TOMSK POLYTECHNIC UNIVERSITY

METAL-WORKING EQUIPMENT

LECTURE 1

Lecturer – Dmitry M. Kozar

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TOMSK POLYTECHNIC UNIVERSITY

INFORMATION ABOUT LECTURER

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INFORMATION ABOUT DISCIPLINE

Lectures - 32 hours
Practical exercises - 16 hours
Laboratory works - 16 hours

View Intermediate examination - an examination

HISTORICAL BACKGROUND

Machine tool – a machine for processing different materials.

Metal-cutting machine – a machine designed for processing of metallic materials by cutting.

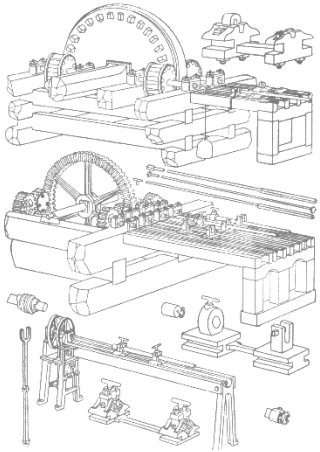
Birth of machine tools

The appearance of a firearm in the Middle Ages led to the emergence of cannon and “rifle forges” equipped metalworking machinery. So for the manufacture of guns, rifles and cannon balls used lathes and drill presses.

For example, in Moscow, on the river Yauza in 1645 year “rifle mill” was built where water engine put in motion six drilling machines and two gun barrels drill. In 1712, Master Sidorov built Tula Arms Plant with dam where a wheel of water mill put in motion a hammers and gun barrels drill machines which had original design. In 1714 Russian master Jacob Batishchev built a number of drilling machines and machine tools. He world's first applied the principle of aggregation machine tools.

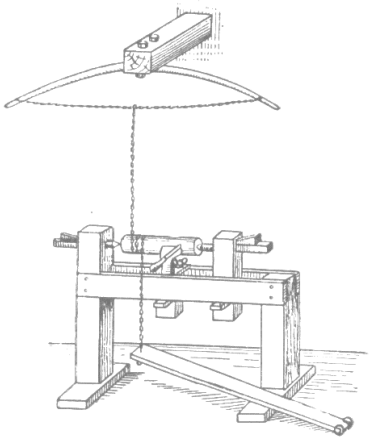
While the cutting tool was kept by hands and accordingly work on such machines required a lot of skill and physical strength and does not provide high accuracy.

HISTORICAL BACKGROUND



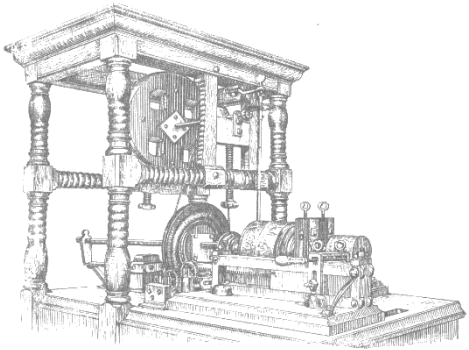
Machine of Jacob Batishchev for drilling gun barrels.

HISTORICAL BACKGROUND



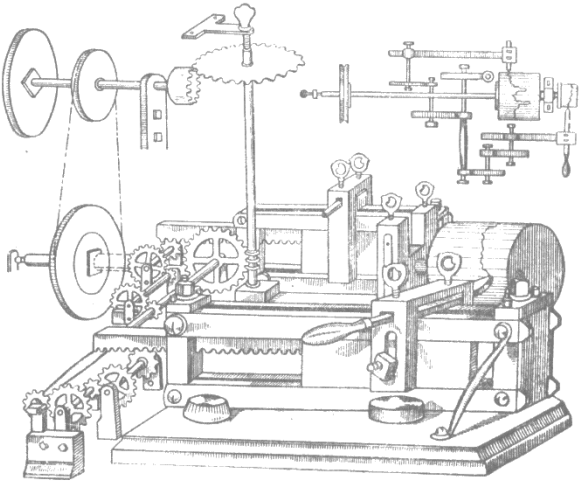
Turning and drilling machines driven by wheels and continuous rotary motion of the workpiece were achieving 15-18 centuries. Thus the prevalent type remained lathe in which the workpiece is rotated alternately in one or the other direction.

HISTORICAL BACKGROUND



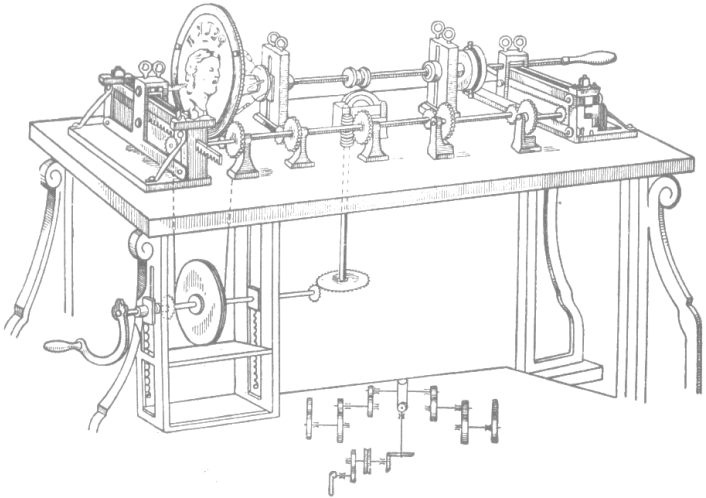
True development of machine tools refers to the beginning of the 18th century, when was invented mechanical caliper is used for fixing and moving the cutting tool. The invention of a support - major technological achievement which was revolutionary in its significance. Caliper was developed in 1738 by the Russian scientist Nartov. In France, support was invented by engineer Jacques de Vaucanson in 1751 and in England, caliper was reinvented by Henry Maudsley only half a century after Nartov.

HISTORICAL BACKGROUND



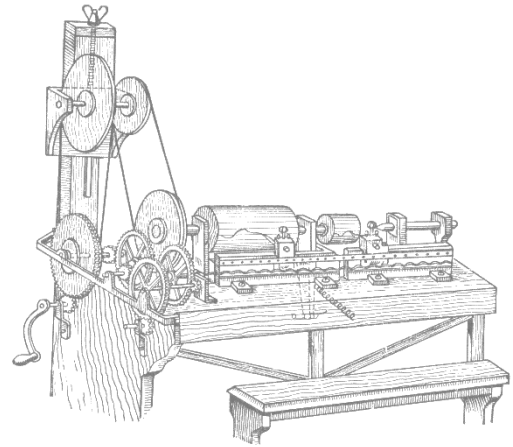
Kinematic scheme of turning-duplicating machine tools of Nartov. Ahead seen caliper driven from the rail.

HISTORICAL BACKGROUND



Turning-copying machine tools for medals developed by Nartov in 1721

HISTORICAL BACKGROUND



Turning-copying machine tools developed by Nartov in 1721. A caliper is driven by a lead screw.

BASIC DEFENITIONS

The factory production process consists of a set of human actions and the work of machines, as a result obtain finished products from materials and semi-finished product. **The operating procedure** (or technological process) is the part of the production process, comprising the targeted actions to change and (or) the definition of the state of the object of labor (changing the size, shape, properties of the treated material or assembly of parts and assembly units in the finished product).

The operating procedure is divided into operation. The operation consists of technological steps, clamping, positions and working steps.

The operation – part of the operating procedure of process one or more workpieces executed continually on a single workstation with one worker or a squad before the treatment of the following part(s).

The technological step – part of the operation, during which process one or multiple surfaces at constant tool and constant processing mode. For removal from the treated surface a large metal layer the technological steps is divided into passes.

BASIC DEFENITIONS

Pass – part of the technological step associated with the removal of one metal layer from the processed surface. The processing mode and the working tool during the pass also not changed (change in the depth of cut is not regarded as a mode change processing).

Operation and technological step – the main elements of the process and the content is recorded in the card of operating procedure. To perform a single operation for the worker set a time limit.

The operation can be performed in one or more technological clamping.

The technological clamping – part of the operation which perform over one clamping workpiece on the machine tool.

The first option. A shaft Installed at the center of the machine tool, at first processed one end of the shaft, then inverted the shaft and clamping it again. After that process other end of the shaft.

The second option. In batch of shafts alternately processed one end of the shaft, then, also alternately processed other end. In the first process option shafts made in one operation, but for the two technological clamping. In the second embodiment, the whole batch of shafts processed in two operations with a single technological clamping for each of them.

BASIC DEFENITIONS

Position – part of the operation performed at a fixed position of the workpiece relative to the working part of the machine.

In determining the time limit for operation is necessary to the division of operation into smaller parts - the working steps.

Working step – completed action of worker in the operation (for example: the inclusion of a mechanical feeder, rotation the tool holder, stopping the machine and so on).

Cycle of technological operation – the interval of the calendar time from beginning to end repetitive technological operation regardless of the number of simultaneously manufactured or repaired products.

Output cycle time – time interval in that is periodically made release of products or certain types of workpieces, size and version.

The rhythm of the issue - the number of items or workpieces of certain names, sizes and designs produced per unit time.

BASIC DEFENITIONS

Process mode – set of parameters of the technological process in a specific time interval. (The parameters of the technological process include: cutting speed, feed, depth of cut, the temperature of the heating or cooling, and so on).

The substrate – the surface which to be exposed during processing.

The technological base – surface, the combination of surfaces, the axis or the point used to determine the position of the object of labor in the manufacturing process.

Machining allowance - a layer of material removed from the surface of the workpiece in order to achieve the desired properties of the treated surface.

Processing - an action directed at changing the properties of the object of labor in the performance of the process.

Machining – processing of cutting or molding.

BASIC DEFENITIONS

Roughing machining – processing, which resulted in the bulk of the allowance is removed.

Finishing machining – processing, which resulted in a predetermined dimensional accuracy and roughness of machined surfaces is reached.

Technological document – a graphical or text document, which alone or in combination with other documents defines process or the operation of manufacturing the product.

The set of procedures required for the preparation and approval process of the technological document in accordance with the procedure established in the company, called the **registration of the technological document**.

Operational description of the technological process – a full description of all operating procedures in the sequence of their execution indicating technological steps and processing modes.

BASIC DEFENITIONS

Routes and operating description of the technological process – a short description of operating procedures in the process sheet in the sequence of their execution.

Depending on the quantity and range of products produced by the enterprise and the laboriousness of machine-building production is divided into three types: 1) mass production; 2) serial production; 3) single-part production.

Mass production – the production of similar products manufactured in large quantities for a relatively long time. Mass production is characterized by the use for machining special machine tools, semi-automatic and automatic machine tools and automated lines. Equipment in shops in this case is set along the production flow, i.e. on the course of the technological process.

Each machine tool usually perform the same operations. It's equipped with high-performance devices and special combined cutting tools. To check the details are used measuring devices, various gauges and templates. The assembly of products are manufactured on the conveyor-production lines.

BASIC DEFENITIONS

Serial production – production in which the manufacture of products is performed during the month or quarter periodically recurring batches.

Depending on the size serial production are divided into small, medium and large.

In serial production are used universal, special, specialized equipment and rarely automatic machine tools.

For each machine tools are fixed the execution of one or more operations. Universal machine tools are equipped with special devices which are make them special.

In series production are used special-purpose cutting and measuring tools. In recent years, more and more at serial production is used batch processing of parts and universal devices.

BASIC DEFENITIONS

Individual or single production – production in which the products are produced in one or several copies while to further their release is not repeated or is repeated after an indefinitely long period of time.

Adjusting movement – movement of workpiece and tools necessary to move them to a position in which is possible with the help of formative movements to get the surface of desired size.

Dividing movement – movement is needed to ensure the uniform position of the identical surfaces at workpiece. For example, when we are processing double thread by shaped cutter we need to turn the workpiece at 180° after cutting the first helical groove for cutting the second helical groove. Rotating the workpiece by 180° is the dividing movement.

Support movement – movement that provide installation, clamp, unclamping, transport, the rapid movement of the workpiece and the cutting tool in the cutting zone, cooling, lubrication, chip removal, editing tools, and so on.

BASIC DEFENITIONS

Movement of control – movements which perform the controls, regulation and coordination of all other executive movements of the machine tool. These controls are include the clutch, tumbler, cams, limit switches, etc.

The decisive role in formation of the kinematic structure of the machine tool are the formative movement, adjusting and dividing.

Coordinated movement of the cutting tool and the workpiece, which create a surface of a given shape, known as the forming and denoted by the letter F. Depending on the shape of the generating line and the method of its formation movements shaping can be simple or complex. Simple movements of formation include rotary movements, which denotes F(R), and direct movements – F(D).

Complex formative movement result from concerted interdependent two or more rotational or linear motion, and combinations thereof. Examples of recording complex formative movements: F(R1), F(R1R2), F(R1D1) and so on.