.M., in "Vsesoyuznaya konferentsiya po fizike i tekhnologii tonkikh plenok" [All-Union Conference on the Physics and Technology of Thin Films], Ivano-Frankovsk, 1984, p 277.

3. Endryus, K., Dayson, D., and Kioun, S., "Elektronogrammy i ikh interpretatsiya" [Electronograms and Their Interpretation], Moscow, Mir, 1971, 256 pages.

4. Moria, T., and Kushida, T., J. PHYS. SOC. JAPAN, Vol 40, No 6, 1976, pp 1668-1675.

5. Khadzhi, P.I., "Kinetika rekombinatsionnogo izlucheniya eksitonov i bieksitonov v poluprovodnikakh" [Kinetics of Recombination Radiation of Excitons and Biexcitons in Semiconductors], Kishinev, Shtiintsa, 1977, 243 pages.

6. Baltrameyunas, R., Zhukauskas, A., and Kuckshtis, E., FIZIKA I TEKHNIKA POLUPROVODNIKOV, Vol 16, No 9, 1984, pp 1610-1615.

7. Rizakhanov, M.A., and Sheynkman, M.K., FIZIKA I TEKHNIKA POLUPROVODNIKOV, Vol 18, No 10, 1984, pp 1788-1794.

8. Panosyan, Zh.R., in "Izluchatelnaya rekombinatsiya v poluprovodnikovykh kristallakh" [Emissive Recombination in Semiconductive Crystals], Moscow, Nauka, 1973, pp 147-203.

9. Strauss, A.J., REV. PHYS. APPL., Vol 12, No 2, 1977, pp 167-184.

12794
CSO 1861/106

UDC 627.141.1

INDICATORS OF LIMITING EQUILIBRIUM STATE OF MUD MASS

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[Article by Ye.G. Kukhalashvili, I.G. Kruashvili, and Z.I. Mirtskhulava, Georgian Agriculture Institute]

[Abstract] The question of the equilibrium of a high density mud mass against shear forces is important in the solution of a number of practical problems, such as determination of the height of tailings. An experiment was performed to study the limiting stress state of a mud mass and its basic parameters. The experiment consisted of a rotating platform with a hollow cylinder 8 cm high and 14 cm in diameter fastened to it and offset 25 cm from the rotation axis. A second cylinder of the same dimensions is placed atop the first and the rotation rate is varied to determine when the shear (centrifugal) force at the interface between the two cylinders causes a loss of stability. The major indicators of the limiting equilibrium state of the mud mass increase with increasing weight ratio up to the critical state of the mud mass, then decrease as the mass is converted to a disordered state.

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