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1950 ACHIEVEMENTS IN SOVIET MACHINE-TOOL BUILDING

The postwar Five-Year Plan marked a significant development of scientific research institutes and organizations of the Ministry of Machine-Tool Building. These include ENIMS (Experimental Scientific Research Institute of Metal-Cutting Machine Tools), VNII (All-Union Scientific Research Tool Institute), VNIIASH (All-Union Scientific Research Institute of Abrasives and Grinding), NIBV, (Scientific Research Bureau of Interchangeability), NIBTN (Scientific Research Bureau of Technical Norms), and others.

The most outstanding accomplishment of ENIMS in 1950, with the participation of VNII and NIBV, was the completion and delivery of the automatic piston plant to the Ministry of Automobile and Tractor Industry. [redacted] 50X1-HUM

A number of new experimental models have been designed and manufactured at ENIMS. The most important of these are described below.

The Model 5P28A gear-cutting semiautomatic is for cutting spiral bevel gears up to 800 millimeters in diameter, with up to 15-millimeter module. The range of spindle speeds is from 21 to 300 revolutions per minute, permitting the use of high-speed steel or hard-alloy cutting tools and an operating speed of from 10 to 300 meters per minute. The teeth are not cut one after the other in successive order; a predetermined number of teeth are passed, which effects a continuous rotation of the gear blank in one and the same direction. The rapid return roll of the cradle (idling) is accomplished at a constant speed and takes about 7.5 seconds, regardless of the total length of the operating cycle. This principle of operation decreases the time required for machining one tooth. An original generating mechanism is used in the machine tool which permits the entire generating and indexing cycle to be accomplished by a continuous meshing of gears. [redacted] 50X1-HUM It is equipped with a 12-kilowatt electric motor and weighs about 10 tons. It was developed by V. N. Kedrinskiy, leading designer, and D. A. Zagryazkin, leading technologist.7

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The Model 5P325 gear-hobbing semiautomatic [redacted] is intended for high-speed machining, by the generating method, of spur and helical gears up to 450 millimeters in diameter with up to 6-millimeter module. The machine is designed for the use ofhard-alloy hobs. Its speed is from 250 to 750 revolutions per minute, and its feed is from 0.25 to 4.0 millimeters per blank revolution. With such a range of cutter speeds, gears can be cut at a speed of from 60 to 300 meters per minute.

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The Model 5P84 universal-type gear-grinding machine [redacted] is designed for grinding spur and helical gears from 60 to 450 millimeters in diameter, face width up to 180 millimeters, and module from 2 to 10 millimeters, with the maximum angle of spiral at 45 degrees. In comparison with similar machines produced by foreign firms, this model is exceptional for its high productivity. The following operations of the work cycle are automatic: in-feed, withdrawal of wheel to dressing position, and dressing and adjusting to compensate for wheel wear. Instead of the usual grinding of adjacent teeth, every few teeth are ground successively on this machine. To grind all teeth, the blank must make several revolutions. This method of grinding decreases the cumulative error in pitch and increases the accuracy of machining.

The Model 5A30 gear hobbing semiautomatic [redacted] is intended for machining small-module spur gears up to 45 millimeters in diameter, with module from 0.05 to 1.0 millimeters. Considering that this machine will be used for machining brass gears, it has been provided with a maximum cutter speed of 2,000 revolutions per minute.

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For machining small-module, straight-tooth, and spiral bevel gears, three unified machine tools have been designed: Model 5P23 for machining spur gears, Model 5P23A for helical gears, and a widely universal machine tool on which either type of gear can be machined. The machines differ from each other in the basic arrangement of the cradle. They are intended for machining gears with a maximum diameter of 120 millimeters, maximum module of 2.5 millimeters, and maximum face width of 20 millimeters, and the number of teeth ranges from five to 100. The entire generating and indexing cycle is a continuous process; not a single mechanism has interrupted movement. During the return roll of the cradle, the blank rotates in a specified and unchanging direction. The moment the work cycle begins, a specified number of teeth are passed. The machine is set up in such a way that this number does not have a common multiple with the number of teeth to be cut on the gear. Consequently, with the repetition of the cycle, all teeth will be cut subsequently and the machine tool will stop automatically.

The cradle in the machine for spur gears and in the widely universal machine carries two disk cutters which simultaneously machine the opposite sides of one recess.

These three machines can reach a cutting speed of up to 190 meters per minute.

Model 1P625 is a high-duty lathe. Its specifications are as follows: maximum workpiece diameter, 500 millimeters; distance between centers, 1,000 millimeters; number of spindle speeds, 18; range of spindle speeds, 32-1,600 revolutions per minute; range of longitudinal feeds, 0.06-1.5 millimeters per revolution.

The machine is designed for complete utilization of the cutting properties of hard-alloy tools. Its design assures increased accuracy and a high surface quality. A great deal of attention has been given to increasing its efficiency by using short kinematic chains, ball bearings for all shafts, and a circulating system of lubricant from the pump in the feed and gear boxes. To shorten the [redacted] 50X1-HUM

time required for auxiliary operations and lessen the fatigue of the operator, the machine is provided with the following: a single shifting lever for selecting the desired speed on a lighted scale; convenient control of the feed box; engagement of longitudinal and cross feed and rapid adjustment by means of a single lever; the use of electromagnetic clutches; mechanical feed from the apron for the upper part of the slide which carries the cutter head and which can be swiveled 60 degrees to either side; a four-cutter head with indexing, the release, swivel, and securing of which are done by one quick-acting lever; "forward," "backward" and "stop" buttons conveniently located on the slide; and an electric copying device. The machine is calculated for an increase in productivity of 1.5-2 times as compared with ordinary lathes.

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Model 3153B [redacted] is a center-type cylindrical grinding automatic for the tool industry. It is intended for grinding plug gauges with a tolerance of 5 microns on the external diameter, which is higher than the first class of accuracy.

The 3153B is a completely automatic precision grinding machine, from the insertion of the workpiece between centers to its unloading after the finishing operation. Grinding is done by the in-feed method. The automatic or semiautomatic cycle of the machine is accomplished by a hydraulic or electric device connected to the measuring device or rigid stop.

In the automatic cycle, the machine is loaded with parts from a hopper device. It can also operate as an ordinary cylindrical grinding machine. The recommended range of grinding diameters is from 10 to 40 millimeters.

An in-feed cylindrical grinding machine with two automatic grinding heads, Model 3G153A and 3G153 (left- and right-hand operation) [redacted] was designed at ENIMS and manufactured for incorporation in an automatic transfer machine line for machining graduated shafts. It can also operate as an individual machine at various machine-building enterprises. The work cycle of this machine, including the measurement of parts, is completely automatic. 50X1-HUM

It is intended for simultaneous grinding of several tapered or cylindrical surfaces. The maximum workpiece diameter is 150 millimeters; maximum distance between centers, 750 millimeters; and the maximum diameter of the journal that can be ground is 60 millimeters.

The Model 1004 automatic [redacted] developed by ENIMS is intended for turning the tapered part and face of heads of wood screws up to 7 millimeters in diameter and from 15 to 100 millimeters long. Its productivity is 1,500 to 2,280 parts per hour. 50X1-HUM

The Model 5996 thread rolling machine is designed for rolling threads on wood screws 3-5 millimeters in diameter, with the threaded part up to 50 millimeters long. The number of double strokes of the machine is from 55 to 120 per minute.

Heretofore, wood screws were threaded by cutting on special machine tools. The new machine is equipped with a hopper for automatic feeding of the blanks. Testing of the machine in 1950 showed good results.

ENIMS designed a dynamic balancing machine, Model 9725 [redacted] for parts weighing from 4 to 90 kilograms with a maximum diameter of 630 millimeters. The machine can make from 560 to 1,600 revolutions per minute. The heavy parts are placed on cradles by means of a special lifting device. Two freely-rolling cradles suspended on thin belts support the parts. Rotating motion is transmitted to the parts by means of a clutch connected to the machine spindle by a cardan shaft; with the rotation of the workpiece, the pivot of the cradle effects a vibration in the coil found in the permanent magnetic field. This element transmits signals to the electrical measuring panel. 50X1-HUM

 [redacted]

OKB MSS (Experimental Design Bureau of the Ministry of Machine-Tool Building) has designed an original high-duty rotary-broaching automatic, Model "RPA" 7592 [redacted], for processing the faces of bolt heads. The faces of bolts and screws with square and hexagonal heads are processed on the machine by a method of continuous broaching, with a productivity which measures up to that of trimming automatics, and in addition, it completely eliminates the operation of undercutting the heads for removing burrs after trimming the faces. In processing large bolts and screws, and bolts and screws with heads having flanges, the productivity of this machine will be ten to 20 times as great as in milling.

The OKB MSS has also designed a group of machine tools for different purposes and of various sizes based on electrical methods of processing. Of special interest among these is the Model 4A722 electric-spark piercing-copying machine [redacted] which is intended for making 2 to 280-millimeter holes or recesses with a maximum depth of 50 millimeters but not more than ten diameters in parts 200 x 300 x 175 millimeters in size and up to 50 kilograms in weight [sic].

The electrical erosion method of hardening cutting tool edges, surfaces of rapidly wearing parts, etc., has found application in industry. In particular, pressmolds used in the abrasives industry for pressing grinding wheels are subjected to very intensive wear. To mechanize the process of depositing a hard-alloy plate and to improve their quality, the OKB MSS has designed the Model 439 semiautomatic machine tool for hardening pressmolds [redacted].

It must be noted that the surface area of pressmolds to be hardened reaches 1,000 square centimeters. To plate such a surface by hand requires up to 30 man-hours. Although the labor consumption is high, abrasives plants have used this method, because the durability of pressmolds plated with hard alloy increased several times.

Model 439 has been designed for plating holes 125-300 millimeters in diameter and external surfaces of pressmold cores 40-180 millimeters in diameter and up to 200 millimeters high. This model can also be used for mechanizing the hard-alloy plating of various types of parts and tools.

Model 4382 [redacted] has been designed by OKB for making chip-winding grooves on hard-alloy tools. It takes one minute to process one 25 x 16 millimeter cutter on this machine.

In connection with the appearance of wheels for high-speed grinding at speeds of 50 meters per second instead of 30-35 meters per second, ENIMS conducted research on using existing grinding machines at high speeds and developed methods for their modernization.

Research showed that with the speed increased from 35 to 50 meters per second and a proportional increase in the depth of grinding or workpiece speed (for increasing productivity), the consumption of power for the grinding wheel drive increased 70-80 percent and the consumption of power for the workpiece drive increased 15-20 percent.

Considering that the motors for the workpiece drive have a large reserve of power, replacing them in modernization is not necessary. In other respects, the measures for the modernization of grinding machines must be accomplished along the following lines: the grinding-head electric motor must be replaced by a more powerful one; pulleys that would increase the speed of the grinding wheel to 50 meters per second, pulleys for increasing the speed of the workpiece, more rigid guards for the grinding wheel, and a splash guard for the table must be manufactured.

ENIMS has developed a method of calculating the necessary elements of grinding machines at the time of their modernization and also the conditions for operation machines at a high grinding speed. To provide industry with on-the-spot guiding

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instructions, blueprints have been developed for units and parts which must be manufactured in the modernization of the most widely used grinding machines, Models 3151, 316M, and 3153, for converting them to high-speed grinding. To decrease auxiliary time used for measuring workpieces, ENIMS worked out blueprints for two instruments which measure parts on cylindrical grinding machines during the grinding process.

ENIMS has made many other improvements in methods, units, machines, etc.; however, a number of tasks have been neglected or left incomplete.

Of great importance is the saving of metal by reducing the weight of machine tools per unit of power. The machine tools now being produced are frequently characterized by extremely massive basic parts, for the most part a result of a thick-walled casting.

Meanwhile, scientific research and experimental work in the field of technology for obtaining thin-walled castings and for the application of lighter housing parts in machine-tool building have not been conducted at ENIMS. In addition, it has not done any work on the use of nonmetallic materials such as reinforced concrete for machine-tool beds.

ENIMS is lagging in the field of heavy machine-tool building. Many problems in this field are far from being solved.

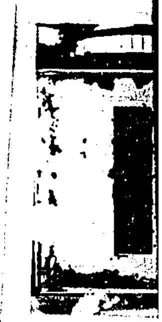
In the field of developing basic models of modern universal machine tools for subsequent series production at plants, ENIMS is behind schedule in preparing plans and manufacturing and testing experimental models (for example, turret lathes for the Alapayevsk Plant, lathes for the Tbilisi Plant, milling machines, etc.), which, in turn, delays the removal of obsolete models of basic types of machine tools from production.

Moreover, in its designs of universal machine tools, ENIMS does not give enough consideration to the work experience of leaders in high-speed methods in production. At present, the greatest attention should be given to the mechanization and automatization of auxiliary operations to bring manual labor in attending machine tools to a minimum. For example, ENIMS has not yet solved the problems of mechanizing and automatizing the clamping of a workpiece on universal machine tools, automatic checking of parts during operation, incorporating devices which would facilitate the removal of chips from machine tools, etc.

ENIMS allowed a serious upset in the output of new models of universal lathes. Model 1P63, 1P62, and 1P61 lathes that had been designed for series production proved to be unsuitable for this purpose without bringing in significant changes; as a result, these machine tools have not yet emerged from behind the institute's walls.

ENIMS is not paying sufficient attention to the possibilities of introducing high-speed methods in those types of operations where high-speed methods are not yet prevalent, such as drilling, planing, broaching, grinding, etc. The possibilities of converting these operations to high-speed methods have not been studied, and models of equipment on which they could be carried out have not been developed. Only recently, under pressure from industry for the introduction of high-speed grinding has ENIMS begun to concern itself with the problem of developing a cylindrical grinding machine for high-speed operations.

One of the existing shortcomings in the work of ENIMS in the past and one of the biggest assignments for the future is the development of typical machine tools which can either be incorporated into automatic transfer machine lines or operate individually. Thus far, automatic transfer machine lines have been designed for special purposes only. This has increased the cost of designing and manufacturing and, to a great extent, excluded the possibility of their utilization in the event that the output of the product for which they were designed were curtailed.



Testing of machines has not been satisfactorily carried out by ENIMS. It has failed to correct mistakes or shortcomings that have been uncovered in design.

During the past few years, the work of ENIMS in the field of departmental normalization has been very feeble.

Finally, a serious fault of ENIMS, as well as of other scientific research organizations of the Ministry of Machine-Tool Building, is its laxness in introducing into production completed scientific research and experimental work.

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