ENGLISH

FOR MACHINE-BUILDING INSTITUTES

Н. Н. НОСОВА, Г. Е. ПИНЗУЛ

ПОСОБИЕ ПО АНГЛИЙСКОМУ ЯЗЫКУ ДЛЯ МАШИНОСТРОИТЕЛЬНЫХ ВУЗОВ

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Нина Николаевна Носова
Георгий Евгеньевич Пинзул

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Редактор *А. И. Гладштейн*
Издательский редактор *Р. И. Заславская*
Художественный редактор *Э. А. Марков*
Технический редактор *Н. М. Тобольцева*
Художник *Н. В. Боровков*
Корректор *З. Ф. Юрескул*

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CONTENTS

Chapter IV

METAL-CUTTING MACHINES

Chapter V

TEXTS FOR HOME READING

ПРЕДИСЛОВИЕ

Настоящее пособие предназначается для студентов машиностроительных вузов и имеет целью подготовить их к самостоятельной работе над научно-технической литературой на английском языке.

Пособие составлено в соответствии с требованиями программы второго этапа изучения иностранных языков в технических вузах и предназначается для обучения, когда пройден учебник общего типа.

Пособие состоит из пяти глав: первая — машиностроительные материалы, вторая — механические инструменты, третья — детали машин, четвертая — металлорежущие станки, пятая — тексты для домашнего чтения.

Большое внимание уделено чтению и переводу специальных текстов из тех областей науки, с которыми специалист-машиностроитель наиболее часто встречается. Эти тексты предназначены для работы в аудитории и содержат большое количество терминологии, используемой в области машиностроения. Дополнительно к этим текстам даны тексты для домашнего чтения. Эти тексты не адаптированы. Они служат для закрепления материала, данного в текстах для работы в аудитории.

Пособие снабжено упражнениями по анализу предложений, а также грамматическими упражнениями, нацеленными на закрепление сложных грамматических конструкций (инфинитивных, герундиальных и причастных), представляющих трудность при переводе. К этим упражнениям даны образцы выполнения.

Для закрепления навыков перевода технической литературы, кроме грамматических упражнений, введены дополнительные тексты для перевода со словарем и без словаря, составленные в соответствии с содержанием учебного текста, которые могут выполняться как классная работа.

Лексические упражнения включают упражнения на подбор синонимов, упражнения на производность, на многозначность слов, на перевод терминов-словосочетаний и на запоминание слов и словосочетаний.

Для закрепления навыков устной речи по специальности тексты снабжены системой упражнений: ответы на вопросы, составление вопросов, составление предложений по заданным словам, пересказ текстов по серии вопросов; тексты также снабжены иллюстрациями, способствующими пониманию излагаемого материала, и серией упражнений к ним, помогающих описанию чертежа.

Пособие снабжено кратким англо-русским словарем, списком общепринятых сокращений и списком составных предлогов, встречающихся в технической литературе.

Материалом для пособия послужили оригинальные источники по машиностроению на английском языке.

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CHAPTER I

MACHINE-BUILDING MATERIALS

Different metals are widely used in the *machine-building industry*. Metals applied for industrial purposes are called "*engineering metals*". There are two groups of metals: *ferrous metals* and *non-ferrous metals*.

1. FERROUS METALS

Ferrous metals consist of *iron* combined with carbon, *silicon*, phosphorus and other elements. Carbon is the most important of all elements present in ferrous *alloys*. Ferrous metals are used in industry in two general forms; *steel* and *cast iron*, which differ in the quantity of carbon content. These two ferrous alloys are derived from *pig iron* which is produced in a *blast furnace* in the form of pigs. Metals are usually melted and poured into a form which is called a "*mould*". This process is known as *casting*. The cast metal is shaped in the mould where it cools and *solidifies*. Thus one can cast different objects known as castings. The *shop* where metals are cast is called a "*foundry*". Castings are used in building engines, automobiles and airplanes, and different types of machinery. Steel is iron with a very little carbon content (from 0.05 to 1.7 per cent), which makes it much stronger than iron and is therefore widely used in machine-building. But very much carbon makes steel brittle, which reduces its strength. Therefore the carbon content in steel is confined to certain limits. Cast iron contains a higher percentage of carbon than steel does (more than 2.0 per cent). It is very cheap, in fact, it is the cheapest of all the engineering metals used in machine-building. *Grey iron* foundries are the most numerous because grey iron can be cast into almost any conceivable shape and size. Grey iron is also adapted to a great variety of castings, such as automobile, gas, steam, and hydraulic engine cylinders, *bed plates* for machines, car *wheels*, agricultural machinery parts, furnace and stove parts, water pipes, *gears*, and general machinery parts. The nature of the metal used for grey iron castings is such that castings can be made so hard that ordinary *tool steel* will not cut them or, on the other hand, so soft that they can be readily *machined*. However, in comparison with other casting metals grey iron is weak and will not stand great shock. Hence, the engineer must allow a large factor of safety[1] when specifying the use of grey iron castings, especially where great strength is required, or specify that the castings must be made from some other metal. The alloy of grey castings is composed of iron, carbon, silicon, phosphorus, *manganese*, and sulphur. These elements are used in different proportions depending on the *grade* of castings.

Alloy Grey Iron. In many lines of *manufacture* and engineering, common grey iron castings have lacked in strength and *wearing qualities*, so that many experiments have been conducted with a view to overcome this shortcoming. This has been accomplished, and the alloy is known as alloy grey iron, which is easy to machine because most of the carbon present is in free or uncombined state. It is used much,[2] if not entirely, for making steam- and gas-engine cylinders, also for many other castings that require greater strength and wearing qualities than are *furnished* by common grey iron. Alloy grey iron is one of the latest alloys developed and has a promising future. It has a *tensile strength* of 40,000 to 60,000 lbs. per square inch[3] as it comes from the mould, and when it is heat-*treated*, a much greater strength is produced. *Malleable iron* castings are being increasingly used every year in the manufacture of machinery.

Many castings that were formerly made of grey cast iron are now made of malleable iron. One of the reasons for using malleable iron instead of grey iron is that malleable iron is much stronger than grey iron castings, particularly in the matter of[4] resisting shock. Malleable iron castings can be made much thinner in section. However, they are seldom used in the form they come from the moulds, as they are hard and brittle, and therefore they should be *annealed*. Malleable iron before annealing is usually spoken of as white iron. White iron is difficult to machine because most of the carbon present is in chemical combination with the iron. Malleable iron can be cast into very large bodies *on account of* its high shrinkage and because of the difficulty of annealing. It is the most easily machined of all ferrous alloys. It has to be melted very hot and poured very rapidly, because it solidifies quickly. Malleable iron castings are used in agricultural machinery, railroad *equipment*, automobile parts, and many other products.

The metal is usually tested for *tensile strength* and *elongation*. The tensile strength *ranges* from 38,000 to 55,000 lbs. per square inch and the elongation is usually about 20 to 25 per cent.

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1. a large factor of safety — большой коэффициент безопасности
2. it is used much — он широко используется
3. lb. per square inch — фунт на квадратный дюйм
4. in the matter of — в отношении

Exercises

I. Use the following words and phrases in sentences of your own:

ferrous metals, steel, cast iron, mould, alloy, pig iron, blast furnace, grey iron, to solidify, foundry, to cast, engineering metals, tool steel, to machine, alloy grey iron, to furnish, malleable iron, to anneal, tensile strength, non-ferrous metals, on account of, grade, to elongate, range, shop

II. Answer the following questions:

1. What are the main two groups of metals? 2. What elements do ferrous metals consist of? 3. What is the difference between iron and steel? 4. What is casting? 5. What do we call the shop where metals are cast? 6. Why is steel widely used in machine-building? 7. What are the main types of iron castings?

III. State the forms and functions of the ing-forms and translate the following sentences into Russian:

1. Machine-building industry is the leading branch of heavy industry. 2. The work of casting metals is performed in foundries. 3. Metals consisting of iron with some other elements are known as ferrous metals. 4. Engineering metals are used in industry in the form of alloys because the properties of alloys are much better than those of pure metals. 5. Steel is iron containing from 0.05 to 1.7 per cent carbon. 6. The blast furnace is called so because a blast of hot air is forced into it while producing the pig iron. 7. Malleable iron before annealing is usually called "white iron". 8. For separating iron from impurities the iron ore must be melted at a very high temperature produced by burning coke in a blast furnace.

IV. Fill in the blanks with prepositions because of, of, for, in, with:

1. Metals are ... great importance ... our life ... their useful properties. 2. They are widely used ... industrial purposes. 3. There are two large groups ... metals: simple metals and alloys. 4. Alloys consist ... a simple metal combined ... some other elements. 5. Almost all the metals are found ... the earth's crust ... the form ... ores.

V. Translate the following sentences with the predicates in the passive form, then change the predicates into active form:

Example: Metals *are usually melted and poured* by founders into a form which is called a "mould".
Founders usually *melt and pour* metals into a form which is called a "mould".

1. Different metals are produced by people in different ways. 2. Three methods are now used by us for producing pig iron. 3. Ferrous metals are used in industry in two general forms such as steel and cast iron. 4. The iron ore charged into the furnace has been melted by the heat produced by the coke burning in the blast of hot air. 5. Malleable iron castings are being increasingly used in industry. 6. Great shock will not be stood by grey iron. 7. The heat in the electric furnace was produced by electricity.

VI. Find in the text nouns for the following verbs:

to cast, to alloy, to anneal, to compare, to manufacture, to machine, to equip, to produce

VII. Make up questions to which the italicized words are the answers:

1. Many experiments have been conducted *to improve the qualities of grey iron castings.* 2. Some castings require *great strength and wearing qualities.* 3. *Malleable iron castings* are much stronger than grey iron castings. 4. Malleable iron can be cast *into very large bodies.* 5. Metals are usually tested *for tensile strength and elongation.*

VIII. Translate the following text in written form using a dictionary:

Production of castings made from different metals requires different types of melting furnaces. The cupola furnace is usually used for melting grey iron. The air cupola, and electric furnaces are used to melt the metal for making malleable iron castings. For melting steel, the open-hearth, crucible or electric furnaces are used. Non-ferrous metals are generally melted in crucibles or electric furnaces. The fuels mostly used for melting metals are coke, coal, oil and gas. Besides the different types of furnaces, different kinds of moulding sand are also required for making the moulds for different metals. In many cases, it is necessary as well to treat either the metals or the castings in some special way before the castings can be used.

2. STEEL

Steel is a ferrous material with some carbon content. There are two kinds of steel: *carbon and alloy steel.* The content of carbon in steel may vary from 0.1 to 1.0 per cent. Carbon steel should contain only iron and carbon without any other alloying elements and is divided into:

(1) *Machine steel* with a low carbon content from 0.05 to 0.15 per cent.

(2) *Medium carbon steel* with a carbon content from 0.15 to 0.60 per cent.

(3) *Tool steel* with a high carbon content from 0.6 to 1.50 per cent. Carbon steels are the most common steels

used in industry, their properties depending only on the percentage of carbon they contain. Machine steels are very soft and can be used for making machine parts that do not need strength. Medium carbon steels are better grade and stronger than machine steels. Tool steel may be used for manufacturing *tools* and working parts of machines because of its high strength and hardness.

Alloy steels are those in which *in addition to* carbon an alloying element is present in some appreciable quantity. They are divided into special alloy steels and *high-speed steels* which, in turn, are called *"self-hardening steels"*. Alloying elements of these steels are: nickel, chromium, manganese, molybdenum, *tungsten*, vanadium, etc. These alloying elements have a definite effect on the characteristic of the steel; nickel increases its strength and hardness, a high percentage of chromium makes steel *rust-resistant* and in this case it is called *"stainless steel"*. The addition of some tungsten and molybdenum gives heat-resistant steel. Vanadium makes steel corrosion, shock and vibration-resistant. The sand used for making moulds for steel castings differs greatly from that used in other branches of moulding. It must be much more *refractory* and open grained,[1] because the metal is poured at an extremely high temperature and solidifies very rapidly. If the sand is not refractory enough, it will *fuse* with the metal. The sand being not open grained, the gases will not escape from the mould rapidly enough, and blowholes will be formed in the casting. Many good steel castings are obtained with *green sand moulds*. Sand moulds are made by shaping the moulding sand around a *pattern* which is to have the same shape as the finished object, but their size should be a little larger as the steel casting shrinks while cooling. Moulding sand is to be mixed with water in a certain proportion. Many of the smaller steel castings are used as they come from the moulds, but most of the larger ones have to be annealed to relieve the cooling *strains* formed when the metal solidifies. Steel can be used for a great variety of castings, and it can be cast into very large bodies.

Cast steel parts enter into the make-up[2] of railroad equipment, agricultural machinery, and many other products where great strength is required. The tensile strength of steel castings is from 55,000 to 70,000 lbs. per square inch. Alloy steel castings are coming into more general use with each year, and they are influencing the manufacturing methods. It has been found possible to cast with this alloy some shapes that formerly were necessarily made in other ways. It is used in castings where the greatest strength is needed. Much research is being done to improve not only its strength, but also its wearing qualities. Castings are now produced that have a tensile strength from 70,000 to 150,000 lbs. per square inch, the strength depending upon the composition of the alloy and the method of heat treatment.

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1. It must be much more refractory and open grained — он должен быть еще более огнестойким и крупнозернистым
2. make-up — состав

Exercises

I. Use the following words and phrases in sentences of your own:

to rust, alloying elements, to resist, to escape, stainless steel, carbon steel, machine steel, alloy steel, to fuse, corrosion, refractory, rust-resistant steel, heat-resistant steel, green sand moulds, pattern, strain

II. Answer the following questions:

1. What is steel? 2. What are the main types of steel depending on the carbon content? 3. What steels are most widely used in industry? 4. What manufacturing purposes may tool steel be used for? 5. What is alloy steel? 6. What alloying elements can change the properties of alloy steel? 7. What sand is used for making steel castings? 8. Why must the pattern be a little larger than the casting which is to be produced? 9. What does the tensile strength of steel depend on?

III. Find in the text verbs for the following nouns:

division, casting, difference, fusion, solidification, improvement, requirement, production

IV. Translate the following sentences into Russian and observe the different ways of expressing obligation:

1. Steel has to be widely used in machine-building because of its high strength. 2. Alloy steel must be made by

adding some alloying elements. 3. Tools made of high-speed steel may do the work at much higher speeds than carbon tool steels. 4. Chromium and tungsten are to increase the hardness and strength of steel. 5. High carbon steel should be hardened by heating it to a certain temperature and then quickly cooling in water. 6. Special alloy steels can be used for parts requiring great wear resistance.

V. Connect the following sentences using Absolute Participle Constructions and translate the sentences into Russian:

Example: 1. Steel is one of the strongest metals.
We use steel for products where great strength is required.
Steel being one of the strongest metals, we use it for products where great strength is required. — Так как сталь является одним из самых прочных металлов, мы используем ее для производства изделий, которые требуют большую прочность.

2. Alloying elements for making steel are nickel, chromium, manganese, etc.
Nickel increases strength and hardness of the steel.
Alloying elements for making steel are nickel, chromium, manganese, *nickel increasing strength and hardness of the steel.* — Сплавляемыми элементами производства стали являются никель, хром, магнезий и другие, причем никель увеличивает прочность и твердость стали.

1. Alloy steels are ever wider used in industry. Manufacturing methods are changed. 2. The metal is poured at an extremely high temperature. The sand used for making moulds for steel castings should be refractory. 3. Steel is a very strong material. We find wide application of steel in engineering. 4. Heat-resistant steel is made by adding some tungsten and molybdenum. Manganese increases the wear resistance. 5. Steel and cast iron differ in carbon content. The carbon content of steel is little, while that of cast iron is much greater. 6. Some alloying elements make steel rust-resistant. Such steels are called stainless steels.

VI. Underline the suffixes and translate into Russian the following groups of words:

strong, strength; addition; appreciable, appreciation; define, definite, definition; form, formation, former, formerly; vibrate, vibration, vibrator, vibratory

VII. (a) Read and translate the following text without using a dictionary:

PRODUCTION OF STEEL

Converter steel is made from molten pig iron by forcing a blast of cold air under great pressure through the metal. The converter represents a large tank made of steel and covered with refractory bricks with an open top through which the molten metal is poured into the converter and out of it. When forcing the blast of cold air through the melted metal, the oxygen contained in the air combines with the carbon of the pig iron, and almost all the carbon in the metal is burned out. Steel made by this method is very cheap, but it is low grade steel because this method of producing steel cannot be well controlled.

Steel made in this way is called "Bessemer steel". One ton of such steel can be made in one minute.

(b) On the basis of the text make up three questions and answer them.

3. NON-FERROUS METALS

Non-ferrous metals are more expensive than ferrous metals and are used only when some characteristic not possessed by iron or steel is essential or desirable in application. These characteristics are: high electrical and *thermal conductivity, high corrosion resistance, non-magnetic qualities,* light weight, etc.

The metals most frequently used to make non-ferrous metal castings are *copper, tin, zinc, lead, nickel, gold* and *aluminium.* Some of the basic non-ferrous metals and their characteristics are described below.

Copper is a reddish-brown, tough metal. It has very high electric conductivity and high corrosion-resistant qualities. Copper is used for making electrical contacts and wires, pipes, telephone cables, tanks, water heaters, etc.

Zinc is a hard, brittle, bluish-white metal that is employed in the pure form as *sheet zinc.*

Lead is a very heavy bluish-grey metal which is very soft. This metal is highly resistant to corrosion, but its strength is so low that it must be *supported* by a *core* of some other metal. Lead is used for *lining* pipes, acid tanks and *coating* electrical cables.

Aluminium is a soft, silvery white metal. It is light in weight, has high corrosion-resistant qualities and is used for automobile and airplane parts as well as for making different light-weight objects used in everyday life such as: frames, cooking utensils, chairs, etc.

Tin is a silvery, corrosion-resistant metal. Tin is hardly used in pure form, but is employed as an alloying element.

Nickel is a hard, tough, silvery metal. It has high corrosion-resistant qualities and is used for plating other metals such as iron or *brass.*

There are many applications of non-ferrous metals in the unalloyed state, but in most cases, some alloying element is added.

The above-mentioned non-ferrous metals may be mixed in various proportions to form many alloys, chief among them being brasses, bronzes, and aluminium alloys. There is a wide range of use for non-ferrous alloys. Their nature differs greatly from that of the ferrous group. By varying the proportions of non-ferrous metals, alloys that are hard or soft, weak or strong, can be produced. When alloying, the metal with the highest melting point should be melted first, then the one with the next highest melting point, and so on until all of the metals that are to make up the alloy are melted together. For example, to make a red-brass alloy, the copper is melted first, then the zinc, then the lead, and at last the tin. As soon as the mixture is hot enough to run the castings, it should be taken out of the furnace, otherwise the zinc, tin and lead may burn away.

Brasses are yellowish or reddish alloys of copper and zinc in different proportions (about 60 per cent copper and 40 per cent zinc, but some brasses contain as high as 90 per cent copper with only 10 per cent zinc). An addition of tin makes brasses stronger. Brasses are very *ductile* and may be treated without heating them. They are corrosion-resistant and are used for making musical instruments, *bearings*, etc.

Bronze is an alloy containing primarily copper and tin, but other elements may be added to the alloy to increase its properties such as hardness and resistance to wear. The most common bronzes are known as *straight bronze*, phosphor bronze, and manganese bronze. Straight bronze is usually a mixture of copper and tin, but there are many bronzes that contain zinc and lead, especially the cheap mixtures. Phosphor bronze may be made by adding a little phosphorus to the mixture. If phosphor tin is used and alloyed with the copper, better results will be obtained than if the phosphorus is mixed with the copper. Manganese bronze alloys are usually made by using both copper that contains from 5 to 15 per cent of manganese and copper that contains no manganese.

Aluminium Alloys. Aluminium is used extensively for castings that are to be light in weight, light in colour, or that must not rust. Since aluminium is too soft for making castings, it is necessary to mix some other metals with it. The metals that alloy freely with aluminium are copper, zinc, and iron. Usually, where aluminium alloys are made, the aluminium predominates.

All non-ferrous castings will take a high polish and will not rust so easily as the ferrous metals, a characteristic that makes them especially useful in wet or damp places. Non-ferrous metals are rather expensive and therefore nowadays scientists try to replace them with some ferrous alloys of lower cost possessing the same properties.

Exercises

I. Use the following words and phrases in sentences of your own:

thermal, mixture, copper, coating, non-magnetic quality, tin, sheet zinc, lining, to support, lead, core, brass, bronze

II. Retell the text giving answers to the following questions:

1. What ferrous metals do you know? 2. What are the main characteristics of non-ferrous metals? 3. What are the properties of copper and what is it used for? 4. What do you know about lead? 5. What purposes is aluminium used for? 6. What are the properties of other non-ferrous metals? 7. What metals are used for producing non-ferrous castings?

8. What do you know about brasses? 9. What do you know about bronzes? 10. What are the main properties of non-ferrous castings? 11. Why are attempts made to replace non-ferrous metals by ferrous ones?

III. State the forms and functions of infinitives and translate the following sentences into Russian:

1. Some metals have *to be melted* at very high temperatures. 2. *To make* non-ferrous castings, such metals as zinc, lead, aluminium and others are melted together. 3. *To line* pipes and electrical cables such metal as lead is used. 4. One must *add* some tin *to make* brasses stronger. 5. Very few objects are made of pure tin, but it is used *to make* bronze, babbit, and other alloy metals. 6. Nickel is used for covering iron and brasses *to make* them look better. 7. Nickel does not rust and can *be polished* to a very bright, silvery finish. 8. *To increase* hardness and strength of cast copper some cold-working operations are performed.

IV. Underline the suffixes and prefixes and translate into Russian the following groups of words of the same stem:

to conduct, conductor, conductivity; red, reddish; silver, silvery; to possess, possessive, possession; to plate, plating; to alloy, alloying; to resist, resistance, resistant; strong, strength, to strengthen; hard, hardness, to harden, hardening; pure, impure, purity, impurity, to purify, purification

V. Translate the following sentences paying attention to the different meanings of the word make:

1. Addition of copper, zinc and iron *makes* aluminium stronger. 2. The Soviet *makes* of new cranes are well known all over the world. 3. The foreman *makes* the learners pay attention to the casting process.

VI. Translate the following sentences into English using infinitive constructions.

Example: Для того чтобы увеличить производство металла, необходимо применить новые методы его выплавки.

To increase the output of metal it is necessary *to apply* new methods of smelting.

1. Для того чтобы увеличить прочность бронзы и сопротивление на износ, к ее составу можно добавить, кроме меди и олова, некоторые другие элементы. 2. Фосфорную бронзу можно получить добавлением небольшого количества фосфора к смеси меди и олова. 3. В практике литейного производства цветные металлы стараются заменить более дешевыми ферросплавами, которые обладают такими же свойствами. 4. Алюминий используется для изготовления различных предметов домашнего обихода. 5. Для того чтобы сделать железо коррозие-устойчивым, его можно покрыть никелем.

VII. Make up as many questions as possible on the basis of the following sentences:

1. Copper is used for making electrical contacts and wires because of its high electrical conductivity. 2. Aluminium possesses high corrosion-resistant qualities. 3. Non-ferrous castings differ greatly from ferrous ones. 4. Aluminium is extensively used for castings that are to be light in weight.

VIII. Translate the following text in written form without using a dictionary:

NON-FERROUS METALS

The metals most frequently used to make non-ferrous castings are copper, tin, zinc, lead, and aluminium. These non-ferrous metals have better resistance to corrosion than steel and they are usually easier cast and worked. There are many applications of non-ferrous metals and only few manufactures or machines are made that do not require the service of some or other non-ferrous component. For most purposes the pure non-ferrous metals are too soft and other alloying elements have to be added to create particular physical properties as required by each application. For this purpose non-ferrous metals are mixed in various proportion to form different alloys, such as brasses, bronzes and aluminium alloys, which can be strong, weak, hard or soft. Their cost is considerably greater than that of carbon steel but less than of some of the alloy steels.

4. PROPERTIES OF ENGINEERING MATERIALS AND METHODS OF TESTING THEM

While using engineering materials in practice we must know their properties because they affect manufacture and application of materials. All engineering materials have definite characteristics which determine their abilities to assume external *loads* because of which materials change their shape. When a metal is treated or when machine parts and tools are in the process of work[1] the metals which they are made of are *subjected* to the influence of *external forces*. These forces are called "loads" and may have different characteristics: *according to* their value they may be small or large; according to the duration and character of their action they may be *constant* and *impact*. According to the influence of the loads upon the metal *causing* different changes of its shape, loads are distinguished as *compression*, *tensile*, *torsional*, *shearing*, and *bending* ones. By testing a metal under a load one can define what mechanical properties it has. In other words, one can determine strength, elasticity, plasticity, hardness and other properties of the metal. In order to have a clear conception[2] of the metal properties it is subjected to tests on special devices and machines. The determination of these properties is made in the laboratory using a *specimen* from the metal to be tested. Let us consider some of the mechanical properties of metals, such as:

Strength of metals is the property of hard materials to be subjected to the influence of external forces without incurring damage and without changing their shape. The *ultimate tensile strength* of a material is that *unit stress* developed in the material by maximum slowly applied load that the material can resist without rupturing in a tensile test. A *stress* is the force within a body which resists deformation *due to* an externally applied load. If this load acts upon a *surface* of *unit* area, it is called a "unit force", and the stress resisting it is called a "unit stress". An external force acting upon an elastic material, the material is deformed and the deformation is in proportion to the load. This distortion or deformation is called "strain".

Special machines, called "*rupture machines*", are used to test metals for strength. Fig. 1 shows one of these machines. When testing a specimen, the upper *clamp* remains fixed and the lower one is being slowly lowered, thus causing the *extension* of the specimen. The load upon the specimen may be easily determined at any moment *by means of pointer* indications on the *dial*.

Elasticity is the ability of a material to change its shape under the influence of external loads and return to its original form upon removal of the loads. All materials are elastic but the range of elasticity varies for different materials. Elasticity is *evaluated* by means of the modulus of elasticity. The modulus of elasticity is the ratio of the unit stress S to the unit deformation $\triangle l$ within the proportional limit of the material to be tested

$$E = \frac{S}{\triangle l}.$$

For determining the elasticity of metals a rupture machine may be used.

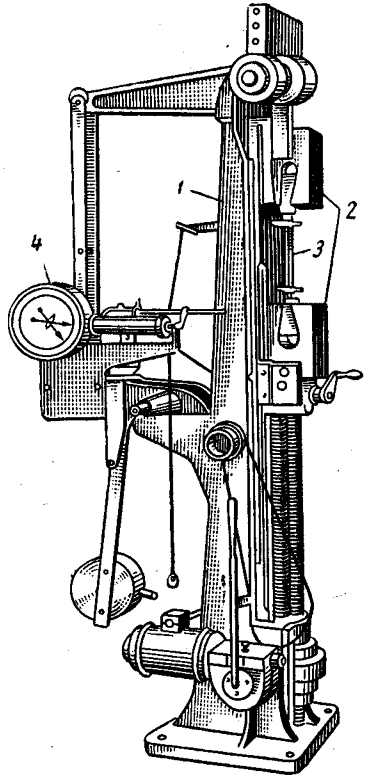

Fig. 1. Rupture Machine:
1 — stand; *2* — clamps; *3* — specimen to be tested; *4* — dial

Plasticity is that property of a material when under the influence of loads, specimens of different materials may elongate while their *cross-section* decreases. Plasticity is the opposite of elasticity. So, plasticity is the ability of material to change its form without breaking under the influence of load and preserve this changed form after removal of the load. For determining the plasticity of metals a rupture machine may be used too.

Hardness of material is the property to resist deformation under applied load. Hardness is the most important mechanical property of metals. Hardness may also be defined as the ability of metals to resist *penetration* of other harder materials or as resistance to wear.

Exercises

I. Use the following words and phrases in sentences of your own:

to penetrate, hardness, cross-section, to determine, to evaluate, plasticity, elasticity, to influence, unit stress, engineering materials, property, to subject, load, external forces, to cause, impact loads, compression loads, torsional loads, specimen, shearing loads, unit, surface, clamp, bending loads, rupture machine, extension, dial

II. Answer the following questions:

1. Why is it necessary to know the properties of engineering materials? 2. To what forces are machine parts subjected in the process of work? 3. How are the loads distinguished according to their influence upon the metal? 4. What are the most important mechanical properties of metal? 5. What special devices are used for testing mechanical properties? 6. What is stress? 7. What is strain? 8. What is strength of metals? 9. What is elasticity of metals? 10. What is plasticity of metals?

III. State the forms and functions of infinitives and translate the following sentences:

1. Malleability of a metal is also known as its ability *to be deformed* permanently under compression without rupture. 2. *To determine* properties of a metal special machines are used. 3. Plasticity of a metal makes it safe *to use* in all types of structures. 4. The materials *to be tested* are clamped between two clamps on the rupture machine. 5. It is common practice *to divide* metallurgical materials into ferrous and non-ferrous ones. 6. Some metals possess special properties, one of which is power *to conduct* electric current. 7. The ability of a material *to take* deformation without breaking is known as plasticity. 8. Engineering materials have large industrial applications and their mechanical properties *to be studied* require much attention.

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1. are in the process of work — обрабатываются
2. to have a clear conception — иметь ясное представление

IV. Fill in the blanks with prepositions to, within, from, into, on, in, of, by means of, per, without, by:

1. The composition ... metals and alloys is important ... the effect it has ... their mechanical, electrical, or magnetic properties. 2. Metals can be cast ... various shapes weighing ... a few ounces ... many tons. 3. Their plasticity, or ability to deform ... rupture allows their formation ... a required shape. 4. The strength ... a metal is generally measured ... tensile tests. 5. Tensile strength is expressed ... pounds ... square inch. 6. When a metal is subjected ... stresses exceeding its elastic limit, the crystals of the metal elongate by an action ... shearing which takes place ... the crystals and between the crystals. 7. One way ... measuring the hardness is to determine the depth ... which a diamond cone or ball will penetrate ... the metal under a given load.

V. Make up nouns and adjectives from the following verbs and translate them into Russian:

to subject, to differ, to compress, to develop, to determine, to extend, to remove, to evaluate, to break, to deform, to define, to penetrate, to resist, to indicate, to consider

VI. Supply synonyms for the following words:

force, to call, to treat, to apply, a specimen, hard, small

VII. Supply antonyms for the following words:

external, constant, tensile, hardness, compression

VIII. Make up questions to which the italicized words are the answers:

1. The deformation test of a metal property is performed *in a laboratory*. 2. *By testing a metal* one can define its mechanical properties. 3. *In some materials, such as stone or iron*, the possible elastic deformation may be very small. 4. In some materials, such as lead, plasticity may imply *an almost total absence of elasticity*. 5. *Elasticity* is the capacity of the material to resist produced deformations without permanent change of form.

IX. Giving answers to the following questions describe the principle of operation of the rupture machine shown in Fig. 1:

1. What is a rupture machine used for? 2. How do the clamps of the rupture machine operate when testing a specimen? 3. By what means is the load upon the specimen under test determined?

CHAPTER II

MECHANICAL TOOLS

1. CHIPPING METAL AND CHIPPING TOOLS

Chipping is a process of removing metal from a *workpiece* by means of a cutting instrument such as a *chisel* and a *hammer*. This process is used when a large piece of metal has to be removed from a workpiece; this process is very labour-consuming[1] and is applied only in cases when the workpiece cannot be machined. Chipping is used in cases when it is necessary to cut off a piece of metal from sheet metal. Chipping of large parts is always done on an *anvil* but very often it is done in a *bench vice*. The workpiece to be tooled is *fixed* during the cutting process in the bench vice.

There are different tools used in metal-working shops for chipping *stocks* such as chisels. A chisel is a tool made of very hard steel, having a *cutting edge* at one end of the *blade*. This cutting edge is *wedge-shaped*. Under the effect of an external force applied to the wedge it cuts into the metal. The work of the wedge depends mainly on its *cutting angle*. The cutting edge of the chisel should be sharpened to an *acute angle* so as to provide for the best cutting ability, depending on the stock

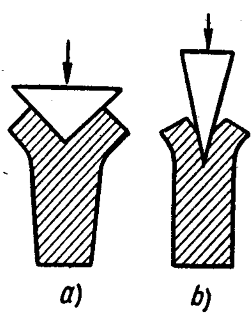

Fig. 2.

a — bar with an obtuse angle; *b* — bar with an acute angle

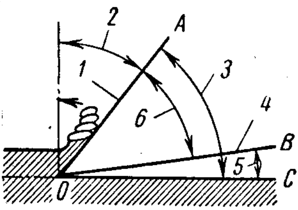

Fig. 3. Process of Chipping by Means of a Chisel:

1 — front cutting face; *2* — front rake; *3* — cutting angle; *4* — back cutting face; *5* — clearance angle; *6* — lip angle

to be chipped. The harder the metal, the larger should be the cutting angle of the chisel and vice versa. An angle of about 70° is suitable for most work. Fig. 2 shows a scheme of the process of cutting into metal, and the angles of the wedge.

Fig. 3 shows the process of chipping by means of a chisel, as well as the cutting angles. The *plane AO* called the "*front cutting face*" or the "*top face*" is given a backward and sidewise slope for sliding the chips off the tool in a convenient direction while the plane *OB* is called the "back cutting face". Being formed between the front and back cutting faces of the chisel the angle *AOB* is known as the *lip angle*. The angle *BOC* is the *clearance angle* which is formed by the back cutting face of the chisel and the surface of the work to be treated. The slope in the direction of the chisel length in which the chip moves is called the "*front rake*" or "*true rake*". The angle *AOC* formed by the lip angle and clearance angle is known as the "cutting angle". There are different types of chisels such as *flat chisels*, *cape chisels*, etc.

Hammers are striking tools used in chipping, bending and other operations. Hammers are made of a *solid* piece of *forged* tool carbon steel, their weight depending on the stock to be removed.

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1. labour-consuming — трудоемкий

Exercises

I. Use the following words and phrases in sentences of your own:

to chip, chisel, stock, mechanical tools, blade, wedge, edge, cutting angle, acute angle, plane, lip angle, clearance angle, cape chisel, front rake, to strike, to forge, solid

II. Retell the text giving answers to the following questions:

1. What is chipping? 2. What instruments are used in chipping? 3. What is a chisel? What types of chisels do you

know? 4. What does the work of a chisel depend on? 5. What does the angle of the cutting edge of a chisel depend on? 6. Why is the top face of a chisel given a certain slope? 7. What is the front rake? 8. What plane is called the "front cutting face"? 9. What plane is called the "back cutting face"? 10. What is the clearance angle, the lip angle and the cutting angle?

III. Fill in the blanks with prepositions by, from, in, of, on:

1. Chisels are used ... removing stock ... works. 2. Chisels are usually made ... a high grade steel. 3. The cutting edge ... a chisel is ... the form ... a wedge. 4. The correct cutting angle ... a chisel depends ... the strength ... a stock to be chipped. 5. Stocks are chipped ... means ... a chisel and a hammer.

IV. Supply antonyms for the following words:

hard, large, suitable, convenient, backward, long

V. Make up adverbs from the following words and translate them into Russian:

different, hard, main, external, large, convenient

VI. Change the following sentences using the Infinitive Construction and translate them into Russian:

Example: The chisels *which are to be used* for chipping metals are made of high grade steel.
The chisels *to be used* for chipping metals are made of high grade steel.

1. Different types of chisels are made of a good grade chisel steel which has to be forged, annealed, and then hardened and tempered. 2. Chisels which must be applied for chipping metal stocks are made of hard steel. 3. Working a metal to a desired shape by forging produces the best combination of physical characteristics for parts which will be highly stressed. 4. An auxiliary equipment which will be used together with the forging hammer must withstand the vibration or impact of the forging blows. 5. The weight of hammers depends on the stock which will be removed. 6. The work required to separate the chip from the stock will depend upon the material which is to be machined and the separation area.

VII. Translate the following sentences, observing different meanings of the words and word combinations given in italics:

1. There are different *means* of chipping stocks. 2. Chipping is performed *by means of* such instruments as a chisel and a hammer. 3. It *means* that you have to remove some more metal from the workpiece. 4. *By no means* should this chisel be used for this workpiece. 5. A chisel must *by all means* be applied for removing some metal from the workpiece.

VIII. Make up questions to which the italicized words are the answers:

1. The workpiece *to be tooled* is fixed during the chipping process in the bench vice. 2. A chisel is a tool made of *very hard steel*. 3. A chisel has a cutting edge *at one end of the blade*. 4. The cutting edge of a chisel is *wedge-shaped*. 5. The angle between the two edges of the tool in the plane of the true rake is called the "*lip angle*".

IX. Using the following words and word combinations describe the drawing shown in Fig. 2:

a chisel, to be a tool of very hard steel, to have a cutting edge, to be wedge-shaped, to be under the effect of an external force, to cut into metal, the work of the wedge, to depend on the cutting angle, to be sharpened to an acute angle, to provide the best cutting conditions

2. METAL-CUTTING AND LOCKSMITH'S CUTTING TOOLS

Metal cutting differs from chipping in substituting impact stresses by *pressing forces* in this operation. Cutting is used for separating some part from a piece of metal as well as to cut angles, *grooves* and pipes. Depending upon the shape and size of workpieces cutting is done by means of different *cutting tools* such as *pliers*, *bench-shears*, *alligator shears*, *hack saws* and *pipe-cutters* made of carbon steel.

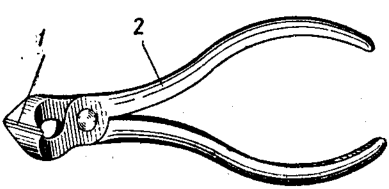


Fig. 4. Pliers:
1 — cutting jaw; *2* — handle

Pliers, or wire-cutters (Fig. 4) are used for cutting thin wire. Pliers consist of two cutting *jaws* and two *handles*. A piece of wire is placed between the cutting jaws and the wire is cut by exerting pressure on the handles of the pliers.

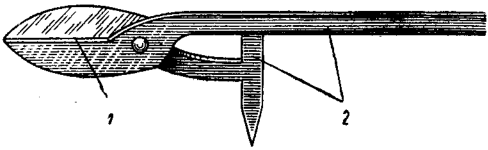


Fig. 5. Bench-Shears:

1 — shear blade; *2* — handle

Bench shears are made of steel. *Lateral* surfaces of shear blades are *hardened*, sharpened and ground.

Bench-shears (Fig. 5) are provided with two handles one of which is at a *right angle* to the other and fixed on a *bench*. The length of the handle is 400-800 mm, while that of the cutting part is 100-300 mm. The material is cut by *pressing* on one of the handles.

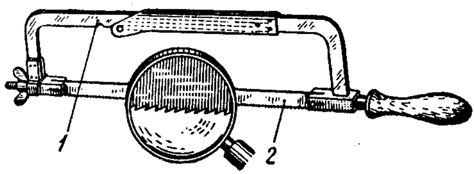


Fig. 6 Hack Saw

1 — frame: *2* — toothed blade

A hack saw (Fig. 6) is used for cutting thick metal sheets, *bars*, round-shaped material, etc. The hack saw consists of a frame and a long toothed blade made of tool carbon steel. The teeth on the blade are hardened. The blades with different *pitches* have different applications, the pitch of the blade depending on the material to be

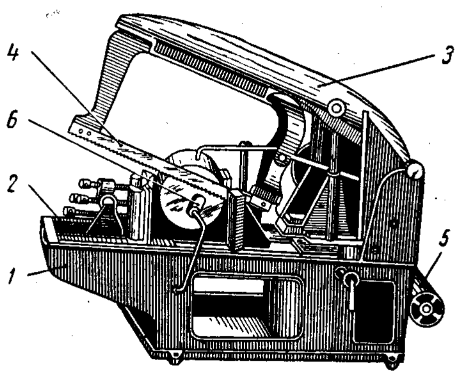


Fig. 7. Alligator Shears:

1 — bed; *2* — bedplate; *3* — arm; *4* — cutting blade; *5* — electromotor; *6* — machine vice sawed. The thinner the material to be handled, the finer must be the pitch of the blade used for sawing this material, and vice versa.

Fig. 7 shows alligator shears which is a *heavy duty machine* for cutting materials of large sections such as pipes, *beams*, auto frames, axles and different types of industrial *scrap*. The alligator shears consist of cast iron *bed 1* and *bedplate 2*. *Arm 3* is *mounted* on the bedplate. Cutting blade *4* is fixed within the arm. Electromotor *5 imparts reciprocating motion* to the arm and the blade. The workpiece to be cut is clamped in machine vice *6*.

Special pipe-cutters (Fig. 8) serve for cutting pipes. The pipe-cutter consists of *body 1*, handle *4*, and three steel cut-

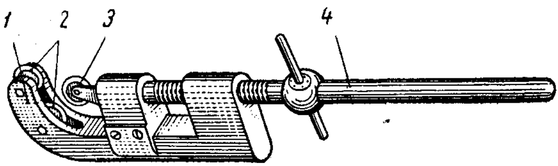


Fig. 8. Pipe-Cutter:

1 — body; *2* — rollers; *3* — roller; *4* — handle

ting rollers. Two rollers *2* installed on the fixed axles of the body and roller *3* installed on the axle of the handle may revolve and cut a pipe fixed in a special pipe fixture. For this purpose the pipe-cutter is turned round the pipe to be cut, pressing the cutting rollers against its surface.

Exercises

I. Use the following words and phrases in sentences of your own:

bedplate, arm, pitch, bar, lateral, metal cutting tools, pliers, pipe-cutters, hack saw, cutting jaws, to harden, right angle, bench-shears, to press, bed, industrial scrap, groove, to impart, reciprocating motion, to install, fixture, body

II. Supply the missing words:

1. The p... of a blade is the distance from the point of one t... to the point of the next t... . 2. This

pitch is expressed by the number of t... per one inch of the b... length. 3. The hand hack saw blade is a thin blade with teeth formed on one e... . 4. The flexible h... s... blade is used for s...ing tin, copper, aluminium and other soft metals. 5. Cutting is done by means of different c... t... . 6. For cutting wire such cutting t... as p... are used. 7. One handle of b...-s... is at a r... a... to the other.

III. Translate the following sentences into English using the infinitive instead of the attributive clauses:

Example: Материал, который нужно разрезать, зажимается в тисках.
The metal *to be cut* is clamped in the vice.

1. Шаг полотна ножовки зависит от материала, который будет распиливаться. 2. Различные виды стали, которые используются для полотна ножовок, изготовляются на нашем заводе. 3. Полотно ножовки, которое надо использовать для распиливания этих тонких листов, должно иметь 32 зуба на один дюйм. 4. Труба, которую надо разрезать труборезом, будет закреплена в специальном приспособлении. 5. При вращении трубореза вокруг изделия, которое надо разрезать, создается режущее усилие.

IV. Make up questions to which the italicized words are the answers:

1. This bar is subjected to *the action of two sets of external forces*. 2. Cutting is used *in cases when it is necessary to separate a piece of metal*. 3. *Thin wire* is cut with pliers. 4. Sheets of metal are cut *with bench-shears*. 5. *Cutting tools* are made of *carbon steel*. 6. Pliers consist of *two cutting jaws and two handles*.

V. Giving the answers to the following questions describe the principle of operation of pliers, bench-shears, and alligator shears and pipe-cutter shown in Figs 4, 5, 7, and 8:

1. What are pliers used for? 2. What do the pliers consist of? 3. What is the funtcion of pliers, jaws and handles? 4. What material are bench-shears made of? 5. What are the bench-shears provided with? 6. What purposes are alligator shears used for? 7. What principal parts do the alligator shears consist of? 8. What part of the alligator shears is the arm mounted on? 9. Where is the cutting blade of

the alligator shears fixed? 10. What motion does the electromotor impart to the arm and the blade? 11. What purpose are pipe-cutteres used for? 12. What parts does a pipe-cutter consist of? 13. How is the cutting performed? 14. Where is the pipe fixed for cutting?

3. FILING AND FILING TOOLS

Filing is the most widely used *fitting operation* in the practice of metalworking shops used for cutting metal by means of a tool known as a *file*. By means of a file it is possible to give a different shape and size to a workpiece, to fit one part to another, etc.

The most widely used operations with a file are: (1) filing separate surfaces, (2) filing *mating surfaces*, (3) filing *holes*.

A file is a hardened steel bar having a great number of fine cutting edges or teeth running diagonally across its face. These teeth can remove fine chips from a treated workpiece. A file differs from a chisel in having a large number of cutting points instead of one cutting edge and in being driven directly by hand instead of by hammer.

There are various kinds of files applied for *finishing* different workpieces depending on the shape of their surfaces (Fig. 9).

Flat files are used for filing flat surfaces but the shape of the files is not quite flat because if the file had been made quite flat, it would have prevented the production of a flat surface, as the file would have cut away at the edges of a work and would have left a *convex surface*.

For filing convex and *concave surfaces half-round files* are used. A half-round file is made with a convex surface to prevent all the teeth from cutting at the same time, which requires too much pressure on the file, as well as to prevent the file from bending.

Square files are applied for filing square holes and rectangle grooves, while *triangular* or three-square files are used for filing angles.

Round files are used for filing round holes of small diameters, and for filing metal in narrow places *diamond-shaped files* made of copper *strip* into which diamond powder has been hammered, or *knife files* are used.

For filing soft metals *rasp files* or rasps are employed.

knife file

rhombic file, diamond-shaped file

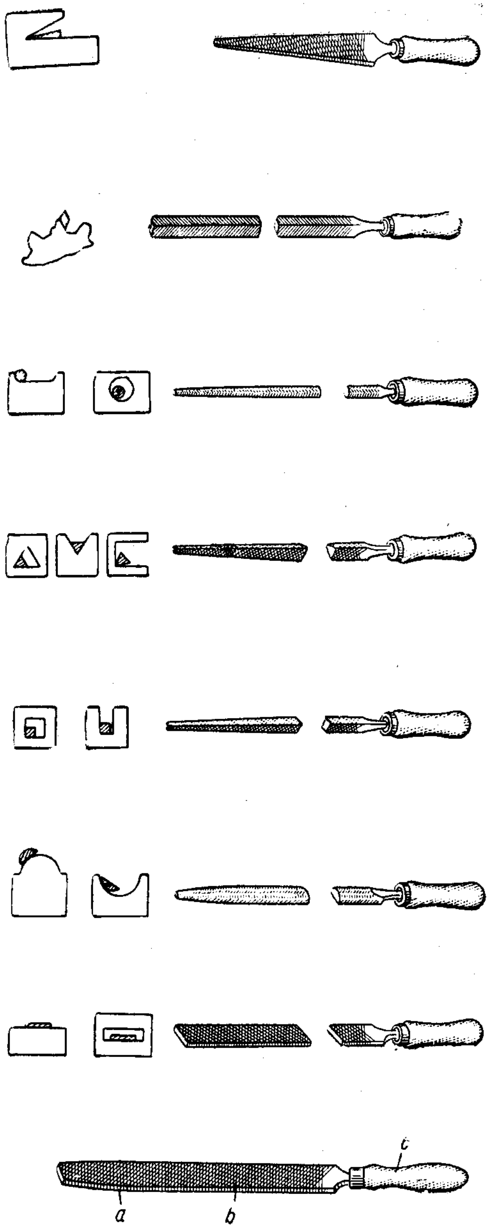
round file

triangular file

square file

half round file

flat file



a — edge; *b* — face; *c* — handle

Fig. 9. Files

Exercises

I. Use the following words and phrases in sentences of your own:

to file, to fit, mating surfaces, face, a great number of, convex surfaces, triangular file, to prevent, strip

II.. Retell the text giving answers to the following questions:

1. What is filing? 2. What tools are used for filing operations? 3. What operations are performed with a file? 4. What is the difference between a file and a chisel? 5. How is cutting performed with a file? 6. What files are used for filing depending on the shape of the surfaces to be finished?

III. Supply antonyms for the following words:

flat, convex, soft, different

IV. Give the derivatives from the following words and translate them into Russian:

to differ, to operate, file, to fit, diagonal, to finish, to separate

V. Change the following sentences using the subordinate clauses instead of participle phrases and translate the sentences into Russian:

Example: Files with convex surfaces, *preventing all their teeth from cutting at the same time*, are used for filing convex and concave surfaces.

Files with convex surfaces *which prevent all their teeth from cutting at the same time* are used for filing convex and concave surfaces.

1. Files are generally made with convex surfaces being thicker in the middle than at the ends. 2. Files having various shapes of cross-section such as square, flat, round, etc. are used in metal-cutting practice. 3. When filing convex surfaces one uses a half-round file. 4. A file is an instrument having teeth on its face. 5. Files are tools belonging to the group of locksmith's cutting instruments. 6. Files having single cut teeth are called "single-cut files". 7. For removing a large amount of metal one uses a coarse-pitched file.

VI. Make up questions to which the italicized words are the answers:

1. A file has a *great number of fine cutting teeth.* 2. These teeth are used *for removing chips from the workpiece to be treated.* 3. *Depending on the shape of the surfaces to be filed* various kinds of files are used. 4. *No, flat files are not used for filing round holes. Round files are used.* 5. *No, knife files are not used for filing soft metals, but rasps are used.* 6. *Yes, diamond-shaped files are used for filing metal in narrow places.*

VII. Giving answers to the following questions describe Fig. 9:

1. What is a file? 2. What principal parts does a file consist of? 3. In what cases is a square file used? 4. Which file is used for filing angles? 5. What material are diamond-shaped files made of? 6. In what cases are knife files used?

4. MECHANICAL TOOLS

Both in *maintenance* and in repair of machines all kinds of fitting operations are applied. An important role is played by disassembling and assembling operations. Special instruments are used for performing these operations.

Among the variety of mechanical tools used for disassembling and assembling machine parts and in their repair-

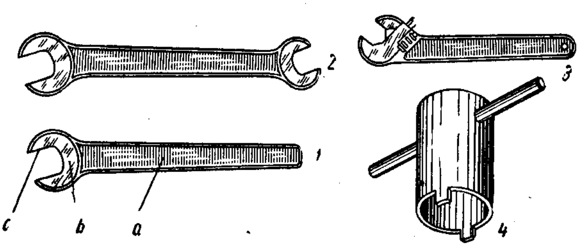


Fig. 10. Wrenches:

1 — single-ended wrench (*a* — handle; *b* — head; *c* — span); *2* — double-ended wrench; *3* — adjustable wrench; *4* — socket wrench

ing are *wrenches* (Fig. 10). According to their construction and application wrenches may be of different types: *single-*

ended and *double-ended nut wrenches, adjustable wrenches, socket wrenches* and *special wrenches.*

A nut wrench is used for *screwing* and *unscrewing nuts.* It consists of a handle and a *head* with an opening known as the *span.*

Adjustable wrenches may be used for unscrewing nuts and bolts of different dimensions.

Socket wrenches are applied in cases when nuts or bolt heads located in *recesses* are hardly accessible for a nut wrench.

Special wrenches are used for unscrewing and screwing nuts of a definite type.

Wrenches are used by drivers for repairing cars, in locksmith's shops and *fitter's shops.* Fitters use them to screw different types of machine parts as: washers, bolts, *shafts,* etc. Plumbers use them to repair pipes, taps, etc. Besides different types of wrenches there are *round pliers* or *needle nose pliers* which are widely used by locksmiths, *electricians* and other specialists for gripping, screwing or cutting off thin metal and wires.

Exercises

I. Use the following words and phrases in sentences of your own:

nut, to screw, to maintain, to unscrew, to assemble, to disassemble, nut wrench, adjustable wrench, socket wrench, to grip, plumber, electrician, fitter

II. Answer the following questions:

1. What operations are applied in maintenance and repair of machines? 2. What instruments are used for disassembling and assembling machine parts? 3. How are wrenches subdivided? 4. What is a nut wrench used for? 5. When are adjustable wrenches applied? 6. In what cases are socket wrenches used? 7. What wrenches are used for screwing and unscrewing nuts? 8. By whom are different wrenches used? 9. What other mechanical tools can be used in repairing?

III. Find in the text nouns for the following verbs:

to maintain, to operate, to construct, to fit, to assemble, to apply

IV. Supply antonyms for the following words:

disassembling, to screw, difficult, single-ended, accessible

V. Supply synonyms for the following words:

to locate, to grip, widely, different, dimensions

VI. State the functions of all the -ed *forms and translate the following sentences into Russian:*

1. Wrenches used to unscrew and screw nuts are known as adjustable wrenches. 2. Different wrenches are used to screw different types of machine parts, such as washers, bolts and shafts. 3. Locksmiths and fitters use special instruments depending on the parts of machines to be disassembled and assembled. 4. Nut wrenches may be used for screwing different nuts. 5. Tools called "wrenches" are used for turning bolts and nuts. 6. Tools known as *S*-wrenches, angle wrenches, etc. are named so according to their shape. 7. The wrenches may also be named from the object on which they are used. 8. Adjustable wrenches are named so because they may be applied for screwing and unscrewing bolts and nuts of different sizes.

VII. Translate the following sentences into English:

1. Обычно механические ключи, используемые при ремонте разнообразных деталей, изготовляются из прочной стали. 2. Кусачки могут применяться для операций, выполняемых слесарями. 3. Торцовый ключ может применяться для завинчивания гаек, расположенных в углублениях. 4. Слесарь часто пользуется инструментами, называемыми разводными ключами. 5. Среди многих инструментов, применяемых электриками, есть круглогубцы.

5. MEASURING TOOLS AND DEVICES

A. MEASUREMENT

The size and shape of all machine parts should be in accordance with the corresponding drawing. The produced parts should be checked by means of measurement, which generally involves comparison either with some accepted standard or with a *mating* part. The significance of any measurement is determined by the degree of accuracy to which the parts may be measured.

Depending on measurements different measuring tools can be used such as *rules*, *slide gauges*, *vernier calipers*, *depth gauges*, *dial indicators*, *micrometers*, *clearance gauges*, *inside* and *outside calipers*, *plug gauges*, *bevels*, *universal protractors*, etc.

B. MEASURING TOOLS

When accurate measurement of the part is required, the vernier calipers, micrometers and slide gauges are used. When it is not so important to have an accurate measurement of the part, metal rules, inside calipers and outside calipers will do.

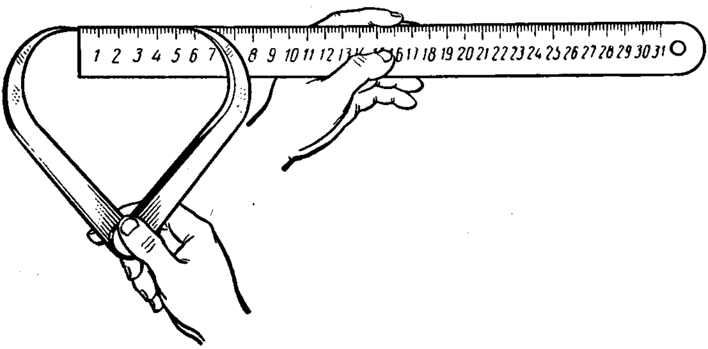


Fig. 11. Steel Rule

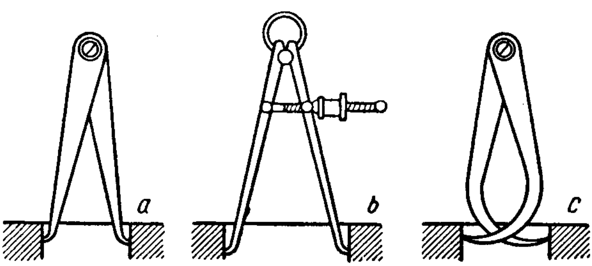


Fig. 12. Calipers:
a — inside; *b* — spring; *c* — outside

Steel rules (Fig. 11) serve for determining the length and sometimes the depth of the part to be measured. Steel rules are graduated in millimetres, but in the USA and England they are graduated in thirty-seconds and sixty-fourths of an inch.[1]

The *outside* (Fig. 12) *calipers* are the simplest instruments for measuring external diameters of the part. The outside caliper consists essentially of two curved legs.

The *inside calipers* are used for determining the internal diameters of the part. Its construction is almost similar to that of the outside calipers. Sometimes the outside calipers may be used for measuring internal diameters of the part. The outside and inside caliper measurements may be read by placing the legs of the calipers on a rule and placing one leg and the end of the rule against a flat surface as shown in Fig. 11.

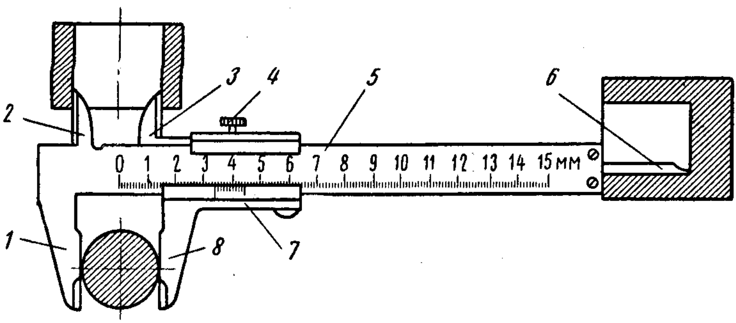


Fig. 13. Vernier Calipers:

1, 2, 3, 8 — jaws; *4* — adjusting screw; *5* — primary scale; *6* — depth rod; *7* — frame with vernier

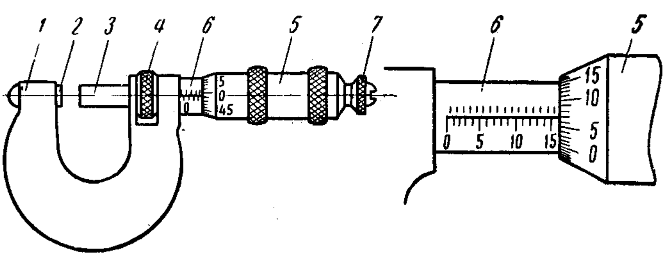


Fig. 14. Micrometer:

1 — frame; *2* — anvil; *3* — spindle; *4* — lock nut; *5* — barrel; *6* — thimble; *7* — ratchet thimble

Vernier calipers (Fig. 13) can be used for measuring both external and internal sizes of a part. By using vernier calipers measurements up to .001″ may be determined. Vernier calipers consist of a *primary* steel *scale* and four jaws. Jaws *1* and *2* are *integral* with the scale. Jaws *8* and *3* are attached to the frame *sliding* along the scale. The frame may be clamped on the scale in any position by means of an *adjusting screw*. External surfaces may be measured with jaws *1* and *8*, while internal surfaces are measured with jaws *2* and *3*. The depth of recesses is measured with a *depth rod* *6*. A *vernier* on the frame *7* serves for measuring fractional parts of a millimetre.

The *micrometer* (Fig. 14) is an instrument for precise measurement of length and thickness of a part to one ten-thousandth of an inch. The principle of operation is similar to that of vernier calipers. A graduated *thimble* serves as the primary scale. The scale on the barrel of the micrometer is used for the vernier *reading*. The part to be measured is placed between the *anvil* and micrometer screw, which is

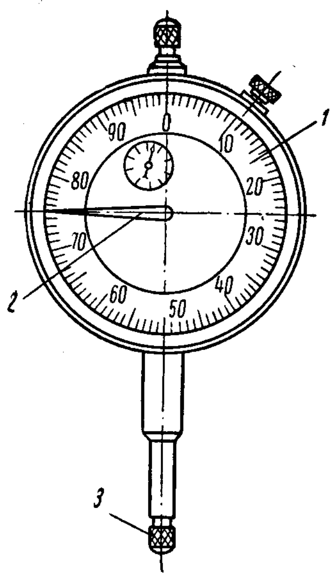


Fig. 15. Dial Indicator:

1 — dial; *2* — indicator pointer; *3* — test point.

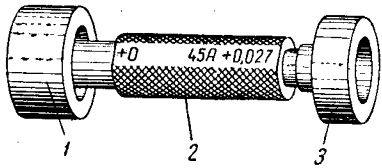


Fig. 16. Go and No-Go Plug Gauge:

1 — go plug gauge; *2* — handle; *3* — no-go plug gauge called a "movable spindle". By rotating the thimble, the spindle is removed or approached to the anvil. By rotating the *ratchet thimble* the spindle is moved and thus the part is pressed to the anvil. Thereupon the rotation of the ratchet thimble is discontinued, the micrometer opening is fixed by the *lock nut* and the reading is taken. The micrometer reading is the sum total of the barrel divisions, the thimble divisions with respect to the axial line on the barrel, and the vernier reading.

Fig. 15 shows a *dial indicator*. The dial indicator is a *gauge* with a graduated dial and an *indicator pointer* connected to a *test point* by a system of *levers*. Any movement of the test point is magnified by the indicator pointer. The dial indicator is used to check the shape of a part, the precision of its machining, as well as for checking the accuracy of *cutting machines*.

Thread plug gauges or *internal gauges*, being of "*go*" and "*no-go*" type (Fig. 16), are generally used for testing *threads* or *tapped holes*.

Depth gauges are used for measuring the depth of grooves and holes. Their principle of operation is similar to that of vernier calipers. A primary scale sliding in a frame

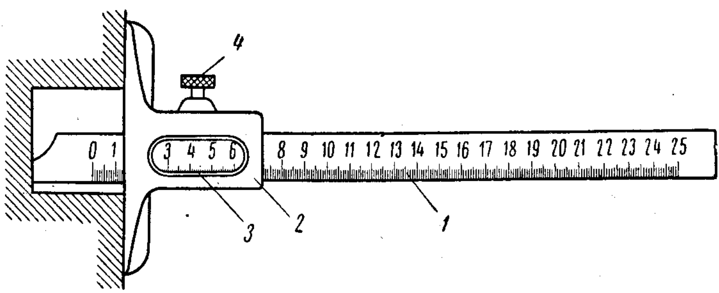


Fig. 17. Depth Gauge:

1 — primary scale; *2* — frame; *3* — vernier; *4* — screw

may be locked in any position by a screw. The depth of a groove or a hole is measured by means of the primary scale and a vernier as shown in Fig. 17. Conical surfaces are measured with control gauges.

A *universal angle gauge* for measuring internal and external angles is shown in Fig. 18. The universal angle gauge consists of a base with a primary scale attached to the base.

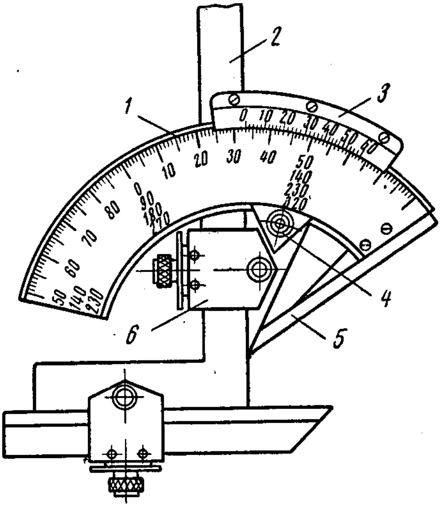


Fig. 18. Universal Angle Gauge:

1 — base; *2* — triangle; *3* — vernier; *4* — quadrant; *5* — detachable rule; *6* — holder

A *quadrant* with a vernier may be moved along the arc of the base. A triangle may be attached to the quadrant by means of a *holder*. In its turn a *detachable* rule is attached to the triangle. The triangle and the detachable rule can be moved along the face of the quadrant. Angles can be measured within the range of 0° to 320° by means of the universal angle gauge.

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1. they are graduated in thirty-seconds and sixty-fourths of an inch — они градуируются в тридцать вторых или шестьдесят четвертых дюйма

Exercises

I. Use the following words and phrases in sentences of your own:

drawing, to measure, to involve, mating part, accuracy, slide gauges, vernier calipers, depth gauges, clearance gauges, micrometer, inside calipers, outside calipers, to graduate, internal diameters, to slide, adjusting screws, lock nut, tapped hole

II. Translate the following groups of words, paying attention to the meaning of suffixes:

to measure, measuring, measurable, measured, measurement; to compare, comparative, compared, comparison; to signify, significant, significance; to depend, depending, dependence, dependent; to graduate, graduated, graduation; accuracy, accurate; precise, precision; general, generally, generation

III. Supply synonyms for the following words:

to place, inside, outside, to be similar, according to, with reference to

IV. Fill in the blanks with prepositions in accordance with, by means of, within, for, to, of:

1. Machine parts should be manufactured ... their respective drawing. 2. ... a micrometer it is possible to make measurements to a very high degree of accuracy. 3. Calipers are used for measurements to ... 0.18 mm. 4. Measuring tools should be chosen ... the machine part to be measured. 5. The micrometer is an instrument ... measuring directly ... thousandths, and estimating to quarter thousandths ... an inch, ... its range.

V. Translate the following sentences observing different meanings of the words in italics:

1. The principle *involved* in the operation of the micrometer is explained in technical text-books. 2. The instruction on the use of this dial indicator is rather *involved.* 3. These drawings and their explanations are given to illustrate the principles *involved.* 4. Different kinds of instruments are used *to measure* holes of considerable depth. 5. A millimetre is a *measure* of length. 6. Steel plates usually vary *by* sixteenths of an inch. 7. *By* dividing the load required to break the specimen *by* its area, the ultimate tensile strength of material is obtained. 8. *By* accuracy of form is meant not only the exact duplication of irregular profiles, but also the accuracy of form embodied in squares, true cylinders, cones, etc.

VII. (a) Translate the following text using a dictionary:

A range of optical instruments for measuring surface finish, which are relatively inexpensive and of very robust design, and afford the advantage that they can readily be applied under both workshop and inspection-room conditions, is being produced by many plants. Known as optical devices, these units are of modern designs. The portable device is intended for checking the relatively coarse finishes produced by planing, turning, and milling. With this device a beam of light is directed past a straight, opaque edge, and through a lens at an angle of 45° to the work surface, and the line of intersection is observed at an angle of 90° to the light beam, through the eyepiece of the microscope.

(b) Make up three questions on the basis of this text and answer them.

VIII. Make up questions concerning the measuring tools shown in Figs 11, 12 and answer them.

IX. Using the following words and word combinations describe the principle of operation of the vernier calipers shown in Fig. 13:

vernier calipers, to be used, to measure, external and internal sizes, a part, to consist of, steel scale, four jaws, two jaws, to be attached, the frame, to slide, the scale, the first two jaws, to be used, measuring external surfaces, the other two jaws, measuring internal surfaces, the depth, to be measured, a spindle

X. Giving answers to the following questions describe the principle of operation of the micrometer shown in Fig. 14:

1. What is a micrometer? 2. What is the function of the graduated thimble of the micrometer? 3. What is the scale on the micrometer barrel used for? 4. Where is the part placed for measurement? 5. How is the part pressed to the anvil and how is the micrometer reading taken?

XI. Describe the measuring tools shown in Figs 15, 16, and 18.

6. MACHINE-CUTTING TOOLS

The cutting tool is that part of a cutting machine which serves for removing material from revolving work. If either incorrect or faulty cutting tools had been used for metal-cutting operations, the quality of work would have become poor and cost would have been higher. That is why careful attention should be given to the cutting tools in any metal-cutting operation.

Cutting tools are made of hardened and *tempered* steel or alloy metals. All the cutting tools are adapted to perform certain work in the most efficient manner and, accordingly, they may be subdivided into *turning tools*, *boring tools*, *milling cutters*, *planing tools*, *shaper tools*, etc. These tools having one *effective cutting edge* along which excess material from the workpiece is removed are known as *single-point cutting tools.*

Other tools removing excess material on two or more cutting edges simultaneously are known as *multiple-point cutting tools.* Each cutting tool consists of a shank for holding the tool in the machine and a *tip* or cutting edge for removing chips from the work.

The single-point cutting tools fall into several types, such as: (1) solid, forged tools having the same material throughout; (2) solid tools having a tough steel shank and a tip made of high alloy steel which is *welded* on to the shank; (3) solid tools with a tip *brazed* (Fig. 19) on to the shank; and (4) *inserted tools* having a small piece of the cutting edge made of carbide steels. Inserted tools held in a tool holder owing to a screw or wedge are used for machines of a complicated nature when it is necessary to prolong tool *life* as long a time as possible.

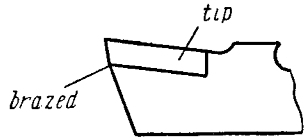

Fig. 19. Cutting Tool

The various types of cutting tools differ in shapes and in the angles to which the surfaces of the tools are ground. The cutting tip should be ground by hand or by machine with correct angles (Fig. 20) on the top face (rake angles) and sides (clearance angles) to a desired shape. The shape of the tool, as well as the proper rake and clearance angles depend upon a large number of factors, such as the specific operation, the material to be cut and the material from which the tool is made. The top rake is usually *provided* for the tool holder by the tool being *set* at an angle, which is correct for machining steel and cast-iron. On solid tools it is necessary to grind the top rake in the tool.

By *adjusting* the tool in the *tool post* through a wedge, this top rake can be varied somewhat to suit the material being *turned.* The softer the material the less the top rake should be as there is a tendency for the tool to dig in if the rake is too great. The side rake also varies with the material being machined.

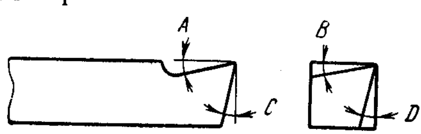

Fig. 20. Cutting Tip:
A — top rake; *B* — side rake; *C* — front clearance; *D* — side clearance

The proper angle is from 6° for soft material to 15° for steel. The front clearance depends on the diameter of the work to be turned. To turn cast-iron it is advisable to set the tool above centre. If the tool were ground square[1] without any front clearance, it would not cut, but rub on the material to be turned below the cutting edge of the tool. The front clearance should be less for small diameters than for large diameters, ranging from 8 to 15°. The tool is ground with the side clearance to prevent the *dragging* of the tool on the *shoulder* formed by the cut. This angle is usually about 6° from the vertical and is constant.

For efficient operation of the machine, the proper surface speed of the work being machined must be maintained. If the speed is too slow, the job takes more time than necessary and often the work produced is unsatisfactory. On the other hand, if the speed is too great, the cutting edge will be worn down too rapidly. Frequent grinding will be necessary, which is also wasteful. For ordinary production work the speed should be as great as the tool will stand without requiring sharpening more often than every two or three hours when cutting continuously.

Cutting tools used for longitudinal turning are subdivided into *roughing tools* and *finishing tools.*

Roughing tools are applied for roughing or removing the excessive metal from the work. Such tools are usually carbide-tipped and they have a long cutting edge. *Angular roughing tools* are very convenient for turning surfaces of the parts which are at the *chuck cams*, as well as for *facing*.

Finishing tools are used after the work has been turned with a roughing tool to give accurate size and clean surface to the work being machined.

Before starting the cutting operation tools should be clamped in the tool-holder (Fig. 21) by means of two or more bolts.

Side tools are used for cutting faces. A side tool has a long cutting edge set at an angle of about 5° with respect to the surface of the work to be cut, and a short cutting edge. This cutting edge is largely *bevelled* to facilitate the approach of the tool tip to the centre of the part fastened between the two *lathe centres.*

Necking tools are used for grooving, since the width of grooves is usually small. The cutting edge of a necking tool is narrow, which increases the danger of its breakage. To prevent this breakage the height of the head is made several times larger than the width of the cutting edge.

Material is cut off by means of tools known as *cutting-off tools*, which are similar to necking tools. The difference is that they have a longer head which should be a little larger than one-half of the diameter of the *blank* to be cut.

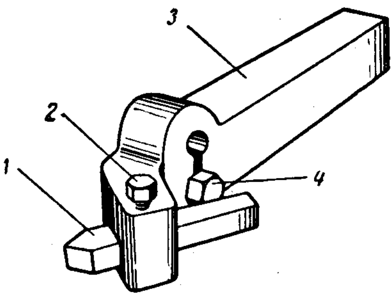

Fig. 21. Tool Holder

1 — cutting tool; 2 — bolt; *3* — shank; *4* — bolt

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1. If the tool were ground square — если бы резец затачивался под прямым углом

Exercises

I. Use the following words and phrases in sentences of your own:

to bevel, side tool, facing, roughing tools, to grind, to rough, speed, finishing tool, to provide, to adjust, to set, single-point cutting tools, turning tools, effective cutting edges, tip, shank

II. Use these verbs in the past participle form and make up sentences using past participles as attributes:

to grind, to turn, to form, to cut, to temper, to harden, to provide

III. Underline the suffixes and prefixes and translate into Russian the following group of words of the same stem:

to adjust, adjustable, adjusting, adjustment; to continue, continual, continuance, continuation, discontinuation, discontinuance, to discontinue; to divide, divided, division, divisional, divisor, to subdivide, subdivisible, subdivision

IV. Choose synonymical groups out of the following list:

to sharpen, to undergo, to understand, precise, accuracy, to realize, to complete, to start, to subject, to finish, to begin, accurate, to clamp, precision, to squeeze, to grind

V. Change the following sentences, using the subordinate clause instead of participle phrases. Translate the sentences into Russian:

Example: Cutting tools *used for various metal-cutting operations* have quite a wide range of shapes.
Cutting tools *which are used for various metal-cutting operations* have quite a wide range of shapes.

1. The number and types of cutting tools used in practice are very large. 2. Tools designed to take heavy roughing cuts are known as roughing tools. 3. Milling cutters have several cutting edges giving the cutter the advantage of cutting. 4. Each blade of the milling cutter is a single-point cutter provided with proper rake and clearance angles. 5. The cutting angle is determined by the physical characteristics of the material being machined. 6. A high cutting speed, a small chip thickness and a large rake angle are factors facilitating the flow of the chip over the face of the tool. 7. Different kinds of cutting tools are used for metal-cutting processes depending upon the kind of metal being cut. 8. The elements of a single-point tool used for turning operations are shown in Fig. 20.

VI. State the kinds of subordinate clauses in the following sentences and translate them into Russian:

1. The distance that the tool is set into the work for cutting operations is referred to as the depth of cut. 2. Metals may be so strong that it is difficult to produce a tool capable of cutting off the chip without frequent failures. 3. If the metal to be cut is soft, the top rake of the tool is decreased. 4. When a tool cuts metal a force is exerted on its face by the material pushed ahead, and a friction force is set up along the face of the tool by a sliding chip. 5. If the tool were not ground correctly, it would not cut freely. 6. The basic principle of design employed in making single-point cutting tools is the wedge which can be modified in accordance with requirements.

VII. Translate the following sentences into English using different ways of expressing obligation:

1. Все резцы, в зависимости от типа машины, на которой они используются, нужно подразделять на токарные,

фрезерные, строгальные и другие. 2. Для того чтобы продлить работу режущего инструмента, следует правильно выбирать скорость резания. 3. Угол заточки инструмента должен меняться в зависимости от материала обрабатываемой детали. 4. Инструмент, который нужно затачивать и устанавливать в определенное положение в автоматическом станке, следует насаживать с меньшей силой, чем обдирочный резец. 5. Режущие инструменты могут затачиваться до тех пор, пока не останется маленькая полоска режущей кромки, и все же их можно еще использовать для резки материала.

VIII. Give different meanings of the words proper, to make, one, for, above, more, that. *Give some examples of their use.*

IX. Make up questions to which the italicized words are the answers:

1. On solid tools it is necessary to grind the top rake *in the tool*. 2. *To turn cast-iron* it is necessary to set the tool above centre. 3. The tool is ground with the slide clearance *to prevent the dragging of the tool on the shoulder formed by the cut*. 4. *If the surface of the work being machined is too great*, the cutting edge will be worn too rapidly. 5. Roughing tools are applied for *roughing or removing excessive metal from the work*. 6. *To prevent the breakage of the cutting edge of a necking tool*, the height of the head is made several times larger than the width of the cutting edge.

X. (a) Read and translate the following text without using a dictionary:

Lathe tools are made of carbon steel, high speed steel and alloys such as stellite and cemented carbide. The stellite and cemented carbide tools are becoming more generally used as their cost is reduced. There are but few carbon steel tools used,[1] the general practice is to use high-speed tool bits in holders. One should determine the kind of tool to be ground, as carbon and high-speed steel require different treatment. Tools should be marked to show the kind of material from which they are made. To ensure the proper operation of a lathe the cutting tools should be ground by hand or machine. In machine grinding the tool is supported rigidly in a chuck or holder and ground semi-automatically to the desired rake and relief or clearance angles. In grinding by hand, the tool should be supported on the work rest and moved back and forth across the entire face of the grinding wheel. The accuracy of a tool ground by hand depends almost entirely on the skill of the operator.

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1. there are but few carbon steel tools used — применяются лишь немногие резцы из углеродистой стали

(b) Answer the following questions:

1. What steel are lathe tools made of? 2. Why should one determine the kind of tool to be ground? 3. How should the cutting tools be ground to ensure the proper operation of a lathe?

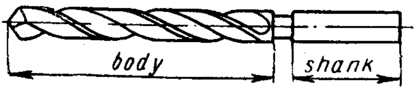
XI. Giving answers to the following questions describe the construction of the cutting tool in Fig. 19 and the angles to which a cutting tool shown in Fig. 20 should be ground, and clamping the tool in a tool holder in Fig. 21:

1. What parts does a cutting tool consist of? 2. What is the shank of the cutting tool used for? 3. What is the synonym for the word "cutting edge"? 4. By what means can the cutting tip of a tool be ground? 5. To what angles should the tip of the cutting tool be ground? 6. What do the shape of a tool as well as its rake and clearance angles depend upon? 7. How can the top rake be varied? 8. What does the top rake depend on? 9. How does the side rake vary for soft material and for steel? 10. What does the front clearance depend on? 11. What action would be performed by the tool if it were ground square without any front clearance? 12. Why is the tool ground with a side clearance? 13. How should the tool be clamped in the tool holder before starting the cutting operation?

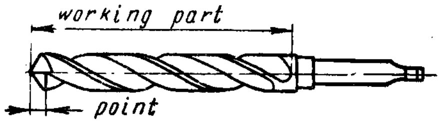
7. DRILLS AND DRILLING

Drilling is one of the cutting operations producing cylindrical holes of different diameter in solid material by means of rotating tools called "*drills*" (Fig. 22).

The most common type of drill in use[1] is the *twist drill* made of a tempered steel round bar stock. Twist drills are made with two, three, or four spiral grooves or *flutes milled* from the solid. These grooves or flutes winding around the body of the drill serve for forming the cutting edges of the drill, as well as for removing the chips formed in drilling from the hole.



Straight-Shank Drill



Tapered-Shank Drill

Fig. 22. Drills

The twist drill comprises ~~three principal parts:~~ *body*, *shank* and *point*. The twist drill has two ~~cutting edges known as the~~ "*lips*". These ~~cutting~~ edges, or lips, are connected by ~~a third edge, called~~ a "*web*". ~~It is~~ this part ~~that~~ gives *rigidity* and strength to the drill. When in use the first two cutting edges remove the material from the work, while the third one penetrates into the material by rubbing rather than cutting.

~~In order~~ to drill holes in a metal the cutting edges of a drill should be correctly ground to a certain angle. When a drill is ground correctly, its ~~cutting edges, or lips,~~ should have equal length whereupon each of them should make the same angle with the centre line. Otherwise the drill will make holes the diameter of which is larger than that of the drill. This may disable the drill and cause an undesirable waste of material. Drills have shanks of various types, the most commonly used being those having straight and tapered shanks. The shank of the drill serves for clamping the drill either in the chuck spindle or *socket* of a drilling machine. The above part of the drill may be either of a cylindrical shape, like in[2] *straight-shank drills*, or of tapered shape in *tapered-shank drills*.

The third part of the drill is called a "drill point". It is always ground to a cutting angle varying with the kind of material to be drilled. For hard materials this cutting angle equals 140° and for soft materials it equals 90°. The cutting edges of *flat drills* used for drilling holes in steel or in cast-iron are ground to an angle of 100° to 120°. All the drills get worn while drilling and they should be re-ground from time to time.

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1. The most common type of drill in use — самым обычным используемым типом сверла...
2. like in — как в, подобно

Exercises

I. Use the following words and phrases in sentences of your own:

to drill, cylindrical holes, rotating tool, twist drill, slute, to mill, lips, web, spiral grooves, tapered shank, focket

II. Retell the text giving answers to the following questions:

1. What is drilling, and its purpose? 2. By means of what tools is drilling performed? 3. Which is the most widely used tool for drilling? 4. What material is a twist drill made of? 5. What purposes do twist drill flutes serve? 6. What are the principal parts of a twist drill? 7. What are the cutting edges of a twist drill called? 8. What part of the twist drill gives it rigidity and strength? 9. Why should the cutting edges of a drill be correctly ground? 10. Why should the cutting edges of a drill have an equal length?

III. Form adverbs from the following adjectives:

proper, cylindrical, certain, good, wide, correct, equal

IV. Underline the suffixes and prefixes and translate into Russian the following groups of words of the same stem:

to desire, desirable, undesirable; cylinder, cylindrical, cylindrically; to straighten, straight; to grind, ground, re-ground; equal, equality, equalization, to equalize, equalizer, unequal, unequalled

V. Supply the missing words:

1. In drilling h... in metal, heavy pressure must be applied at the drill p... . 2. Spiral f... are found on most drills. 3. The c... angle at the outer corner of the l... should be

about 12°. 4. The cutting edges of t... d... have angles of top rake and clearance the same as any other c... t... have. 5. The body of metal between the flutes forms what is called the w... . 6. The drills are held in place by their t... shanks or by gripping straight-s... drills in a c... .

VI. Connect the following sentences using the conjunction either... or:

Example: The body of the twist drill has two spiral grooves. The body of the twist drill has flutes cut on its surface.
The body of the twist drill has *either* two spiral grooves *or* flutes cut on its surface.

1. The twist drill is formed by twisting grooves in a flat piece of steel. The twist drill is formed by milling a cylindrical piece of steel. 2. The grooves serve to form cutting edges of the drill. The grooves serve to remove the chips formed in the process of drilling. 4. The drill flutes serve to lubricate the drill. The drill flutes serve to remove chips from a hole being drilled. 5. The work to be drilled should be clamped in a vice. The work to be drilled should be clamped in a chuck. 6. The web of a drill penetrates into the material being cut. The web of a drill rubs the material.

VII. Translate the following sentences into English using the past participle instead of the attributive clauses:

Example: Часть сверла, которая называется режущей частью, всегда затачивается под определенным углом резания.
The part of the drill *called a "drill point"* is always ground to a certain cutting angle.

1. Операция, которая выполняется при помощи инструмента, называемого «сверлом», называется «сверлением». 2. Стружки, которые образуются при сверлении, удаляются по канавкам сверла. 3. Режущие кромки сверла, которые используются для сверления, должны затачиваться под определенным углом. 4. Инструмент, который используется для сверления, называется «сверлильным сверлом». 5. Одна из кромок сверла, которая называется «перемычкой», не режет металл.

VIII. Analyse and translate the following sentences:

1. Different kinds of drills are used in drilling, such as: a single-lipped twist drill, normally less than 1" (inch) in diameter. 2. It is formed of a tubular shank which is twisted of seamless tubing to make a single flute. 3. Coolant is carried through the hollow shank, through a small hole in the drill tip, and chips are washed out through the single flute. 4. A four-lipped hollow core drill is designed to carry chips out through a hollow drill shank. 5. This tool is used for enlarging holes and not for drilling solid metal. A two-lipped hollow type deep drill normally is used in drilling solid metal holes ranging from 1" to 3" in diameter and the tip is attached to a tubular steel shank. 7. Coolant carries chips through the flute into the centre of the drill and then out through the hollow shank. 8. Drills of the same design are also used for holes larger than 3". 9. These are provided with replaceable blades in the tip.

IX. Describe Fig. 22 orally using the following words and word combinations:

the body of a twist drill, to represent, a cylindrical rod, to have two spiral grooves, to serve, forming, the cutting edges of the drill, to be called lips, the lips, to be connected, a third edge, to be known, a web, to penetrate into material by rubbing, the shank, the drill, clamping the drill in the chuck, to be of different shapes, cylindrical shanks and tapered shanks, the third part of the drill, a drill point, to be ground to a cutting angle, to depend on, material to be drilled

8. THREADING TOOLS

There are different types of thread-cutting tools depending upon the operations to be performed. Thread-cutting tools are classified according to the work done into *female screw-cutting tools* and *male screw-cutting tools.*

According to their construction they are known as *taps, nut taps* (Fig. 23), and *threading dies.* The tap used for cutting *female threads* in holes is made in the form of a screw provided mostly with straight grooves forming the cutting edges of the tool. The tap made of a steel cylindrical bar stock consists of the working part and the shank.

The shank serves for fastening the tap in a chuck or in a *tap wrench* (Fig. 24).

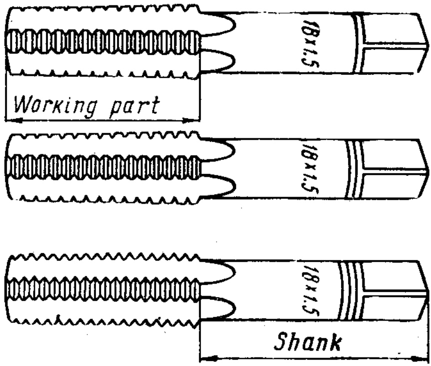


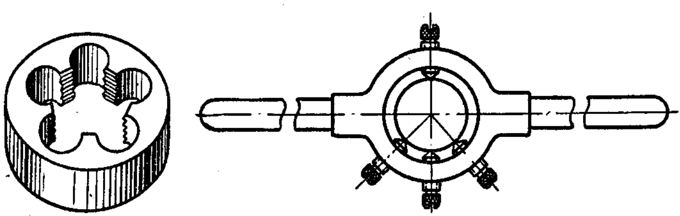
Fig. 23. Set of Taps

Threads can be cut by means of taps either by hand or on a machine. With manual tapping usually a set of two or three taps is used. The first tap serves for cutting threads; then the second tap is used; the third tap is applied for final thread cutting. With mechanical tapping in such materials as cast iron, bronze, brass, copper, aluminium, etc. one tap is used. When steel is tapped sometimes a set of two tools is used. Before cutting threads the tap should be set so that its axis strictly coincides with that of the hole to be cut, otherwise

Fig. 24. Tap Wrench

the thread may be *oblique*. To cut *male threads* such an instrument as a threading die is used, which is held in the *die holder* (Fig. 25).

A threading die is usually made of internally threaded



Threading Die

Die Holder

Fig. 25.

flat steel stock with cutting grooves or flutes. Between these grooves or flutes there are the cutting edges of the tool by means of which male threading is performed.

Exercises

I. Use the following words ***and phrases*** *in sentences of your own:*

thread, to classify, female screw-cutting tools, nut tap, to tap, threading die, die holder, tap wrench, male threads, female threads

II. Retell the text giving answers to the following questions:

1. What are thread-cutting tools? 2. How are thread-cutting tools classified according to the work done by them? 3. How are thread-cutting tools classified according to their construction? 4. What instrument is used for cutting threads? 5. What is the construction of a tap? 6. How can threads be cut? 7. What is needed for manual tapping? 8. What is the purpose of the first, second and third tap? 9. How should the tap be set before cutting threads and why is it necessary to do that? 10. What instrument is used for cutting male threads?

III. Suppy synonyms for the following words:

to perform, female thread, male thread, construction, instrument, form

IV. Give derivatives from the following words and translate them into Russian:

to operate, to perform, to cut, to construct, to thread, to tap, to fasten, usual, to hold

V. Supply antonyms for the following words:

straight grooves, manual tapping, final, to coincide

VI. Translate the following sentences observing different meanings of the word machine:

1. This *machine* is mainly used for removing large pieces of metal. 2. The engineer explained in his lecture how to *machine* workpieces of different shapes and sizes. 3. The size and shape of all *machine* parts should be checked by means of different measuring tools.

VII. Make up questions to which the italicized words are the answers:

1. With mechanical tapping in cast iron, bronze, brass, copper, and aluminium *one tap* is used. 2. *When steel is tapped* a set of two tools is used. 3. *Before cutting threads* the tap should be firmly set in a tap wrench. 4. A threading die is made *of internally threaded flat steel stock.*

VIII. Describe Figs 23 and 24 orally using the following words and word combinations:

the tap, to be made, a cylindrical bar stock, to consist, the working part, the shank, to be used, fastening the threading tool, in a chuck or in a tap wrench, two or three taps, to be applied, manual tapping, the first and the second taps, to serve, to cut threads, the third tap, final thread cutting

IX. Giving answers to the following questions describe the threading die shown in Fig. 25:

1. What operations are performed with a threading die? 2. What material is a threading die made of? 3. How is a threading die threaded? 4. What is there between the cutting grooves of a threading die?

9. METHODS OF HOLDING TOOLS BETWEEN CENTRES

When machining a piece of work on a lathe the former is usually mounted between the lathe *centres*. Having been mounted on the lathe the work is supported by the conical points of the *live* and *dead centres*. The work must therefore have centre holes in each end drilled by using a combined drill and a *countersink*. The size of the centre hole has to be proportioned to the weight of the work and the size of cut to be taken. By virtue of the clearance holes the work does not rest on the extreme points of the centres. This is important because otherwise the position of the work will be indefinite. Owing to this method of holding work between centres, the work can be removed from the lathe as often as may be desired. If the work has to be mounted again between centres for further treatment, it will rotate about the same axis as before.

The two lathe centres are mounted in two spindles: one —the live centre is held in the *headstock* spindle and turns

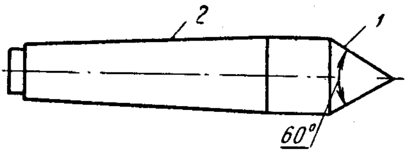


Fig. 26. Centre:
1 — cone; 2 — tapered shank

together with the spindle and the work, the other— the dead centre is held in the *tailstock* spindle and in most cases does not turn and rubs against the work piece. The point of the dead centre should be hardened to prevent its wearing during the operations performed on the lathe. Both lathe centres should always be *aligned*, i. e. the points are to meet when the tailstock with its centre is moved up to the headstock centre. A turner tests the *alignment* of the centres by taking a cut and then measuring both ends of the cut by a micrometer. Having got the same measurements, the turner may be sure that the centres are aligned and he may proceed with the turning. The centre shown in Fig. 26 consists of a cone, on which the work to be treated is installed, and of a tapered shank, which *fits* corresponding *taper* holes in the headstock spindle and tailstock *poppet*.

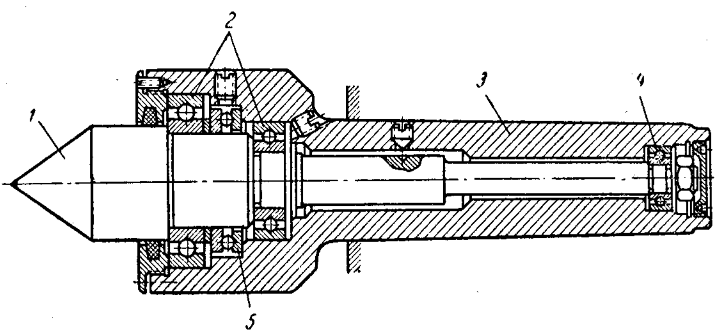


Fig. 27. Running Centre:
1 — centre; 2, 4 — ball bearings; 3 — tapered shank; 5 — ball thrust bearing

When works are machined at high speeds or when the former are too heavy a dead centre and the work will be heated up so as to cause excessive wear from friction. In such cases the so called "*running centres*" are used. Fig. 27 shows a running centre *inserted* into the taper hole of the tailstock poppet. The centre rotates on ball bearings. The *thrust* exerted on the centre is taken by the *available ball thrust bearing*. The tapered shank fits the taper hole of the tailstock poppet.

Exercises

I. Use the following words and phrases in sentences of your own:

to countersink, to mount, live centre, dead centre, headstock, tailstock, to align, taper hole, to fit, tailstock poppet, running centre, to insert, speed, to exert

II. Retell the text giving answers to the following questions:

1. What is the most widely used method of holding work in the lathe? 2. By what parts of the centres is the work supported while being turned? 3. By what means are centre holes drilled in the work? 4. What would happen if the work rested on the extreme points of the centres? 5. Owing to what method of holding work in the lathe, can it be removed from the lathe as often as may be desired? 6. Where are the two lathe centres mounted on the lathe? 7. What kinds of centres are used on lathes? 8. Where is the live centre held and how does it operate? 9. Where is the dead centre held and does it turn or not?

III. Underline the suffixes and prefixes and translate into Russian the following groups of words of the same stem:

to combine, combined, combination, uncombined; to lubricate, lubrication, lubricant; to mount, to dismount, mounting, mountable, dismountable

IV. Find in the text English equivalents for:

зенковка, предотвращать, шпиндель задней бабки, шпиндель передней бабки, вращающийся центр, хвостовик, неподвижный центр, подогревать, центрировать

V. Give derivatives from the following words and translate them into Russian:

to support, to live, to wear, point, to align, to insert, to fit

VI. Change the sentences using the predicates in the Past and Future tenses and translate them into Russian:

Example: Each end of the work *must be countersunk.*
Each end of the work *had to be countersunk.*
Each end of the work *will have to be countersunk.*

1. When being machined the work must be fastened between the lathe centres. 2. Countersinking must be done by means of a countersink. 3. The axial adjustment of the tailstock centre must be done carefully. 4. The poppet must be re-adjusted from time to time during the process of work. 5. The live centre of the lathe can turn together with the spindle and the work. 6. The dead centre of the lathe cannot turn. 7. Both centre points of the lathe must be aligned.

VII. Connect the following sentences using participle constructions and translate the sentences into Russian:

Example: A piece of work has been delivered to the shop. The work was machined on the lathe.
Having been delivered to the shop, a work was machined on the lathe.

1. The work has been countersunk with a combined drill and countersink. The work is ready to be machined. 2. The tailstock reduced wear of the dead centre. It has been lubricated. 3. The turner has got different measurements. The turner has to change the position of the dead centre. 4. The worker has turned a special screw in the tailstock. The worker removed the tailstock centre from the tailstock spindle. 5. The point of the dead centre has been hardened. The point of the dead centre increased its wear-resistance. 6. The work has been mounted in the lathe. The work is turned.

VIII. Giving answers to the following questions describe the construction and principle of operation of the centre shown in Fig. 26:

1. What parts does the centre consist of? 2. Where is the work to be machined installed? 3. Where does the tapered shank of the centre fit? 4. What causes excessive wear of the dead centre and the work?

IX. Describe the construction of the running centre shown in Fig. 27.

10. HOLDING WORK IN A CHUCK

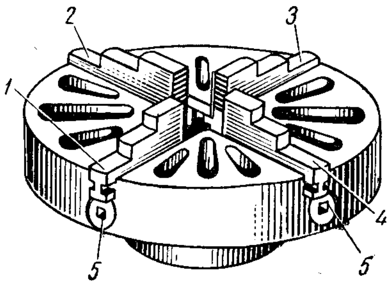


Fig. 28. Independent Four-Jaw Chuck

1, 2, 3, 4 — jaws; 5 — screw

Short parts are usually held in a chuck. This method of holding work is of great importance since it is widely used with lathes. A chuck is a rotaing vice which may be attached to *the nose* of the lathe spindle. There are three important varieties of lathe chucks, such as *independent jaw chucks*, *concentric* or *self-centering chucks* or *contracting chucks*.

Fig. 28 shows an independent four-jaw chuck belonging to the group of simple chucks. The chuck has four jaws *1*, *2*, *3*, *4* carried in radial slots in the chuck body. Each jaw of

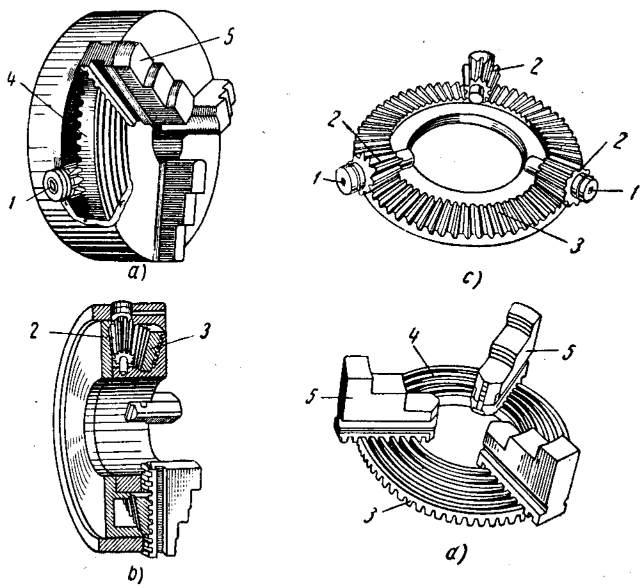


Fig. 29. Concentric Chuck:

1 — chuck key; *2* — bevel gears; *3* — large bevel gear; *4* — multi-turn spiral groove; *5* — jaws the chuck can be adjusted independently by means of its own screw *5*. It offers the possibility to fasten works of both cylindrical and non-cylindrical shape in such chucks. The body of the chuck is provided with a screwed hole to fit the spindle nose of the lathe. Fig. 29, *a* shows a concentric chuck.

The concentric chuck usually has three jaws which can be moved in and out[1] together by means of a *chuck key*, which is inserted into the opening of one of the three *bevel gears* (Fig. 29, *c*) *meshed* with a large bevel gear (Fig. 29, *c*). A multi-turn spiral groove (Fig. 29, *d*) is cut on the flat *reverse* side of the large bevel gear. The bottom *projections* of the jaws are inserted into the separate turns of the groove. When one of the bevel gears is turned by means of the chuck key its *motion* is transmitted to the large bevel gear. The rotation of that large bevel gear causes simultaneous and uniform motion of all the three jaws along the slots of the chuck by means of the spiral groove. When the gear with the spiral groove is rotated in that or another direction[2] the jaws are either approached to or removed from the centre thus clamping or unclamping the work. The concentric or self-centering chuck is very convenient in operation as all its jaws are moved simultaneously. Consequently a work of cylindrical shape is clamped exactly along the spindle axis. This centering is done automatically, therefore such chucks are called "self-centering".

The jaws of the chuck are made of hardened and tempered steel to prevent their wear. The chucks are characterized by strong, all-steel construction,[3] and are designed to be mounted directly on the spindles of machines without any intermediate *plate* or *adapter*, thus *ensuring* utmost accuracy and rigidity. Fig. 30 shows a *collet* or a *contracting chuck*. Such chucks are applied for rapid fastening short works of small diameter. The tapered shank of the chuck is inserted into the taper hole of the headstock spindle. A

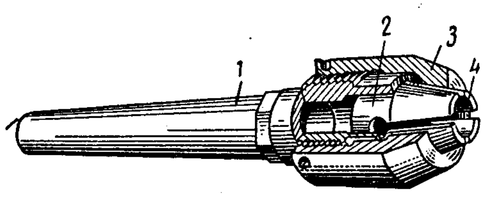


Fig. 30. Collet Chuck or Contracting Chuck:

1 — shank; *2* — collet; *3* — nut; *4* — collet opening collet with a cone is placed inside the groove of the chuck. The work to be treated is set into the hole of the collet. When the nut is screwed on the body of the chuck the collet is *contracted* and the work gets clamped. *Magnetic chucks* are adapted to work which is difficult to hold in chuck jaws, either on account of its shape or because the pressure of the jaws may distort the work. The magnetic chucks have no jaws, as the work is held by magnetic force instead of by mechanical means. Some workpieces are so shaped that they cannot be held in a chuck, and work of this kind is often clamped to a *faceplate*. Most lathes are equipped with two faceplates: one small plate is used for driving workpieces turned between centres, and a large one is used to hold heavy or irregularly shaped pieces.

For finishing the external diameter of work which is already *bored* axially a *mandrel* is used. A mandrel is a bar with centre holes at each end. The mandrel is mounted between centres and enables the outside of a workpiece to be turned concentric with the inside and in general such work would have the hole finished first and the outside finished on a mandrel subsequently. The andvantage of mounting work on a mandrel is that of being able to reverse the work on the centres so that the whole of the work *exterior* can be operated on by cutting tools.

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1. to move in and out — вдвигать и выдвигать
2. in that or another direction — в том или ином направлении
3. all-steel construction — цельнолитая конструкция

Exercises

I. Use the following words and phrases in sentences of your own:

chuck, rotating vice, lathe spindle, independent jaw chuck, contracting chuck, chuck body, chuck key, to project, to reverse, motion, to transmit, to mesh, bevel gear, faceplate, mandrel

II. Answer the following questions:

1. Where are usually short parts held when being turned in a lathe? 2. What is a chuck? 3. What types of chucks do you know? 4. What purposes are chucks used for? 5. What

kind of work are magnetic chucks adapted to? 6. How is the work held in a magnetic chuck? 7. How many faceplates are most lathes equipped with? 8. What kind of work is a mandrel used for? 9. What is the advantage of mounting work on a mandrel?

III. Supply English equivalents for the following words and word combinations:

self-centering chuck, independent jaw chuck, collet chuck, radial slots, groove, spindle nose

IV. Find in the text synonyms of the following words:

collet chuck, comfortably, with the help of, slot, to revolve

V. Give derivatives from the following words and translate them into Russian:

to divide, dependent, possible, cylinder, to open, to transmit, to ensure

VI. Read and translate the following text without using a dictionary and analyse the ing-*forms and* ed-*forms:*

The standard chucks generally furnished are mechanically operated by an automatic mechanism which gives the operator total freedom of both hands for handling the work. While the machine is running to cycle time[1] he simply places the work in the chuck which is held there by the work locator[2] then he releases the safety foot treadle.[3] There are no chucking levers or valves and gauges that require his attention and time. Standard chucks can be furnished with either two or three simple jaws and with the jaws contracting or expanding. Chucking pressures are the same at all positions and the pressures are adjustable for different types of work. All standard chucks are constructed entirely of steel having a solid steel body, and all the moving parts are made of hardened alloy steel to withstand wear.

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1. cycle time — цикл хронометрирования
2. work locator — фиксатор
3. safety foot treadle — предохранительная ножная педаль

VII. Giving answers to the following questions describe the independent four-jaw chuck shown in Fig. 28 and its principle of operation:

1. What kind of chuck is shown in Fig. 28? 2. What group of chucks does the independent four-jaw chuck belong to? 3. How many jaws has the chuck? 4. Where are the four jaws of the chuck situated? 5. How can each jaw of the chuck be adjusted? 6. What possibility is offered by the independent adjustment of jaws? 7. What is the body of the chuck provided with? ●

VIII. Using the following words and word combinations describe the construction and principle of operation of the concentric chuck shown in Fig. 29:

a concentric chuck, to have three jaws, to move in and out, a chuck key, to be inserted, the opening, one of three bevel gears, to be meshed with a large bevel gear, on the flat reverse side, the large bevel gear, a multiturn spiral groove, to be cut, the motion of one of the bevel gears, to be transmitted, by means of the chuck key, to move simultaneously and uniformly, the slots of the body, due to the spiral groove, rotating in that or another direction, the gear with the spiral grooves, to cause, approaching or removing, the jaws of the cuck, from the centre, due to this, the work, to be clamped or unclamped, the advantage, the concentric or self-centering chuck, in moving all jaws simultaneously

X. Describe the construction and principle of operation of the contracting chuck shown in Fig. 30.

11. HOLDING WORK IN A VICE

Vices are *attachments* which are mainly used for holding workpieces in machine and fitting shops. It should be noticed that a vice may also be used as an attachment for holding workpieces on a metal-cutting lathe.

Depending on the character of operation performed *bench vices* or *parallel vices* may be applied. Bench vices are made from forged steel and are of *rugged* construction. If their construction were not rugged, they could not be used when *heavy-duty operations* such as cutting, *riveting*, etc. are performed. A bench vice consists of two jaws: the *movable jaw* and the *solid jaw*. At the end of the solid jaw there is a *lug* for *securing* the vice to a bench. The *extension rod* of the jaw is built-in a wooden *pillow*. When a workpiece is clamped between the jaws they are moved together by means of a square-threaded screw. By unscrewing the screw the jaws are moved apart by a spring riveted to the solid jaw. In parallel vices the jaws move parallel to each other. It should be pointed out that parallel vices in their turn are subdivided into *swivel vices* and *plain vices*.

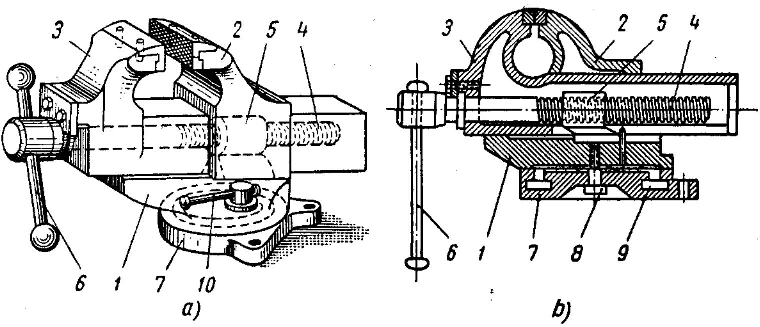

Fig. 31. Swivel Vice:

a — front view; *b* — cross-sectional view; *1* — vice base;* *2* — solid jaw; *3* — movable jaw; *4* — screw; *5* — fixed nut; *6* — handle; *7* — swivel plate; *8* — spindle; *9* — bolt; 10 lever

A swivel vice (Fig. 31), being the most convenient vice in operation, consists of a vice base,* a solid jaw and a movable jaw. The motion of the movable jaw is provided by the rotation of a screw inserted into a *fixed nut*. When the screw is rotated by means of a handle the former will screw in and move the movable jaw to the workpiece to be clamped. The vice base is mounted on a *swivel plate* being connected with the latter by a spindle. A bolt is inserted into a *T*-groove. By turning a handle the bolt may be *loosened* and the vice may be turned in a desired direction.

Plain vices differ entirely from swivel vices in the absence of the swivel plate and that the vice base is bolted directly to a bench. The vice of such a type is made from grey iron, steel hardened plates with a nut being screwed to its jaws. Parallel vices are convenient for clamping workpieces, but as their jaws are of little strength they are non-suitable for heavy-duty operations.

* American — vice ground

Exercises

I. Use the following words and phrases in sentences of your own:

vices, attachment, bench vice, to rivet, rugged, parallel vices, heavy-duty operation, to secure, movable jaw, solid jaw, lug, pillow, extension rod, swivel vices, plain vices, front view, cross-sectional view, fixed nut, to loosen

II. Answer the following questions:

1. What are vices and what purposes are they used for? 2. On what lathes are vices used? 3. Depending on what features may bench or parallel vices be applied for holding workpieces? 4. What material are vices made of? 5. If the construction of the vices were not rugged, could they be used for heavy-duty operations? 6. What main parts does a bench vice consist of? 7. Why is the end of the solid jaw of the bench vice provided with a lug?

III. Find in the text English equivalents of:

тиски, вид спереди, проекция поворотных тисков в поперечном разрезе, поворотная плита, пружина, основание, завинчивать, неповоротные тиски, тавровый или *Т*-образный паз, закрепленная гайка, поворачивать, обеспечивать, приспособление

IV. Underline the suffixes and prefixes and translate into Russian the following words:

attachment, mainly, operation, movable, wooden, convenient, unscrew, disconnect, extension, rugged, performed

V. Translate the following sentences, paying attention to different meanings of should *and* would:

1. It is necessaty that all fitting shops should be supplied with bench vices. 2. If the jaws of parallel vices had not been of low strength, the parallel vices would have found greater application in industry. 3. It is very important that workpieces being in the process should be firmly clamped in vices. 4. If fitting shops were not supplied with vices, how would workers clamp workpieces? 5. It is necessary that the vice should be fastened to a bench. 6. Great attention should be paid to the proper securing of the vice to the bench. 7. Prov-

iding all the requirements were met, the efficiency of the swivel vices would be increased. 8. If the bolt had been loosened enough, we should have been able to turn the swivel vices in a desired direction.

VI. Translate into English:

1. Следовало бы отметить, что неподвижные тиски не очень удобны для работы. 2. Важно, чтобы к губкам тисков привинчивали стальные закаленные пластинки. 3. Необходимо, чтобы на пластинках, привинчиваемых к губкам, была насечка. 4. Следовало бы указать, что параллельные тиски имеют существенный недостаток, заключающийся в малой прочности их губок. 5. Если бы губки параллельных тисков были более прочными, тиски могли бы использоваться для закрепления тяжелых деталей. 6. Если бы крепление стуловых тисков на верстаке обеспечивало надежность их установки, они двигались бы во время работы.

VII. (a) Read and translate the text without using a dictionary:

Vices are used in tool-rooms and as attachments on metal-cutting lathes for holding workpieces. Vices of rugged construction can hold heavy work, easily withstanding the most severe duty imposed on them. There are different types of vices such as plain vices and swivel vices. The jaws of all the vices are made of accurately ground tool steel. They may be moved together or apart by means of a handle. The plain vice is used for light milling operations and is fastened to the bench by means of a screw. The swivel vice may be turned through any angle as the base of the vice is held to the table with a swivel plate. Universal vice may be used for general tool-room work. It can be swivelled up to 90° in the vertical plane and up to 360° in the horizontal plane.

(b) Answer the following questions:

1. Where are vices widely used? 2. What do they serve for? 3. What types of vices do you know? 4. What is the difference between plain and swivel vices? 5. By what means are the jaws of all vices moved together or apart? 6. What may the universal vice be used for?

VII. Using the following words and word combinations describe the principle of operation of the swivel vices shown in Fig. 31:

a swivel vice, to be the most convenient vice, to consist, a base, a solid jaw, a movable jaw, the motion, the movable jaw, to be provided, the rotation, a screw inserted, a fixed nut, the screw, to be rotated, a handle, the vice base, to be mounted, a swivel plate, by means of a spindle, to loosen, the bolt, the vice, to be turned in any direction

CHAPTER III

MACHINE PARTS

1. WELDING

Welding is a process which provides a *non-detachable joining* of two like metal pieces[1] by heating them till melting condition or *fusion* without or with mechanical pressure. Fusion of two metal pieces may be brought about[2] by different types of welding, such as *hammer welding*, *thermit welding*, *electric welding* and *gas welding*.

Hammer welding is a process in which two metal pieces are joined and fused together by force from a hand or *power hammer* after having heated these pieces in a *blacksmith's forge* until they reached their plastic stage.

Thermit welding is a process consisting of a chemical reaction obtained by *igniting finely* divided aluminium and *iron oxide*. This type of welding is used in repairing *rails*, frames, etc.

Electric resistance welding is a process consisting of heating metals to be welded to their plastic temperature and then applying mechanical pressure for achieving a non-detachable joining of the metals.

Resistance welding processes form a group consisting of many types of welding. Selection of each type of welding depends on the kind and size of metals to be welded. Resistance welding embraces such processes as *spot welding*, *butt welding*, *electric arc welding*, etc.

Spot welding is a process in which two metals are held between *electrodes* passing a heavy current through the metals to be welded. The electrodes having been forced together by pressure join the surfaces of the metals in a spot, the size of which is about the same as that of the tip of the electrode. This kind of welding is suitable for welding parts of airplanes, refrigerators and automobiles.

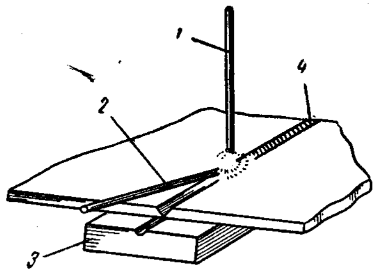

Fig. 32. Electric Arc Welding:
1 — carbon electrode; 2 — additive; 3 — plate; 4 — weld

In butt welding the parts to be welded are pressed together while heat is generated by passing a heavy current through the area of the joint. Butt welding may be applied for welding pipes, tubing, rods, etc.

Electric arc welding is a process in which surfaces to be joined are fused together by the heat of an electric arc. The electric arc was invented in 1802 by the famous Russian scientist V. V. Petrov, who demonstrated the possibility of utilizing its heat for fusing metals. Fig. 32 shows the process of electric arc welding. By bringing the work and the electrode together as *conductors*, an *electric circuit* is established. When the conductors are separated, an electric arc is created in which the electrical energy is converted into heat, its temperature being as high as 7000°F.[3] An *additive* is placed into the flame of the electrical arc. An additive is a metal which is externally applied to the place of welding and melted to form a *weld* together with the material of the work. The electric arc melts both the edges of the parts to be melted and the additive used. The electrode having been removed from the place of welding, the molten metal cools, solidifies and forms a weld, joining the parts of the work.

In *autogenous* (gas) *welding* the source of heat is the gas flame obtained from a gas which is often *acetylene*. Acetylene mixed with oxygen in a *torch* when ignited gives a steady flame. The welding torch consists essentially of a *gas mixing chamber* and is designed in two types: the low-pressure injector type and the equal-pressure type. In the injector-type torch the acetylene is delivered at very low pressure and the oxygen enters the torch at high pressure and *velocity* expanding in the mixing chamber. Then the acetylene is drawn by suction created in the mixing chamber in a constant ratio to the oxygen. Autogenous welding is carried out in different ways and methods. According to the movement of the torch, welding may be divided into *rightward welding* and *leftward welding*. In rightward welding the torch moves ahead of the additive, and in leftward welding the additive moves in front of the torch. In practice rightward welding is mostly used. Gas welding may be used for cutting metals and repairing agricultural machines and *implements*.

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1. two like metal pieces — два однородных куска металла
2. fusion of two metal pieces may be brought about — сплавление двух кусков металла может быть произведено (выполнено)
3. 7000°F=7000 degrees according to Fahrenheit ['fɑ:rənhaɪt] — 7000 градусов по Фаренгейту

Exercises

I. Use the following words and phrases in sentences of your own:

electrode, to weld, fusion, non-detachable joining, electric resistance welding, to ignite, iron oxide, arc welding, spot welding, torch, velocity, autogenous welding, to generate, current

II. Answer the following questions:

1. What is welding and what is it used for? 2. What types of welding do you know? 3. What is the source of heat for arc welding? 4. What is the source of heat for gas welding? 5. What gas is used in autogenous welding? 6. What methods of autogenous welding do you know? 7. What is spot welding? 8. What is butt welding used for? 9. What is hammer welding? 10. What does the selection of a given type of welding depend on? 11. What processes does resistance welding embrace?

III. Supply synonyms for the following words:

burner, to fuse, various, to get, to convert, ahead of, to utilize

IV. Underline the suffixes in the following words and state what part of speech they belong to:

detachable, fusion, mechanical, pressure, obtained, finely, resistance, molten, rightward, agricultural, implement, suitable, possibility

V. Give derivatives from the following words and translate them into Russian:

to obtain, chemistry, final, to achieve, to conduct, electrical, external, press, wide

VI. Change the following sentences using the subordinate clauses instead of participle and gerundial constructions and translate the following sentences into Russian:

Example: 1. *Having fused two metal pieces* we obtained a weld.
When we have fused two metal pieces we obtained a weld.
2. We heard *of their having applied a new kind of additive to obtain firm joining.*
We heard *that they have applied a new kind of additive to obtain firm joining.*

1. After having heated two metal pieces in a blacksmith's forge they reached their plastic stage. 2. Having heated the additive to its melting temperature it began to diffuse into the metals to be joined. 3. We heard of their having applied thermit welding to provide a non-detachable joining of two like metal pieces. 4. The engineer informed them of the hammer welding of two metal pieces having been completed. 5. We know of Petrov's having invented the electric arc. 6. Having been asked to join these rods by butt welding, I had to prepare my instruments for this work. 7. Having found a new method of welding, we were able to join machine parts better and faster.

VII. Give English equivalents of the following words:

сварка встык, контактная сварка, термитная сварка, сплавлять, шов, соединение, выбор, электрод, ток, площадь, присадочный материал, зажигать, ремонтировать, газосмешивающая камера, затвердевать, остывать, скорость, пламя

VIII. Giving answers to the following questions describe the process of electric arc welding shown in Fig. 32:

1. What process is shown in Fig. 32? 2. How can an electric circuit be established in electric arc welding? 3. When is an electric arc created? 4. Where is the electrical energy converted into heat? 5. What is an additive? 6. Where is an additive to be placed? 7. What is melted by the electric arc? 8. When does the molten metal cool, solidify and form a weld, joining the parts of the work?

2. INDUCTION BRAZING AND SOLDERING

Brazing and *soldering* is a method of joining metals by applying a *filler* metal of low melting temperature between the metals to be joined. When the filler metal melts it slightly *diffuses* into the base metals thus holding the parts together.

Soldering is divided into two classifications: soft and hard. In *soft soldering* filler metals with low melting temperature are used, while in *hard soldering* the melting temperature of filler metals is comparatively high.

In recent years, many complex forgings and *stampings* have been re-designed to allow fabrication by brazing or soldering of parts produced by mass-production techniques.[1] Such new designs have often resulted in striking reductions in cost.[2] In other instances, brazing and soldering have permitted the construction of assemblies too costly or complex to be produced by other techniques. Induction heating has proved to have been a valuable aid in these joining processes for many reasons. Among these are rapid heating and precise heat control. The former offers the possibility of localized heating for joining high-strength components with minimum loss of strength. The latter permits *sequential brazing* or soldering operations to have been performed effectively. Rapid heating also minimizes discolouration and thus facilitates cleaning.

Uniform joints with smooth *fillets*, obtained by induction soldering and brazing, decrease alloy consumption and produce parts which are identical in appearance.[3] Frequently, induction brazing and soldering permit a reduction in the required number of holding fixtures. At the same time, the *resultant* minimum of the fixtures increases their life and maintains their accuracy in alignment of the components to be joined. Basically, brazing and soldering involve fusion of a joining alloy between the surfaces of metal parts to be joined. If the metal surfaces are clean, intimate contact[4] is established and the joining material alloys with each surface, forming a *joint* upon solidification during cooling. The two methods of joining differ primarily in the type and melting temperature of the alloy used to form the joint. In soldering, low-melting-temperature alloys, generally containing lead and tin, permit joints of limited strength to be made at temperatures below 800°F. Soldering with these alloys is often termed "soft soldering" and is used in fabricating radio condenser cans,[5] radiators, *terminal strips*, instrument cases, etc., and with the metals to be joined consisting of copper and copper alloys such as brass and bronze, carbon and alloy steels, nickel alloys and *clad* or plated aluminium. Thorough cleaning *prior to* and during heating is basic for successful soldered joints.

Many joint failures may have been traced direitly to poor cleaning and *inadequate fluxing*. Surfaces to be joned should have been chemically cleaned (freed of heat treatment *scale*, corrosion products, grease, embedded graphite, etc.) prior to heating, and the joint areas fluxed as soon as possible to avoid contamination from handling or *exposure*. Suitable fluxes prevent *oxidation* of the joining alloy and metal surfaces to be joined and also dissolve any residual oxides during heating. They improve the wetting characteristics[6] of the joining alloy, thus *promoting* its free flow upon melting. Zinc chloride and ammonium chloride fluxes in paste form are most frequently used in induction soldering, since they are the most active. Unfortunately, these fluxes leave residues which are corrosive, electrically conductive and hygroscopic. Such flux residues must be thoroughly removed. When this is impossible, as in soldering fine electrical assembly units, *rosin* or *activated* rosin-type fluxes which leave non-corrosive and electrically non-conductive residues are used. Fluxes for induction soldering are usually used in paste or liquid form.

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1. mass-production techniques — технические методы серийного производства
2. to result in striking reductions in cost — вызывать резкое снижение стоимости

3. identical in appearance — одинаковые по внешнему виду
4. intimate contact — прочный контакт
5. radio condenser can — корпус радиоконденсатора
6. wetting characteristics — характеристики смачивания

Exercises

I. Use the following words and phrases in sentences of your own:

brazing, soldering, filler metal, to diffuse, soft soldering, hard soldering, to result in, induction brazing, induction heating, cleaning, smooth fillet, flux, paste, liquid, joint, sequential brazing

II. Answer the following questions:

1. What is soldering? 2. How does the filler metal hold the parts together? 3. How may soldering be classified? 4. What kinds of filler metals are used in soft soldering? 5. What kinds of filler metals are used in hard soldering? 6. Why has soldering reduced the cost of production of many assemblies? 7. What type of heating is used in soldering or brazing? 8. What are the advantages of induction brazing or soldering?

III. Supply synonyms for the following words:

to join, aid, rapid, precise, to decrease, to produce, to improve, clean, melting, clad, promoting

IV. Supply antonyms for the following words and translate them into Russian:

adequate, cooling, dirty, to decrease, to destroy, low-temperature, conductive, heating, to assemble, fortunately

V. Underline the suffixes and prefixes and translate into Russian the following words:

redesign, fabrication, induction, non-corrosive, effectively, facilitate, non-conductive, costly, frequently, reduction, basically, discolouration, primarily, successful, failures, hygroscopic, thoroughly, impossible, electrically, conductive

VI. Find the predicates in the following sentences, then analyse and translate the sentences into Russian:

1. Recently, techniques have been developed for induction brazing in a reducing atmosphere[1] to avoid the use of flux and thus the problems of thorough removal of flux residues. 2. There is a special unit for controlled-atmosphere brazing.[2] 3. In this unit, a purified dry reducing gas, such as hydrogen, enters the unit at the top, displaces the air and surrounds the part to be heated. 4. Upon heating to elevated temperature, oxide films on the metal surfaces to be joined and on the joining alloy are reduced, permitting satisfactory flow of the alloy into the joint by capillary action, thus producing a good bond.

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1. reducing atmosphere — восстановительная газовая среда
2. for controlled-atmosphere brazing — для пайки регулируемой газовой средой

VII. Make up questions to which the italicized words are the answers:

1. Soft soldering is used in fabricating *radio condenser cans and radiators.* 2. *Brazing and soldering* involve fusion of joining alloy between the surface of metal parts to be joined. 3. In soldering, low-melting-temperature alloys permit joints of *limited strength* to be made at temperatures below 800°F. 4. Ultrasonic energy is used *in fluxless soldering*. 5. *Suitable* fluxes prevent oxidation of the joining alloy and metal surfaces to be joined. 6. Precise heat control is used *to permit effective performance of sequential brazing or soldering operations.*

VIII. State the forms and functions of infinitives and translate the following sentences:

1. The metals to have been joined included carbon and alloy steels, stainless steel, cast iron, copper and copper alloys, nickel and nickel alloys and, to a limited extent,[1] aluminium alloys. 2. The properties of solder may have been changed by addition of some elements such as zinc, aluminium, and phosphorus. 3. A torch should have been used to heat the hard solder and object to be brazed. 4. In order to solder aluminium, flux should be mixed with a special

solder used for aluminium. 5. The ternary alloy of silver, copper and phosphorus was largely self-fluxing when used with copper but should have not been used on ferrous metals since it formed a brittle iron phosphide.

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1. to a limited extent — в ограниченной мере

X. *Translate the following text in written form without using a dictionary:*

It is interesting to note that brazed joints involving cast-iron parts are more dependably gas-tight and liquid-tight and have strength if the parts are electrolytically treated to remove graphitic carbon from the joining surfaces before fluxing and induction heating. Fluxes containing fluorides and alkali salts, preferably potassium, are generally used for induction brazing, particularly with the silver-brazing alloys. These fluxes, normally used in paste form, become fluid and active below 1100°F, protecting the metal surfaces to be joined, dissolving residual oxides and promoting better flow of the alloy upon melting.

3. THREADS

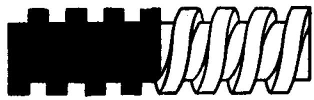
Threads are applied for interconnection of machine parts and for transmitting motion from one part to another. When a thread is cut on the outside of a part it is known as an "*external*" or "*male thread*". A thread is called an "*internal* "or "*female thread*" when cut inside a part. Depending on the shape of the threading tool different profiles of thread are obtained, such as *triangular*, *square* or *trapezoidal*, shown in Fig. 33.

In practice triangular threads are most widely used. The main elements of a thread are: the *angle of the thread*, the *major*, *minor* and *pitch diameters*, the *depth* and the *pitch*. These elements are shown in Fig. 33.

The angle of a thread is the angle included between the sides of the thread and measured in an axial plane. The major, or outside, diameter of a thread d_0 (sometimes referred to as "*full diameter*") is the distance between the two extreme outside points of the thread in the direction square to the axis.[1]

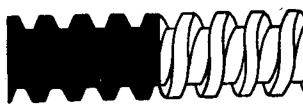
triangular thread, or V-thread

square thread, or flat thread



buttress thread

trapezoidal thread or acme thread



round thread

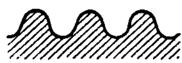


Fig. 33. Profiles of Threads

The major diameter is the largest diameter of the thread of a screw or a nut.

The minor diameter d_1, being the smallest diameter of the thread, is the distance between the two extreme inside points of the thread measured at the right angle to the axis. The minor diameter is also called the "*core diameter*" or "*root diameter*".

The pitch diameter d_2 is the distance between the two opposite parallel sides of the thread profile perpendicular to the thread axis. The depth t_2 of the thread is the distance between the *crest* and the base of the thread measured normal to the axis, or

$$t_2 = \frac{d_0 - d_1}{2}.$$

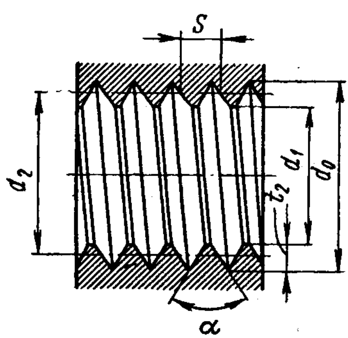


Fig. 34. Main Elements of a Thread:

d_1 — minor diameter; d_0 — major diameter; d_2 — pitch diameter; S — pitch; t_2 — depth

A crest is the top surface joining the two sides of a thread, while a base of a thread is the bottom surface joining the two *adjacent* threads. The pitch of a thread is the distance from a point of thread to the corresponding point of the next thread measured parallel to the axis.

Screw threads are of both *right-hand* and *left-hand* types. In right-hand threads the direction of the thread is from the right to the left. Right-hand threaded screws are turned clockwise to be screwed into a nut, while left-handed screws

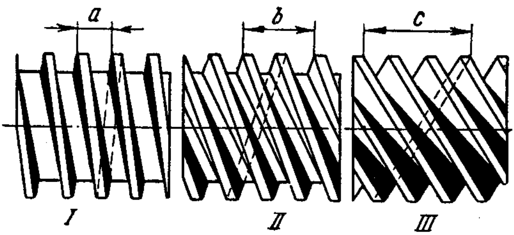


Fig. 35. Screw Thread:

I — single thread screw; *II* — double thread screw; *III* — triple thread screw; *a, b, c* — pitch

should be turned counterclockwise to do that. In screw fastenings threads are made of various shapes, but always of the triangular type, such as: *single thread*, *double thread* and *triple thread* (Fig. 35). On the type of the latter depends the *lead* of the thread which is the distance a screw thread advances axially in one turn. On a single thread screw the lead and the pitch are the same; on the double thread screw the lead is twice the pitch, while on a triple thread screw the lead is three times the pitch.

The most widely used systems of triangular threads in machine-building are: *metric*, *inch* and *pipe threads*. Each thread has its own angle and application. A metric thread profile resembles a triangle with an angle of 60° at its *apex*. Such a thread is widely used for bolts and nuts. An inch tread profile has an angle of 55°. This type of thread may be used when making *spare parts* for foreign-made machines. An angle of 55° is also used with pipe threads. Pipe threads are applied for gas and water pipes, as well as for *clutches* connecting such pipes.

---

1. in the direction square to the axis — в направлении, перпендикулярном к оси

Exercises

I. Use the following words and phrases in sentences of your own:

round thread, internal thread, triple thread, profiles of thread, triangular thread, square thread, buttress thread, pitch of thread, right-hand thread, screw thread, single thread, left-hand thread

II. Retell the text giving answers to the following questions:

1. What are threads used for? 2. What types of threads do you know? 3. What are the main elements of a thread? 4. What types of screw threads do you know? 5. What are the most widely used systems of triangular threads in machine-building?

III. Find in the text synonyms of the following words and word combinations:

square thread, trapezoidal thread, major diameter, minor diameter, root diameter

IV. Analyse and translate the following sentences:

1. The metal cannot be compressed, but is cold forged into a different form, and what takes place when the thread shaped dies are forced into the metal to form a thread is displacement of the surface which is forced into grooves, that is, the material from the depressions forms the elevations on either side. 2. The *V*-shaped thread must not be made sharp because the sharp crest of the *V*-thread is very easily broken, and the taps and dies will not stand long due to the sharp thread. 3. The finished thread is of greater diameter than the original diameter of the wire, which in turn is larger than the diameter of the finished thread at the root. 4. A screw or bolt of a given size has a greater minor diameter and a greater strength if the pitch is fine rather than coarse. 5. The finished product is therefore larger in diameter than the blank by an amount approximately equal to the depth of the thread. 6. This process of rolling threads, grooves and screw blanks is used in the manufacture of many articles in preference to cutting the threads or grooves with ordinary slow-cutting tools or threading dies.

V. Make up as many questions as possible concerning the following sentences:

1. During the operation the metal is cold forged into a different form. 2. The finished thread is of greater diameter than the original diameter of the wire. 3. A crest of a thread is the top surface joining the two sides of the thread. 4. A base of a thread is the bottom surface joining the two adjacent threads. 5. In screw fastenings threads are made of triangular type.

VI. (a) Read and translate the following text using a dictionary:

The process of rolling screw threads has been greatly developed and its usefulness extended by the rather recent introduction into common use of a material suitable for roll threading. Iron of ordinary quality does not lend itself well to this process on account of its fibrous structure, which makes this material liable to split or fracture under pressure, but in the modern low-carbon steel we find a material in every way suited to the rapid and economical forming of screw threads. By this process the blank is rolled between two flat dies with their working surfaces grooved to the shape of the thread required, these grooves being cut across the face of the dies at the proper angle to suit the pitch and diameter of the screw.

(b) Retell the text.

VII. On the basis of Fig. 33 describe what profiles of thread are obtained depending on the shape of the threading tool.

VIII. Giving answers to the following questions describe the main elements of a thread as shown in Fig. 34:

1. What are the main elements of a thread? 2. What is the angle included between the sides of the thread called? 3. What is the distance between the two extreme outside points of the thread in the direction square to the axis called? 4. What is the largest diameter of a thread called? 5. What is the minor diameter of a thread? 6. What is called the "pitch diameter" of a thread? 7. What is the distance from a point of thread to the corresponding point on the next thread measured to the axis called? 8. What is the depth of a thread?

IX. Describe the shapes of threads in screw fastenings on the basis of Fig. 35.

4. GEARS

A gear is a *toothed wheel* used to transmit rotary motion from one shaft to another. If power is transmitted between the two shafts, the *angular velocity* ratio of these two shafts is constant and the *driving shaft* and the *driven shaft* rotate at a uniform rate. Shafts may be parallel, intersecting, and non-coplanar. Types of gears may be diverse depending upon the above positions of the shafts. Gears may be classified according to their shape and according to the position which the teeth occupy respectively to the axis of rotation. The teeth cut on the face of a gear may be curved, straight or *helical*.

The main types of gears are: *bevel gears, eccentric gears, helical* or *spiral gears, herringbone gears, screw gears, spur gears* and *worm gears*.

Bevel gearing (Fig. 36) is used to transmit power between two shafts, which lie in a common plane and whose axes intersect each other. The axes may be inclined to each other at any angle, although 90° is the most common one. The teeth of bevel gears may be either straight or spiral. In the straight bevel gears the elements of teeth converge to a common point called the "apex".

Eccentric gears operating on parallel shafts are used to transmit a varying angular velocity either continuously or for a portion of *revolution*.

Helical or spiral gears (Fig. 37) operate on parallel shafts at high speeds, providing maximum strength of gear teeth for a given width of face. Such gears are heat-treated and then

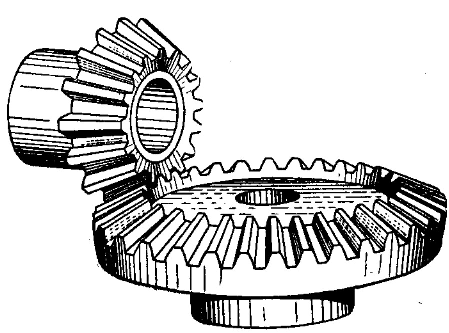


Fig. 36. Bevel Gearing

ground to accurate shape and size, necessary for smooth and quiet *running* at high speeds. The teeth of helical gears, having been cut on a conical surface, curve continually toward or away from the apex of the cone upon which they are cut. These gears closely resemble bevel gears and are frequently called spiral bevel gears.

Similarly to helical gears, herringbone gears also operate on parallel shafts. Herringbone gears have helical teeth ra-

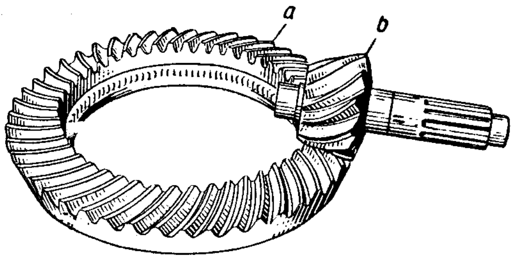


Fig. 37. Gearing:
a — spiral bevel gear, *b* — hypoid gear

diating from the centre of the face towards the sides of the gear body. They are used where high speeds and high gear ratios are necessary.

Screw gearing is used for converting some rotary motion into a *forward motion*, and for connecting shafts which are not intersecting. Spur gears are gears having straight or

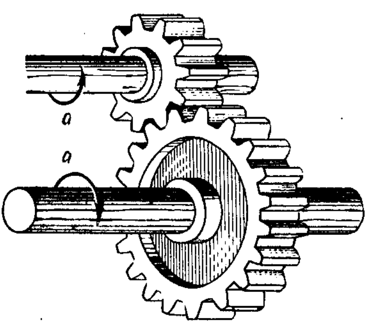


Fig. 38. Spur Gearing:
a — parallel shafts

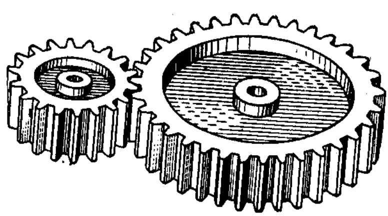


Fig. 39. Spur Gear Wheels with External Gearing

helical teeth cut on a cylindrical surface at an angle to the shaft axis.

Spur gearing (Fig. 38) is used to transmit power between two shafts, the axes of which are parallel. Spur gearing may be divided into three types such as: *external gearing* (Fig. 39), *internal gearing* (Fig. 40) and *rack-and-pinion gearing* (Fig. 41). Rack-and-pinion gearing serves for converting rotary motion into forward motion and is widely used in lathes. It consists of a *rack*-and-*pinion*.

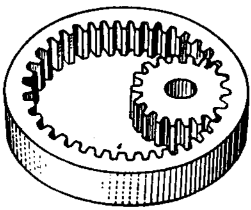


Fig. 40. Spur Gear Wheels with Internal Gearing

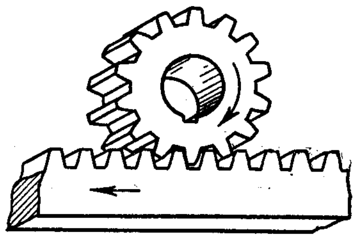


Fig. 41. Rack-and-Pinion Gearing

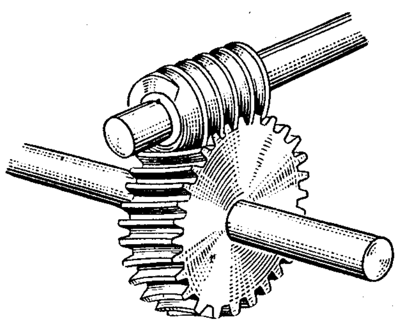


Fig. 42. Worm Gearing

A worm gear (Fig. 42) is a gear having the teeth cut at an angle to the axis of rotation of the gear body and radially in the gear face. A worm gear is driven by a *worm* which resembles a large screw. *Worm gearing* is applied for transmitting power between non-intersecting shafts which are at right angles to each other.

In practice *friction gearing* and *toothed gearing* are most widely used for transmitting power from one shaft to another and for connecting the shafts. Friction gears are used for light and medium powers in machinery which is frequently started and stopped. Their advantages are *flexibility* and noiselessness. The disadvantages of friction gears are the thrust on the bearings and slippage. Toothed gears are used when a constant speed is desirable and the distance between the shafts is rather small. Transmission of rotary motion is performed by means of shafts and gears or *gear trains* mounted on them with the help of *inserted keys*.

Shafts may be of different length and diameters. When rotating, the shafts transmit both the rotation and the *torque*. Gears replace *belt-and-pulley drives* where *positive* motion is required. Gear teeth for all types mentioned above are made in mass production by the *generating* process on specially designed machines. In this process, the cutter used for cutting teeth has the form of a tooth of the mating gear. One of the most important gear-cutting processes is that of *hobbing*. In this process, the cutter used for hobbing gear teeth is made like a worm with *gashes* parallel to the axis to provide cutting edges on the worm. Such a cutter is called the "*hob*".

Exercises

I. Use the following words and word combinations in sentences of your own:

a toothed gear, gearing, to hob, to run, to generate, rotary motion, intersecting shafts, spur gearing, bevel gearing, worm gearing, driven shaft, angular velocity, positive motion, inserted key

II. Answer the following questions:

1. What is a gear and what is it used for? 2. Where do gears replace belt-and-pulley drives? 3. What types of shafts do you know? 4. What do types of gears depend on? 5. According to what features may gears be classified? 6. What kinds of teeth cut on the gear face do you know? 7. What main types of gears can you enumerate? 8. By what processes are gear teeth produced?

III. Choose synonymical groups out of the following list:

velocity, to transmit, to intersect, smooth, to converge, to transfer, speed, to cross, quiet, to approach

IV. Underline the suffixes and prefixes and translate into Russian the following groups of words:

controllable, controller, incontrollable; caller, calling, recall; section, sectional; intersect, intersection, non-intersecting

V. Translate the following sentences observing different meanings of the words in italics:

1. When the rain has stopped I noticed a *worm* on the lawn of our garden. 2. *Worm* gearing is applied to transmit power between shafts placed at right angles to each other. 3. The Great October *Revolution* broke out in 1917 and liberated the working class in our country from the yoke of capitalism. 4. Eccentric gears are applied for transmitting a varying angular velocity for a portion of *revolution*. 5. I locked the door of my flat and left the *key* on the shelf. 6. Gears are mounted on shafts by means of *keys*.

VI. Find in the text English equivalents of:

передача с внешним зацеплением; передача с внутренним зацеплением; винтовая передача; закладная шпонка; прямой зуб; кривой зуб, винтовой зуб, косой зуб, реечная передача, фрикционная передача, цилиндрическое зубчатое колесо, коническое зубчатое колесо, шестерня с косыми или спиральными зубьями, шестерня с шевронными зубьями, вращательное движение, давление, зубчатая передача, червячная передача

VII. Make up questions to which the italicized words are the answers:

1. Modern requirements for gears demand *that they run quietly at high speeds*. 2. Gear-cutting machines have been developed *for the rapid mass production of similar parts*. 3. The gear blank is pressed *on an arbor* and held *between centres of the dividing head and the index tailstock*. 4. Bevel gearing is used *to transmit power between two shafts whose axes intersect each other*. 5. *Spur gearing* is used to transmit power between parallel shafts.

VIII. Using the following words and word combinations describe the bevel gears shown in Figs 36 and 37 and explain the difference between their teeth:

bevel gears, to be used, to transmit power, two shafts, axes, to intersect each other, the teeth, to be straight or spiral, Fig. 36, one can see, the straight bevel gears, to converge, a common point, to be called the apex, Fig. 37, a spiral bevel gear, to have helical or spiral teeth, to have been cut, a conical surface, to curve toward or away, the apex, helical or spiral gears, to be applied, operation, parallel shafts, high speeds

IX. Giving answers to the following questions describe the difference between gearings shown in Figs 39 and 40:

1. What types of gearings do you see in Figs 39 and 40? 2. What type of gearing do external and internal gearings belong to? 3. Are the teeth in Figs 39 and 40 straight or helical? 4. How must two shafts be placed when external and internal gearings are used for transmitting power between them? 5. What engagement of two gears does an external gearing provide? 6. What engagement of two gears does an internal gearing provide?

X. Look at Figs 38, 41 and 42 and describe in detail the difference between the given gearings.

5. BELT AND CHAIN DRIVES

The *belt drive* is the most widely used kind of *driving* on metal-cutting lathes. The belt drive in lathes is used mainly for transmitting rotation of an electromotor from one *pulley* to another owing to the tension of the *belt*. For instance, in some lathes *drive* to the headstock is provided by belts from a motor, the *mounting plate* of which is allowed *to pivot* freely so that the belts are tensioned by the weight of the motor.

The belt-and-pulley system of transmitting rotary motion is subject to belt slippage and is therefore not positive. Belts are still incorporated in the drive, because of the safety factor inherent in a friction drive and because of the silence, as compared with gearing run at high speeds. Fig. 43 shows a belt drive consisting of two pulleys *A* and *B*, mounted on two parallel shafts which are connected by an *endless* *belt*. The pulley *A* which transmits rotation is called the "*driving pulley*",* while the pulley *B* receiving rotation from the pulley *A* and transmitting it to its shaft is known as "*driven pulley*."** The friction surface of a driving pulley should be of a comparatively soft material, while that of the driven pulley is usually made of hard material. Such an arrangement ensures the maintenance of the friction surfaces. Otherwise, if the driven pulley were made of the softer material, its surface would be injured and ruined.

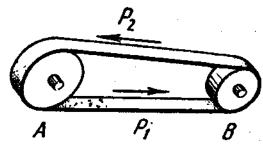


Fig. 43. Belt Drive

P_1, P_2 — belt tension

There are two main kinds of belts such as *flat belts* and *V-belts*. Flat belts are made of leather, cotton yarn or rubberized cloth. *V*-belts manufactured of rubberized cloth are of a trapezoidal shape. They are pulled over the pulleys into special grooves, which considerably reduces their slipping off the pulleys during operation. Therefore this kind of belt finds ever increasing application on *metal-cutting tools* and is tending to replace flat belts. When a *chain* is applied there is no rolling contact as with gears. It transmits its tension uniformly to every tooth of the *chain gear* coming into contact with it. In this case there is no one-tooth action as in gears, and no losses due to *rolling friction* and the shock of transferring the load from the tooth. The *link-belt silent chain* can be, and should be, run *slack*. Belts require a tension in excess of the effective working tension, and to that extent there is a loss of power on the pulley of the shaft. Belts run on[1] by *inertia* and slip and lose power in that way and the less the belt tension is the more it slips, but the link-belt silent chain never slips.

1. Belts run on — ремни набегают

Exercises

I. Use the following words and phrases in sentences of your own:

metal-cutting tools, to pivot, to slip, to lose power, tension of the belt, driven pulley, driving pulley, rubberized cloth, chain gear, slack, to tend, to incorporate, inertia, to ruin, to injure

* American — driver

** American — follower

II. Answer the following questions:

1. What is the belt drive used for and in what machines? 2. Because of what feature is the belt-and-pulley system of transmitting rotary motion not positive? 3. Owing to what features are belts still incorporated in the drive? 4. What are the main two types of belts? 5. What are different belts made of? 6. For what purpose are *V*-belts pulled over the pulleys into special grooves? 7. How does a chain transmit its tension to every tooth of the chain gear which comes into contact with it? 8. What are the advantages of a link-belt silent chain over a belt?

III. Underline the suffixes in the following words and state to what part of speech they belong:

tension, pulley, friction, widely, endless, manufacture, special, slipping, effective

IV. Connect the following sentences using participle constructions and gerundial constructions:

Example: 1. *V*-belts are of a trapezoidal shape. They are made of rubberized cloth.

V-belts *made of rubberized cloth* are of a trapezoidal shape.

2. *V*-belts are pulled over the pulleys into special grooves. The special grooves reduce slipping of *V*-belts.

V-belts are pulled over the pulleys into special grooves *for reducing slipping of V-belts.*

1. The belt drive is used for driving lathes. The belt drive transmits rotation of an electromotor from one pulley to another. 2. The chain transmits tension to every tooth of the chain gear coming into contact with it. The chain is applied on the lathe. 3. The lathe is provided with an electromotor. The electromotor sets in motion the belt drive. 4. The two pulleys of the belt are mounted on two parallel shafts. The shafts are connected by an endless belt. 5. Flat belts are widely used on metal-cutting tools. Flat belts are made of leather or rubberized cloth. 6. The driving pulley is incorporated in the lathe drive. The driving pulley transmits rotation of an electromotor.

V. Translate into English:

1. Следует указать, что ремень тем больше проскальзывает, чем слабее его натяжение и чем меньшую часть шкива он охватывает по окружности. 2. Клиновидные ремни натягиваются по нескольку в ряд и укладываются на шкивах в канавки. 3. В токарных станках передачи как клиновидными, так и плоскими ремнями применяются только с натяжным устройством. 4. Передача плоскими ремнями отличается от передачи клиновидными ремнями. 5. Ременная передача в токарных станках применяется главным образом для передачи вращения приводному шкиву от электромотора.

VI. (a) Read and translate the text without using a dictionary:

While a motor drive is standard equipment there are certain cases where pulley and belt drive meets the conditions of varied power requirements. It is possible to obtain belt connection with idle pulley and motor mounted in special way. In such a case the 6 inch 6 spindle machine when pulley drive is desired is equipped with 14 inch diameter pulley with $4\frac{1}{2}$ inch face which should run at 760 r.p.m., but the 8 inch 6 spindle machine is equipped with 14 inch diameter pulley with $4\frac{1}{2}$ inch face which should run at 600 r.p.m.

(b) On the basis of this text make up questions and answer them:

VIII. Giving answers to the following questions describe the principle of operation of the belt drive shown in Fig. 43:

1. What is shown in Fig. 43? 2. How many pulleys does this drive consist of? 3. Where are these two pulleys mounted and how are they connected? 4. What are the functions of the pulleys used in belt drives? 5. How are pulleys classified depending upon the functions performed by them? 6. What pulley is called the "driving pulley"? 7. What pulley is called the "driven pulley"?

6. BEARINGS

A bearing is a machine part which supports shafts and spindles. We know bearings to be classified as *plain bearings* and *antifriction bearings.*

In plain bearings one friction surface slides upon another. Plain bearings may be of two classes: bearings with a continuous rotary motion and those with an *intermittent motion.* The first class of plain bearings is represented by *journal bearings* and *thrust bearings.* Journal bearings are bearings carrying a load which acts at right angles to the shaft axis. Thrust bearings take a load acting in the direction of the shaft axis. The second class of plain bearings embraces bearings of parts having a *rocking motion*, or a *linear reciprocating motion.*

Antifriction bearings are also subdivided in two main classes depending upon the type of rolling elements: *ball bearings* and *roller bearings.* In rotating machines, noise and vibration are indications of faulty operation of ball bearings or roller bearings. A ball bearing consists of two rings: an inner ring and an outer ring between which there are hardened steel balls spaced in a ball *retainer* or *cage.* If the inner ring had been lifted to a tilt position, the balls would have been forced to climb one side of the *raceway* during a part of revolution, with resulting drag on the bearing retainer, then, the balls would have accelerated down the raceway to climb the opposite side in the other part of the revolution, reversing the strains on the bearing retainer. In this instance, the balls, instead of rotating about a true horizontal axis, rush to turn from contact with the sides of the raceway and to reverse their direction of turn during the second half of the revolution. In rotating machines, the balls are spaced so that they do not touch each other, thus reducing wear and noise. They require an absolutely parallel raceway to roll upon, entirely free from eccentricity, *wobble* or other variations.

Ball bearings may be of the following types: *radial bearings, thrust bearings*, and *radial-thrust bearings.* In their turn radial ball bearings which serve to take loads acting at right angles to the shaft axis, may be of two types: *single-row* (Fig. 44) and *double-row radial bearings.* All the radial bearings are used when high speeds are required. The precision-made radial bearings give the finest service together with a long bearing life. Thrust ball bearings are bearings taking *axial loads* and giving maximum efficiency with combined *journal* and thrust loads. They are also recommended for thrust duty[1] at high speeds. Radial ball bearings can take both *radial* and axial loads.

In roller bearings hardened steel rollers are used between the rings instead of balls. Roller bearings permit a larger load and have a longer bearing life in comparison with ball bearings. The rollers used in roller bearings may be of different shape: cylindrical, conical, spherical, and concave. Roller bearings, in turn, may be subdivided into single-row and double-row bearings. Bearings with cylindrical rollers are intended to take radial loads, while those with conical rollers may take both radial and axial loads.

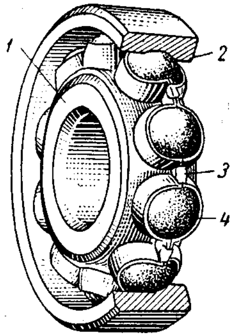


Fig. 44. Single-Row Ball Bearing:

1 — inner ring or inner race; *2* — outer ring or outer race; *3* — ball retainer or cage; *4* — ball

1. thrust duty — работа при осевых нагрузках

Exercises

I. Use the following words and phrases in sentences of your own:

bearing, plain bearing, to support, antifriction bearing, continuous rotation, intermittent motion, to carry load, rocking motion, journal bearing, linear reciprocating motion, axial load, radial load, hardened steel balls, to touch, to reduce wear, long bearing life, precision-made radial bearings

II. Answer the following questions:

1. What are bearings used for? 2. How are bearings classified? 3. How may plain bearings be classified? 4. What bearings belong to the first class of plain bearings and what loads are they intended to take? 5. How are antifriction bearings classified? 6. What bearings belong to the second class of plain bearings? 7. What are the main types of ball bearings?

III. Find in the text English equivalents of:

подшипник качения, подшипник скольжения, опорный подшипник, шарикоподшипник, упорный подшипник, однорядный подшипник, роликовый подшипник, сепаратор подшипника, внутреннее кольцо подшипника

IV. Give derivatives from the following words and translate them into Russian:

class, to move, to carry, to direct, to rock, to depend, to roll, to retain, to require, fine, axis, efficient, long, cylinder, cone, to determine, assembly

V. Find the predicates and state the forms and functions of infinitives in the following sentences. Translate the sentences into Russian:

1. We know taper roller bearings to have been manufactured by many plants, in both single- and double-row types, each with plain and flanged outer rings, in a range of sizes covering bore diameters from 35 to 210 mm. 2. We also know taper roller bearings to have been designed and manufactured for use on machine tool spindles where a high degree of accuracy coupled with rigidity and cool running over a range of speeds is demanded. 3. The cage is centred on the inner ring to allow only a small proportion of the oil to flow along the bearing tracks for lubrication purposes. 4. We have noticed that some balls made of special steel increase their hardness.

VI. Find the predicates and state the kind of subordinate clauses in the following sentences and translate them into Russian:

1. These bearings are finding other applications where similar characteristics are necessary, for example in printing machinery. 2. Among the features of these bearings are the hollow rollers which, together with special cage construction, ensure that full use is made of the oil flow for lubricating and cooling purposes. 3. A light alloy cage, the surface of which has oil retaining properties, is employed and almost entirely encloses the rollers occupying practically the whole space between the inner and outer rings.

VII. Change the following sentences using the subordinate clauses instead of the complex objects and translate them into Russian:

Example: We know *bearings to be subdivided* into several classes.
We know *that bearings are subdivided* into several classes.

1. We know a bearing to be a machine part for supporting shafts and spindles. 2. We know bearings to be classified as plain bearings and antifriction bearings. 3. I find in plain bearings one friction surface to slide upon another. 4. I have noticed thrust bearings to take a load acting in the direction of the shaft axis. 5. I know antifriction bearings to have been subdivided into two main classes.

VIII. Translate the following sentences into English using the complex object:

Example: Мы предполагаем, что они окончили новую конструкцию сепаратора подшипника.
We suppose *them to have completed* a new design of the bearing retainer.

1. Мы знаем, что опорами валов и шпинделей служат подшипники. 2. Мы знаем, что подшипники подразделяются на подшипники качения и подшипники скольжения. 3. Мы предполагаем, что подшипники скольжения получили свое название из-за вращения вала по внутренней поверхности вкладыша. 4. Мы ожидаем, что трение, нагрев и износ подшипников уменьшится при применении обильной смазки. 5. Общеизвестно, что, для того чтобы обеспечить различные условия работы шпинделя, вкладыши подшипников изготовляются из различных материалов.

IX. (a) Read and translate the text without using a dictionary:

Automatic assembly and inspection machine for antifriction bearings. The range of air-operated gauging equipment made by some plants for checking ball and roller bearings is being extended to include fully- and semi-automatic machines for carrying out assembly as well as inspections on most types of precision antifriction bearings. One of the new machines for automatic assembling and inspecting taper roller bearings is discussed below. On this machine, the inner race is automatically checked for diameter, and rollers of the required size are selected. Assembly of the race, rollers and cage is next carried out to produce a bearing with predetermined clearance. The bearing is then checked for torque, noise level,[1] and assemblies which are not acceptable are automatically rejected.

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1. noise level — уровень шума

(b) Retell the text.

X. *Using the following words and word combinations describe the construction of the ball bearing shown in Fig. 44:*

single-row bearing, to be represented, this picture, to consist, two rings, an inner ring, an outer ring, there are, these rings, hardened steel balls, to be placed, each other, to reduce, this feature, wear and noise, balls, to require, to roll upon, parallel raceway, free from wobble

7. CLUTCHES

A *clutch* is a device for connecting two parts, such as shafts or a shaft and a pulley. The difference between a *coupling* and a clutch is that a coupling is used to connect two shafts permanently, while a clutch may ensure easy and quick connection and disconnection of two shafts. Clutches used in lathes are subdivided into several types, such as *rigid couplings* and *disengaging clutches.* A rigid coupling serves for connecting *coaxial* shafts which are not *disengaged* in the process of operation. Fig. 45 shows a rigid coupling, which consists of a *solid bushing* connecting electric motor and lathe shafts by means of a *key.* Disengaging clutches are applied in lathes for temporary engagement and disengagement of a shaft and parts connected with it. They are divided into *friction clutches* and *jaw clutches.* Friction clutches serve to connect a stationary machine part to transmit the required power. Sometimes friction clutches are intended as

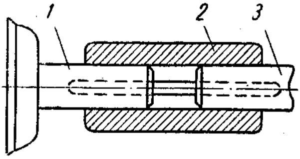

Fig. 45. Rigid Coupling:
1 — electric motor shaft; *2* — solid bushing; *3* — lathe shaft

safety devices to prevent the breakage of parts in the *transmission train.*

Friction clutches may be divided into two groups, according to the direction of the acting force: *axial clutches* and *radial* or *rim clutches.* In axial clutches the contact pressure is applied in a direction parallel to the axis of rotation, while in rim clutches the contact pressure is applied upon a rim in a radial direction. Axial clutches can be subdivided into *cone clutches*, and combined cone and *disc clutches.* Fig. 46 shows a cone clutch. By moving a movable wheel the cone disc connected with the toothed wheel by a key may engage the cone located in the movable wheel. Thus the cone disc is pressed against the inside cone of the movable disc, friction necessary for transmitting rotary movement to the movable

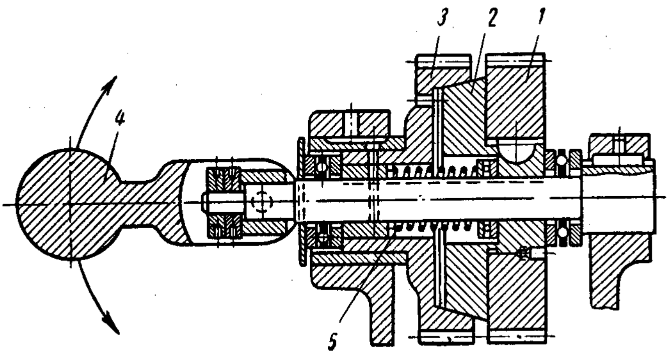

Fig. 46. Cone Clutch:

1 — toothed wheel; *2* — cone disc; *3* — movable wheel; *4* — eccentric clamp; *5* — spring

wheel being created between the two cones. The outside cones are meshed by an eccentric clamp. By turning the eccentric clamp to 90° the friction clutch is disengaged, a spring pressing out the toothed wheel from the friction disc. Radial or rim clutches may be classified as *band clutches*, *block clutches*, and as external, internal, and combined internal and external clutches. Jaw clutches consist of two half-clutches—a *fixed* one and a movable one which have jaws on their faces. The fixed half-clutch is rigidly fastened on one shaft, the movable one being keyed to another shaft.

The shafts are connected through the coupling of jaws on both half-clutches.

The following factors are decisive in selecting the type of clutch to be used: torque, rotative speed, available space, and frequency of operation. When a heavy torque should be transmitted a clutch must have sufficient gripping power, which is usually ensured by *multi-disc clutches*. For low-speed service cone and rim clutches are used. For high rotative speeds light, compact and internally balanced clutches of the multi-disc type may be applied. Space being limited, multi-disc, twin-cone and double-cone clutches are used because of their greater compactness in comparison with other types of clutches. Single-disc clutches with metal contact surfaces and cone clutches are the most suitable ones for frequent or continuous operation.

Exercises

I. Use the following words and phrases in sentences of your own:

clutch, coupling, rigid coupling, disengaging clutch, coaxial, key, friction clutch, transmission train, axial clutch, rim clutch, jaw clutch, to engage, fixed clutch, eccentric clamp, suitable

II. Retell the text giving answers to the following questions:

1. What is the difference between a clutch and a coupling? 2. How are clutches subdivided? 3. What does a rigid coupling serve for? 4. What is a disengaging clutch applied for? 5. What is a friction clutch? 6. How are friction clutches classified? 7. What is the difference in application of the contact pressure in axial clutches and in radial clutches?

III. Choose synonymical groups out of the following list:

rigid, to connect, frequently, different, to engage, tendency, to join, various, hard, to gear, often, direction, rotation, transmission, revolution, transferring

IV. Choose antonymical groups out of the following list:

to divide, movable, to engage, external, to connect, immovable, to disconnect, to unlink, to stop, internal, to start, to combine

V. Underline the suffixes and prefixes and translate into Russian the following words:

engage, engagement, engaging, disengaging, disengagement; determination, predetermination; station, stationary; intensity, intensive; rigidly, rigidity

VI. Connect the following sentences using the absolute participle construction and translate them into Russian:

Example: A rigid coupling connects coaxial shafts.
Coaxial shafts are not disengaged in the process of operation.
A rigid coupling connecting coaxial shafts, they are not disengaged in the process of operation.

1. The construction of some new clutches has already been completed. We ordered some of them. 2. Numerous experiments have been carried out. The design of the new jaw clutches was approved. 3. The clutches used in lathes are subdivided into several types. The friction clutches are subdivided into two groups. 4. A spring presses out the wheel from the disc. By turning the eccentric clamp, the cone clutch is disengaged. 5. Clutch constructions are based on the positive-action and friction principles. Couplings are made in two main types: rigid and flexible.

VII. Translate the following sentences into English using the absolute participle construction:

Example: Когда расстояние между валами ограничено, используются многодисковые муфты.
The distance between shafts being limited, multi-disc clutches are used.

1. Так как некоторые валы имеют небольшое отклонение от соосности, применяется упругое соединение. 2. Схематическое устройство конусной фрикционной муфты показано на рис. 46; конический диск может при перемещении подвижного колеса входить во внутренний конус. 3. Когда кулачковая муфта включена влево, вращение от ведущего вала передается ведомому валу через колеса. 4. Если кулачковую муфту включить вправо, то вращение передается ведомому валу через зубчатые колеса. 5. Так как кулачки легко повреждаются, кулачковые муфты переключаются только при остановленном станке.

VIII. Translate the following sentences into Russian observing different meanings of the word "part":

1. The *part* of the work was completed in time. 2. The second *part* of London's complete works has been published. 3. This *part* of the machine was worn due to bad lubrication. 4. They *part* when he goes to sea. 5. They took *part* in a discussion on the manufacture of new clutches.

IX. Translate the following text in written form using a dictionary:

The multi-disc clutch is usually equipped with automatic cone brake. Moving the clutch control handle to the left compresses the clutch driving discs to set the lathe driving shaft in motion. To disengage the clutch, the clutch control handle should be moved to the right. The clutch driving discs then automatically separate and the brake takes hold to stop the lathe driving shaft with a smooth, quick stop, holding it rigid for ease in locking work in chuck or other operations requiring a fixed spindle. When necessary to turn the spindle by hand, it may be entirely disconnected from the driving shaft by throwing the lathe's regular gearshift handles into their neutral position.[1] The speed with which the brake will stop the lathe is affected by weight of the workpiece that is in the lathe.

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1. throwing... into neutral position — переключением ... их в нейтральное положение

X. *Using the following words and word combinations describe the clutches in Figs 45 and 46:*

a rigid coupling, to be represented, Fig. 46, to consist, a solid bushing, to connect, electric motor, lathe shafts, a key, axial clutches, to be subdivided, cone clutches, disc clutches, to be shown, the cone disc of the cone clutch, to be connected, the toothed wheel, to engage the cone, to be located, the movable wheel, friction necessary, to transmit rotary motion, to be created, the two cones, to be meshed, an eccentric clamp, the friction clutch, to be disengaged, the eccentric clamp, to be turned to 90°, a spring, to press out, friction disc

CHAPTER IV

METAL-CUTTING MACHINES

1. LATHES

A lathe is known to be essentially a machine tool for producing and finishing surfaces of workpieces. The machine is designed to hold and revolve work around an axis of rotation so that it may be subjected to the action of a cutting tool moving in a horizontal plane through the axis of the work. When the cutting tool moves in a longitudinal direction or parallel to the axis, the operation is known as "turning"; when it moves in a transverse direction, it is known as "facing". In addition to turning and boring, which the machine is primarily designed for, many other operations, such as drilling, threading, tapping, and by employing special adapters grinding and milling, may be performed on a lathe.

Lathes used in shop practice are known to be of different designs and sizes. These lathes fall into various types, either according to their characteristic constructional features, or according to the work for which they are designed. The size of a lathe is determined by the diameter and length of work that may be swung between centres. Lathes of comparatively small size, which may be mounted on a bench, are termed *bench lathes*, and are intended for small work of considerable accuracy; lathes provided with tools held in a revolvable *turret* are called "*turret lathes*": lathes in which workpieces to be treated are held in a chuck are known as "*chucking lathes*"; lathes in which most of operations are performed automatically are named "*automatic lathes*".

Besides there are also many special-purpose lathes such as *crankshaft* lathes and *wheel lathes* for turning *crankshafts* or engine driving wheels respectively; *screw-cutting lathes* for threading screws, etc. The *engine lathe* (Fig. 47) used for metal-turning operations is fitted with a power-actuated *carriage* and *cross-slide* for clamping and holding the cutting tool. In engine lathes the cutting tools are generally guided by the machine tool itself, in other words, they are operated mechanically, while in some lathes the cutting tools are guided by hand. The engine lathe consists essentially of the following basic parts: the bed, the headstock, the tailstock, the feed mechanism, and the carriage.

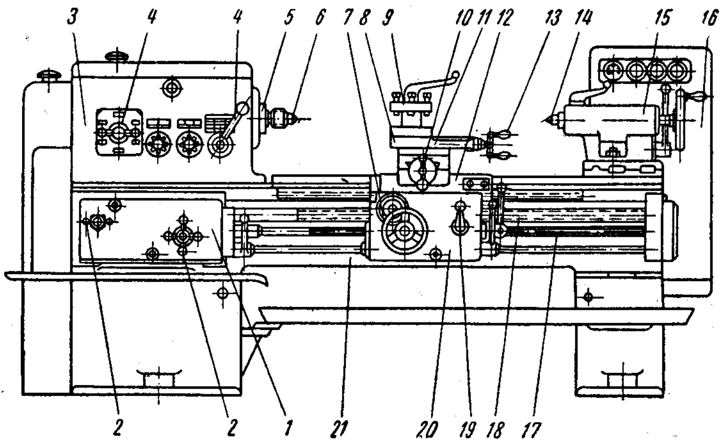

Fig. 47. Engine Lathe:

1 — feed gearbox; *2* — feed selection levers; *3* — headstock and gearbox: *4* — speed change levers; *5* — spindle; 6 — live centre; *7* — sliding hand traverse; *8* — tool rest; *9* — tool post; 10 — cross-slide lever; *11* — compound rest; *12* — saddle; *13* — tool rest lever; *14* — dead centre; *15* — tailstock; *16* — electric motor; *17* — feed shaft; 18 — lead screw; *19* — sliding feed lever; *20* — apron; *21* — bed

The *bed* (Fig. 48) is a *rigid* casting with two longitudinal walls firmly connected by cross ribs integral with the casting. The bed serves as a base to support and align the rest of the machine. The upper surface of the bed is provided with parallel *V*-type and flat *ways* or *guides* for accurate aligning of the sliding parts of the lathe—the carriage and the tailstock. The *headstock* is located and firmly bolted to the left-hand side of the bed, and carries a pair of bearings in which the spindle rotates. Many modern lathes have a motor built into the headstock with the spindle serving as the motor shaft. The *spindle* (Fig. 49), being one of the most important parts of a lathe, is a steel hollow shaft with a taper bore for the insertion of the live or running centre on which the piece to be turned is placed. The other end of the work is supported by the non-rotating dead or cup centre. The nose of the spindle is accurately threaded for chucks to be screwed on it. The chucks, in turn, hold and revolve workpieces together with the spindle. The headstock also incorporates the *change gearbox* driven by a set of *speed change levers*. The change gearbox serves for running the lathe at different speeds required in turning and boring workpieces of various diameters.

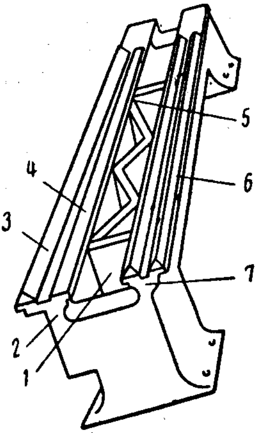

Fig. 48. Bed:
1, *5* — ribs; *2*, *7* — casting walls; *3*, *6* — *V*-type ways; *4* — flat way

The *tailstock* (Fig. 50) located at the right-hand side of the bed, is a casting carrying a non-rotating *sleeve*, which

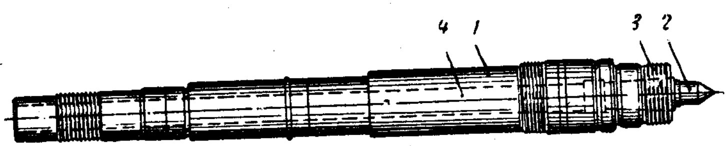

Fig. 49. Spindle:
1 — hollow shaft; *2* — live centre; *3* — thread; *4* — through hole

together with the nut can be *advanced* or *retracted* by means of the tailstock *revolving screw* operated by the *handwheel*. The tailstock may be moved anywhere along the lathe bed and can be clamped in place at any point. On changing the position, the tailstock slides along the two inner bed ways one of which named flat way is of rectangular cross-section and the other one is of *V*-section. The tailstock sleeve mounts a hollow spindle with a standard taper bore for holding the lathe centres or tapered tool shanks. The dead centre fits in a Morse taper hole in the sleeve and may be removed by retracting the sleeve, thereby bringing the end of the tailstock screw against the rear of the centre and forcing it out. The tailstock spindle has a large area bearing[1] in both the front and rear of the tailstock. To facilitate measurement of the spindle travel the tailstock spindle is graduated.

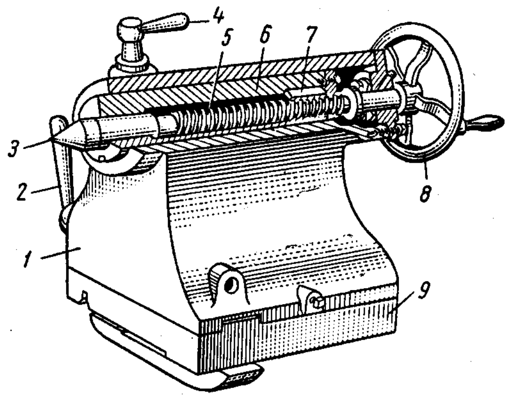

Fig. 50. Tailstock:

1 — casting; *2* — tailstock clamping wrench; *3* — tailstock spindle centre; *4* — tailstock spindle clamp lever; *5* — revolving screw; *6* — sleeve; *7* — nut; *8* — tailstock handwheel; *9* — bed

The *feed mechanism* for both longitudinal and cross *feeds* of the engine lathe is simple and easy to operate. It comprises a *cone of gears*, an *intermediate shaft* and a set of sliding gears. The fine *change shifter* slides on a *splined shaft* and carries a *tumbler gear* which is dropped into engagement with a gear on the *cone* corresponding to the thread or feed selected on the *index plate* above it.

Movement of the carriage and the *cross-slide* can be reversed either by reversing the feed mechanism with the *reverse handle* or by shifting the single lever located on the carriage *apron*. Suitable speed ratios between the spindle and the feed mechanism are provided by a *change gearbox*. The *carriage* is a *unit* intended for mounting the tool, and capable of sliding along the two outer *V*-type ways, on which it is supported, in a direction parallel to the spindle axis.

For turning and facing operations the carriage is driven from the headstock spindle by gearing or belting through a *feed shaft*. For thread cutting, where a definite amount of carriage movement is required for every spindle rotation, a *lead screw*, geared to the spindle, is used for the motion of the carriage. The carriage is made up of two principal parts, one of which carries the *saddle*, which slides upon the bed and on which the *cross-slide* and the *tool rest* are mounted. The other part, termed the *apron*, represents the front wall of the carriage. It provides a support for the operating handwheel and *control levers*, as well as carries the mechanism for engaging the feed mechanism of the lathe to drive the carriage. The cross-slide mounted on the carriage can move at right angles to the spindle axis. It is operated by the cross-slide screw which turns in a nut fixed to the carriage.

On the top of the saddle there is the *compound rest* for mounting the *tool post*. The compound rest is similar to the cross-slide, except that it can be swung around at an angle. It has a circular base graduated in degrees, so that it may be set at any angle, and may be used for cutting bevels, tapered work and similar jobs. The compound rest is actuated by a screw which rotates in a nut fixed to the saddle. The tool post intended for holding the tool fits in a tee slot in the compound rest, and the toolholder is adjusted, and clamped by the tool post screw. Engine lathes are fitted with a multiple disc clutch and brake. The powerful multiple disc clutch when disengaged automatically engages the *plate brake*.

There are three important methods of holding and rotating work in engine lathes, which may be referred to as turning between centres, chuck work, and faceplate work. In turning between centres, the work is supported by the 60° conical points of the live and dead centres. It turns together with the live centre on the dead centre. In chuck or faceplate work, the work to be machined is held in a chuck or a faceplate.

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1. large area bearing — подшипник с большой площадью опоры

Exercises

I. *Use the following words and phrases in sentences of your own:*

bench lathe, turret lathe, to bore, engine lathe, carriage, cross-slide, rigid, bed, change gearbox, to revolve, sleeve, to advance, handwheel, to retract, feed mechanism, feed shaft, to actuate, feed, apron, to swing

II. *Retell the text giving answers to the following questions:*

1. What is a lathe? 2. What operations may be performed on a lathe? 3. What devices enable grinding and milling operations on a lathe? 4. With respect to what characteristic features are lathes classified? 5. What types of lathes are mentioned in the text? 6. What kind of work is the bench lathe intended for? 7. What are turret lathes? 8. Why are some lathes termed chucking lathes? 9. What are automatic lathes? 10. What lathes belong to special-purpose lathes? 11. What basic parts does the engine lathe consist of? 12. What is the function of the lathe bed? 13. What is the upper surface of the bed provided with? 14. What do the bed ways serve for? 15. Which side of the bed is the headstock bolted to? 16. What does the change gearbox serve for? 17. What is the tailstock and where is it located? 18. Which bed ways does the tailstock slide along?

III. *Choose antonymical groups out of the following list:*

dead centre, alignment, regular, right feed, fasten, disalignment, irregular, left feed, easy, to prohibit, unfasten, live centre, difficult, to permit

IV. *Change the sentences using the "Nominative with the Infinitive" and then translate them into Russian:*

Example: It is known that the lathe is the most important machine tool used for machining surfaces of a workpiece.

The lathe is known *to be* the most important machine tool used for machining surfaces of a workpiece.

1. It is known that the lathe is regularly furnished with a multiple disc clutch and brake incorporated in a driving pulley. 2. It is intended that the compound rest slide is actuated by a screw rotating in a nut fixed to the saddle. 3.

It is known that the headstock and the tailstock are fastened at opposite ends of the lathe bed. 4. It was said that the independent chuck had been suitable for almost any type of work. 5. It seems that this new feed mechanism is simple and easy to operate. 6. It proved that the functions of the new lathe were fully automatic. 7. It was evident that the engine lathe has been widely used for metal-turning operations.

V. *Make up questions to which the italicized words are the answeres:*

1. The lathe is a machine tool *for machining surfaces of a round workpiece.* 2. The tailstock of a lathe rests *on a saddle.* 3. The lathes are generally furnished *with brakes.* 4. *To start* the spindle one can use either the head or apron control. 5. The *cross-slide* is mounted on the carriage. 6. The *tool holder* is clamped by the tool post screw. 7. The feed mechanism comprises a *cone of gears, an intermediate shaft and a set of sliding gears.* 8. The change shifter slides *on a splined shaft* and carries a *tumbler gear.*

VI. *(a) Read and translate the following text without using a dictionary:*

The automatic lathe is designed so that all of the tool movements are automatically controlled, although the work must be inserted and removed by an operator. In the automatic lathe two or more heavy duty slides, each with its own drive, rate of feed and direction of feed, may be applied. All functions of the machine are completely automatic, including advance of the platen to working position, feeding of all tools, and retraction of slides and platen at completion of cycle, at which time stopping of the spindle is also accomplished automatically. One operator may run two or more lathes. Such lathes are not limited to automative parts but are reducing production time and cost on pump parts, motor and generator parts, pipe flanges, brass and bronze castings, chuck bodies, bevel gears, airplane engine cylinders, etc.

(b) Make up questions on the basis of this text and answer them.

VII. Giving answers to the following questions describe the construction of the spindle shown in Fig. 49 and the bed shown in Fig. 48:

1. What part of the lathe is a spindle and what purpose is it intended for? 2. What kind of shaft does a spindle represent? 3. For what purpose is a spindle supplied with a taper bore? 4. What has to be done with the nose of a spindle for the chuck to be screwed on it? 5. What does the lathe bed serve for? 6. What kind of walls is the bed supplied with? 7. How are the walls of the bed connected? 8. What is the function of the bed ways?

VIII. Using the following words and word combinations describe the construction of the tailstock shown in Fig. 50:

a casting, to consist, the tailstock, to be fitted to the bed, to carry, a non-rotating sleeve, to be advanced, the revolving screw, to operate, the handwheel, to move along the lathe bed, to be of the *V*-section, a hollow spindle of the tailstock sleeve, to be provided, a standard taper bore, to hold the lathe centres, the tailstock spindle, to be graduated, to facilitate measurement, the spindle travel

2. DRILLING MACHINES

Drilling machines are very old machine tools mainly employed for drilling holes of different sizes in metal or any other solid material. In addition to drilling holes, such operations as *tapping*, *reaming*, *lapping*, *countersinking* and *counterboring* may be performed on the drilling machines. Since drilling machines are used for a great variety of operations, they fall into various classes, the main of them being *upright* or *vertical spindle*, *multiple-spindle*, and *radial spindle machines*. In all three types, the drill spindle rotates in a sleeve or *quill* which does not rotate but is free to move axially to provide the necessary feed for the drill.

In vertical spindle drilling machines the spindle is in a vertical position. The *upright drilling machine* (Fig. 51) has an upright column resting on a heavy base. The column equipped with a gearbox providing a wide range of speeds has a feed mechanism. The feed mechanism represents a feed shaft with its necessary gearing by which the drill is cut into the work at a proper speed. The feed shaft and the gearing provide a mechanical feed and any adjustment of both the drilling head mounted on the top of the column and the table for drilling operations. Since in the upright drilling machines the spindle sleeve supports are fixed, all adjustment for different classes of work is made by moving the table which is accomplished by turning the *crank*. The table can be moved in a horizontal plane, clamped at any point or, if desired, swung out of the way so that large work may be placed on the base. The machine is also equipped with a *ratchet lever* for hand feeding the drill. A handwheel is fastened to a worm shaft whose worm engages a worm gear on the pinion feed shaft, giving a motion much finer than that obtained by using the hand lever. Speed changes in the upright drilling machines are effected either by cone pulleys or by a geared head.

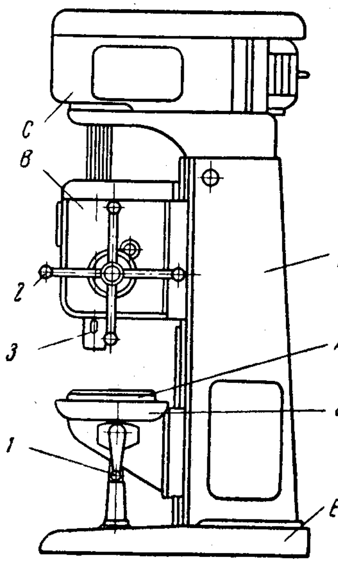

Fig. 51. Upright Drilling Machine:

1 — table traverse lever; 2 — feed change lever; 3 — spindle; 4 — swarf tray; A — table; B — feed change gearbox; C — gearbox; D — column; E — base

The upright drilling machines, in turn, are classified as: *heavy duty*, *plain*, and *sensitive*. The heavy duty drilling machine is used for heavy drilling, the plain vertical spindle machine being employed for lighter work. The sensitive drilling machine is a vertical or upright machine of comparatively light construction adapted to very high speeds of drilling holes in delicate works.[1] The *multiple-spindle drilling* machines are built in both vertical and horizontal types. Saving considerable time and space this machine is used for simultaneous drilling of many holes in a large number of workpieces. The machine may have a number of movable drills mounted on the cross way, all the spindles being driven from the same shaft by a worm gear. One of the types of the multiple-spindle machines is the fully automatic multiple-spindle drill head machine requiring only *push-button* operation once it has been set up. The machine is provided with a large number of spindles ranging from four to a hundred or even more, which are driven by the same spindle drive gear in the same head.

The *radial drilling machine* has a vertical column mounted on a cast iron base. The column carries a *radial arm* which moves not only in a horizontal plane with the column, but may also be moved in a vertical plane. A drilling head carrying the drill and power feed mechanism may be moved along horizontal ways of the arm. Bored to take a Morse taper shank, the spindle is driven by a reversing motor, flange mounted on top of the gearbox.[2] The drill can be moved over the work to any desired position so that many holes may be drilled in the work without moving it from one place to another. The radial drilling machine is therefore adapted to heavy work where it is easier to move the drill than the work.

Spindle speed and feed changes are effected by gearing. Drilling speeds may vary from 40 ft. per min[3] for cast and alloy steels to 300 ft per min for brass and bronze, drilling feeds ranging from .002″ per revolution for $\frac{1''}{8}$ diameter drills to .15″ per revolution for drills 1″ in diameter and over.

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1. delicate works — хрупкие заготовки
2. Bored to take a Morse taper shank, the spindle is driven by a reversing motor, flange mounted on top of the gearbox — шпиндель, расточенный под конический хвостовик Морзе, приводится в движение реверсивным двигателем, а установочный фланец расположен на верху коробки скоростей.
3. ft. per min — foot (feet) per minute — футов в минуту

Exercises

I. Use the following words and phrases in sentences of your own:

to tap, drilling machine, to ream, vertical spindle drilling machine, quill, to swing, crank, ratchet lever, radial arm, to accomplish, multiple-spindle drilling machine, sensitive drilling machine

II. Retell the text giving answers to the following questions:

1. What operations may be performed on drilling machines? 2. How are drilling machines classified? 3. Where does the drilling machine spindle rotate? 4. How is the spindle sleeve moved? 5. What is provided by such a movement? 6. What are vertical spindle drilling machines? 7. What structural feature gives the upright drilling machine its name? 8. How is a wide range of speeds obtained on this machine? 9. What does the feed mechanism of the drilling machine consist of? 10. What is the function of the feed shaft? 11. How can the table be moved? 12. What does the ratchet lever serve for? 13. How are speed changes effected in the upright drilling machines? 14. When are the heavy duty drilling machines used? 15. What is the plain vertical spindle machine employed for? 16. For what type of work is the sensitive drilling machine designed? 17. What are multiple-spindle drilling machines and what are they used for? 18. How many spindles may be used in a fully-automatic multiple-spindle drill head machine? 19. For what kind of work is the radial drilling machine intended? 20. What main parts does the radial drilling machine consist of? 21. What range of spindle speeds and feeds may the radial drilling machine have?

III. Give derivatives from the following words and translate them into Russian:

to bore, light, sensitive, high, to construct, to employ, to vary, to provide, to move, to adjust, to drill, to revolve

IV. Give different meanings of the following words:

arm, head, work, way

V. Translate the following sentences observing different meanings of the italicized words and word combinations:

1. *Drilling means* removing some metal from the work. 2. A *drilling* machine is *by all means* the most important machine for drilling holes of different size in metal. 3. *By no means* can a *boring* machine be used at speeds exceeding permissible ones, as it may result in breakage. 4. *Boring* may be *performed* on drilling machines. 5. The main driving motor drives the shaft *by means of* Vee-belts. 6. When we speak of the operations *performed* on the drilling machine, we *mean* such operations as tapping, reaming, lapping, etc.

VI. Find the predicates in the following sentences. Translate the sentences into Russian:

1. The hydraulic sliding head is said to be actuated by a large diameter cylinder. 2. We know the hydraulic sliding head to contain the feed and rapid traverse hydraulic pumps. 3. The two work spindles are driven by heavy helical gears through pick-off gears for controlling the spindle speeds. 4. The main drive motor, mounted on top of the head, drives the main shaft by means of *V*ee-belts. 5. On the outside of the plate there is a table showing spindle speeds and the proper pick-off gears to be used for the required speed. 6. This machine may be used for boring operations in shorter cylinders.

VII. (a) Read and translate the text without using a dictionary:

A semi-automatic, vertical boring machine is designed to facilitate the machining of heavy components such as railway wagon wheels, with weights up to 700 lb. The machine has two hydraulically-operated 5-jaw chucks mounted on a table which can be traversed to bring either beneath the spindle.[1] Power for operation of the chucks, the movement of the table, and the feed of the spindle, is supplied by a separate unit. The spindle is 7 ft long, and is supported on two taper roller bearings at the top and one at the lower end. It is driven by a 75-h.p. variable motor, and speeds suitable for a variety of bore sizes can be obtained. The boring bars are fitted with throw-away carbide inserts,[2] which are clamped in position, two square roughing and two cylindrical semi-finishing tools being arranged alternately, 90 deg. apart. A surface speed[3] of 225 ft per min is normaly employed, and the spindle is fed at the rate of $\frac{1}{16}$ in. per rev. No coolant is employed.

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1. to bring either beneath the spindle — для того чтобы подвести каждый из этих патронов под шпиндель
2. throw-away carbide inserts — сменные карбидные вставки
3. surface speed — скорость резания

(b) Retell the text.

VIII. Using the following words and word combinations describe all drilling machines that you know:

drilling machines, to be old machine tools, to employ, drilling holes, operations, tapping, reaming, and lapping, to be performed, to fall, various classes, upright spindle drilling machines, to have the spindle, to be placed, a vertical position, to be classified, heavy duty, plain and sensitive machines, multiple-spindle drilling machines, to be provided, a large number of spindles, to be used, simultaneous drilling, many holes, the radial drilling machine, to have a vertical column, to carry a radial arm, to move in a horizontal and vertical planes, the drill, to be moved over the stationary work, any position, to be adapted, heavy work

IX. Describe the principle of operation and construction of the radial drilling machine shown in Fig. 51.

3. MILLING MACHINES

Milling machines are used for milling operations. *Milling* is the process of removing material from work with a multi-toothed rotating cutter. There are various classes and types of milling machines in use, from small hand-operated types to fully automatic ones, the main of them being: *column and knee-type*, *bed type*, *planer type*, and *rotary type*. Column-and knee-type milling machines are made in three styles: *horizontal plain*, *vertical* and *universal spindle milling machines*. They are used for both toolroom and manufacturing work because of the ease with which they may be *handled*.

Fig. 52 shows the essential features of the horizontal milling machine. The machine is provided with a massive streamlined column rising from a base which rests on a solid wooden or concrete floor which is sufficiently heavy to withstand the weight of the machine. The base, hollow inside, contains a coolant tank with *cutting fluid** that is delivered through piping by means of a motor-operated *pump* to the cutters and the place where the milling operation is performed. The centrifugal type pump is mounted on the *pad* located at the side of the base and is connected directly to the coolant tank. The cutting fluid flow can be regulated by means of *valves* con-

* American — cutter coolant

nected to the *outlet nozzles* which can be swivelled for distributing a low pressure volume of cutting fluid to all diameter and types of cutters. A constant supply of clear oil is pumped to the column top, distributed through perforated pipes and flooded down over all gears, shafts, and bearings throughout the entire column and *feed gearbox*. In the lower part of the column there is a motor for driving the spindle and the change

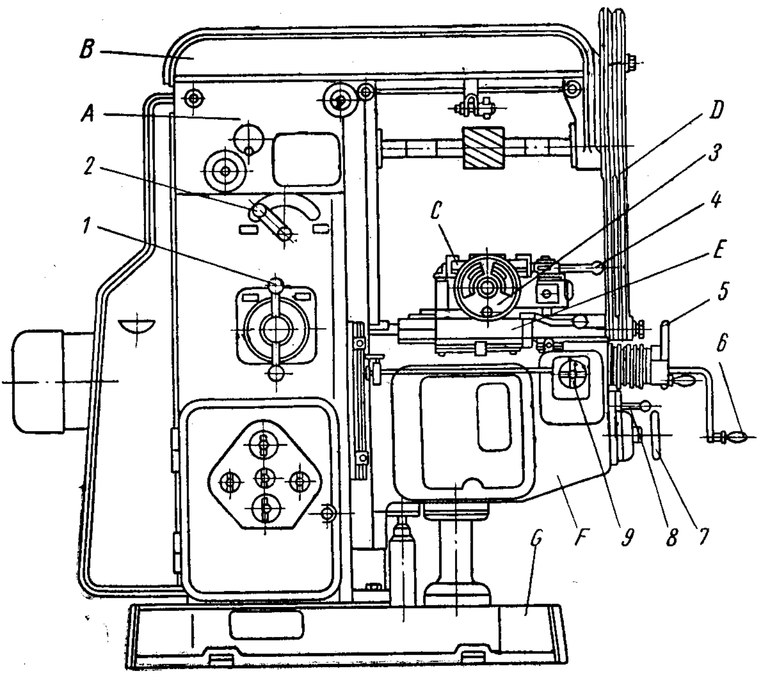

Fig. 52. Horizontal Plain Milling Machine:

A — column with speed gearbox and spindle unit; *B* — overarm; *C* — table; *D* — additional link between knee and overarm; *E* — saddle; *F* — knee with feed gearbox; *G* — base; *1* — gearbox change lever; *2* — spindle speed change lever; *3* — longitudinal feed table handwheel; *4* — longitudinal feed table lever; *5* — cross feed table handwheel; *6* — vertical feed knee hand lever; *7* — feed gearbox handwheel; *8* — gear train lever; *9* — vertical-cross feed table lever

gears for the *power feed*. A set of change gears for driving the spindle at a proper speed required for any work being done on the machine is *housed* in the upper part of the column. The change gears are shifted either manually by a *spindle* *speed change lever* located on the face of the column or by power to form various *trains* for providing the necessary cutting speeds.

The horizontal plain milling machine has a horizontal spindle rotating in anti-friction bearings in the column. The spindle is a hardened, ground, hollow shaft spaced horizontally from the front to the back of the column. In operation, the milling cutters are either attached to the spindle nose or carried on an arbor. Secured to the top of the column is an *overarm* consisting of one or two heavy steel bars. The overarm is provided with bearing *brackets* for supporting arbors or mandrels. The *knee* which supports the table and saddle units is mounted on the face of the column and can be moved up and down by means of an *elevating screw* for adjusting workpieces with respect to cutters.

During each milling operation the knee should be clamped to the column, and in heavy-duty operations the knee is clamped to the overarm to ensure maximum rigidity. The upper part of the knee is provided with horizontal *dovetail* guides, which support the saddle unit mounted on them. The saddle, in turn, supports the table which is a heavy, semi-steel casting[1] sliding in the dovetail guides on the saddle. The table has *T*-slots of ample depth serving to fasten work-holding devices. All the three elements, table, saddle, and knee, may be either power- or hand-fed by screws turning in fixed nuts. By means of a hand lever on the knee, the machine can be set for continuous *pendulum milling*, or for automatic cycle operation, with power feed movement of the table in either direction. The machine is provided with a *backlash eliminator*, which enables *climb milling* to be performed with both right- and left-hand cutters and is automatically disengaged upon reversal of the table. The eliminator can also be disengaged by movement of a lever when *conventional milling* is to be performed.

Vertical milling machines are similar to plain milling machines, but their spindle is positioned vertically.

Universal milling machines are also similar to plain milling machines but the saddle is mounted on and swivels on a clamp bed which in turn slides on the knee thus permitting the saddle to swing at an angle, and permitting table motion at other angles than 90° to the spindle axis.

Modern heavy-duty milling machines are equipped with a standardized spindle end which has a locating taper hole in the spindle. The arbor is seated by turning a draw-in-bolt[2] which extends through a hole in the spindle, and screws into a threaded hole in the arbor. The arbor is driven by an adjusting key on the spindle nose which fits into slots in the arbor shoulder. The arbor support provides a cylindrical bearing for the *pilot* of the arbor, and in many instances, an intermediate arbor support, serving as a bearing for an oversize *collar*, is employed. The arbor support is often connected to the knee by overarm *braces* for additional rigidity.

Cutting speeds on the milling machine depend upon the nature of the work, the type of cutter, the condition of the machine, and, in many instances, upon the experience and ability of the machine operator. *Feed rates* in milling are expressed in two ways: in. per min,[3] or thousandths of an inch per revolution of the spindle. Delicate or fragile work requiring an accurate finish will need *fine feeds*, while heavy work, from which a considerable amount of metal is to be removed, can be subjected to *coarse feeds*. A good finish can usually be obtained by using a feed rate from 0.30″ to 0.50″ per revolution of the cutter. Finer feeds, such as 0.15″ per revolution, will result in an excellent finish.

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1. semi-steel casting — отливка из сталистого чугуна
2. the arbor is seated by turning a draw-in-bolt — оправка устанавливается поворотом втяжного стержня
3. in. per min—inch per minute — дюйм в минуту

Exercises

I. Use the following words and phrases in sentences of your own:

cutter, milling machine, column, knee, cutting fluid, power feed, fine feed, to swivel, pump, to house, elevating screw, to adjust, to clamp, overarm, feed rate

II. Answer the following questions:

1. What is milling? 2. What are the main types of milling machines? 3. How are column- and knee-type milling machines classified? 4. What does the base of the plain milling machine serve for? 5. By what means can the cutting fluid flow be regulated? 6. What is located in the lower part of the column? 7. What is housed in the upper part of the column? 8. What can you say about the spindle of the horizon-

tal plain milling machine? 9. What is secured to the top of the column? 10. What is supported by the knee? 11. By what means can the knee be moved up and down? 12. Why should the knee be clamped either to the column or to the overarm during each milling operation?

III. Find in the text antonyms of the following words:

to raise, light, to be unfixed, fine feed, back, lower part

IV. Underline the suffixes and prefixes and translate into Russian the following words:

principle, principal; long, longitudinal; horizon, horizontal; to obtain, obtainable; automatic, automatical, automatically; to cut, cutting, non-cutting; convention, conventional; dependent, dependently, independently

V. State the kind of the subordinate clauses in the following sentences and translate them into Russian:

1. The profile of the teeth on the pinion is identical with the straight line profile of the teeth of a rack that meshes with the generated gear. 2. In the same way as one and the same rack will mesh with gears of different pitch diameters (number of teeth), but of identical diametral pitch, one and the same hob can be used to hob all gears of identical diametral pitch regardless of the number of teeth on the gears being hobbed. 3. The fact that the hob form nearly approaches a straight line rack tooth shape is a fundamental advantage of the hobbing process, because the hob teeth being straight-sided or nearly so, are readily made to a high degree of accuracy and are easily measured, as compared with curved cutter teeth in other methods of gear cutting.

VI. Make up questions to which the italicized words are the answers:

1. The milling machine is a machine *for removing metal from* the workpiece. 2. There are *horizontal, vertical and column knee milling machines* used in practice. 3. *The knee* is mounted on a vertical guide. 4. The saddle slides from front to back *on guides*. 5. *A maximum distance of 15 in.* is obtainable between the spindle axis and the working surface of the table.

VII. Translate the following text in written form without using a dictionary:

The cutter spindle is large in diameter, hardened and ground, and has double opposed bearings on the front end. The back end is mounted on ball bearings which are so arranged that compensation for expansion is provided. A ram type overarm with double angle bearing on the ram overarm ways, provides rigid support for cutters and attachments. The column has added way length for securely holding the ram unit. The base contains a coolant tank. The knee is massive in size to provide the greatest support for the table and saddle units. The entire feed change transmission unit is contained in the knee, and is operated through the vertical drive shaft from the drive unit located in the base and column. Dependable automatic lubrication ensures an adequate supply of oil to all moving parts.

VIII. Using the following words and word combinations describe the principle of operation and construction of the horizontal plain milling machine shown in Fig. 52:

the horizontal plain milling machine, to be provided, a column, to rise, a base, to rest, a concrete floor, the lower part of the column, to incorporate, a motor, to drive the spindle and the change gears, the upper part, to house a speed gearbox, a proper speed, an overarm, to consist, one or two heavy steel bars, to be secured, the top, the knee, to support the table and saddle, to be mounted on the face, to be moved up and down, an elevating screw, to adjust workpieces, cutters, work-holding devices, to be fastened, *T*-slots, cutting speed, to depend upon the nature, the work, cutting tools

4. PLANERS

Planers like *shapers* and *slotters* are machine tools that employ single-point tools to generate flat surfaces. In each of these the relative motion of the cutting tool and the work is *rectilinear* and either the tool or the work feeds in a direction perpendicular to the cutting *stoke*. All three machines finish surfaces in a similar manner, and their selection depends primarily upon the nature of the work. The planer is generally used for machining large work requiring long cuts. The work is held on a horizontal table and moves back and forth past a stationary tool. The planer is also known to be used when a large number of like parts are to be finished. In this case the parts are frequently placed on the planer table in rows, and a number of parts are *planed* at one setting. This operation is referred to as *string planing*.

Planers and shapers are used for machining surfaces to a high degree of accuracy, and in general require less power per cubic inch of metal removed than machine tools employing multi-toothed cutters. Planer and shaper tools are con-

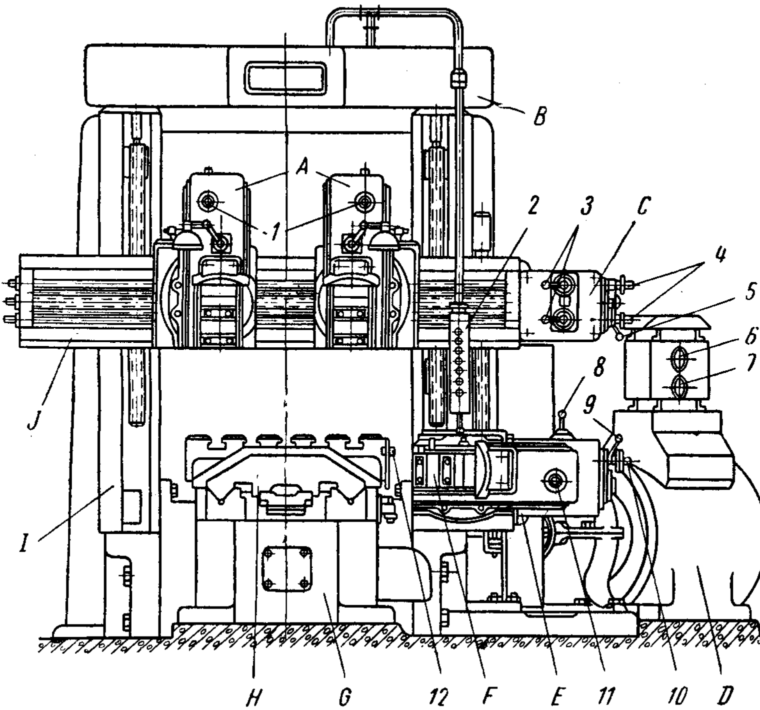

Fig. 53. Double-Housing Planer:

A — tool rests; *B* — portal; *C* — tool rests feed gearbox; *D* — cutting drive; *E* — side rest feed gearbox; *F* — side rest; *G* — bed; *H* — table; *I* — two vertical housings; *J* — cross rail; *1* — vertical feed tool slides quadrant; *2* — pendant control; *3* — tool rest feed change levers; *4* — horizontal feed tool rest quadrant; *5* — tool rest feed lever; *6* — working speed table handwheel; *7* — idle travel handwheel; *8* — vertical feed change side rest lever; *9* — side rest feed lever; *10* — feed side rest lever; *11* — horizontal feed side rest lever; *12* — supports siderably less expensive than milling cutters; the planer may therefore be used in preference to a milling machine if the castings are poor and subject to hard spots.[1] There are several standard types of planers that are in extensive use in jobbing and production shops such as *double-housing planers*; *open-side planers*; *tandem planers*, and *rail planers*. The double-housing planer (Fig. 53) has two vertical housings and is used for rapid roughing and finishing such works as engine and lathe beds, etc.

Ample strength and support of the housings are assured by their thick-walled, box-section internal *bracing*. The housings are keyed and bolted to the bed, forming a unit as rigid as a one-piece construction. The large-size planer of this type is provided with two *cutter heads** mounted on the *cross-rail*. The heads serve for holding two tools, which may cut material simultaneously, thus increasing the work capacity of the planer. In a planer with two cutter heads both vertical and *side feeds*,** being independent of each other, are performed automatically. In addition, some planers are equipped with a side-head mounted on each housing. This arrangement makes it possible to machine simultaneously both the side and the top surface of a work to be treated. The work to be planed is bolted or otherwise securely fastened to the table. The table is made of alloy iron and is of a box-section construction with top and bottom plates tied with side walls and the centre rib running the full length,[2] and with cross-ribs. The upper part of the table has three or more tee slots running lengthwise, and numerous holes for inserting *stops* and clamping blocks, while the under side is provided with two accurately machined guides which slide in guide ways on the planer bed. The table moves between two housings against one or more cutting tools, which are held by the cross-rail and side-heads screwed to the housings, at a speed adapted to the material to be cut. The return stroke, during which no cutting takes place, is usually constant, but is from two to four times as fast as the cutting stroke so as to economize on time.[3] Planer size is determined by the maximum stroke of the table and the width and height of the work that will pass through the housings and underneath the cross-rail. A double housing 30×30×8″ planer,

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* American — cutting head

** American — lateral feeds

for instance, will machine a part 30″ high, 30″ wide and 8″ long. *Open-side planers* are classified by the cross-rail height and the length of stroke, and are generally used for handling work that is somewhat wider than its height. The open-side planer has but one vertical housing[4] with the cross-rail attached to it. The *tandem planer* is equipped with two work tables sliding on the same bed. This permits to load one table while the other is in operation, or to use the two simultaneously when working on a large workpiece. The rail planer is a machine used for machining rails, which is provided with a narrow long table. Planer work may be held in a vice bolted to the planer table, or the work may be clamped directly to the table.

Castings can generally be clamped in place[5] by using straps or clamps on projecting portions of the work. All planers are equipped with single-point cutting tools, which are similar to shaper tools, but are usually larger and stronger. In many cases, *gang planer tools*, carrying three or more tool *bits* closely adjacent, are used. As each chip is comparatively small, a planer equipped with a gang tool will carry a far greater total feed and depth of cut than are possible with a single-point tool.

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1. If the castings are poor and subject to hard spots — если отливки плохие и имеют твердые места
2. the centre rib running the full length — центральная поперечина, проходящая по всей длине
3. but is from two to four times as fast as the cutting stroke so as to economize on time — но в два—четыре раза быстрее хода резания, для того чтобы сэкономить время
4. has but one vertical housing — имеет только одну вертикальную стойку
5. castings can generally be clamped in place — отливки обычно могут закрепляться на месте

Exercises

I. Use the following words and phrases in sentences of your own:

planer, rail, housing, stroke, rectilinear, machining, work table, brace, slot, cross-rail, side-head, to employ, to cut, to plane, to equip, to bolt, arrangement, adjacent, gang planer tools

II. Answer the following questions:

1. What is a planer? 2. What is the planer used for? 3. Where is the work to be treated on the planer held? 4. What is string planing? 5. Name the main types of planers. 6. What is the main feature of the double-housing planer? 7. By what is ample strength of the housings assured? 8. What are the housings keyed and bolted to? 9. How many cutting heads are the large-size planers provided with? 10. What are the cutting heads mounted on and what are they used for? 11. What operations is it possible to carry out on planers provided with side-heads in addition to two cutting heads mounted on the cross-rail? 12. What is the work table designed for? 13. What is the construction of the table and what is it made of? 14. How does the work table move?

III. Give derivatives from the following words and translate them into Russian:

relative, to move, to machine, to plane, to attach, rough, flat, brace

IV. Give different meanings of the following words:

plane, head, rib, poor, bed, table, unit, plate, house

V. Supply synonyms for the following words:

surface, to mount, fast, accurate, speed, to determine, wide

VI. Supply antonyms for the following words:

flat, vertical, open, narrow, fast, high, hard, long, large, heavy

VII. Find the predicates and state the kind of the subordinate clauses in the following sentences and translate them into Russian:

1. A tool apron extends the full width of the slide and is provided with horizontal *T*-slots running the full width of the apron so that tool holding bolts may be laterally adjusted to properly hold the tool. 2. This construction allows the greatest variety of possible tool positions and, therefore, greatly reduces the number of tool shapes required. 3. The

tool frame supporting the tool apron swivels 20 degrees, either side of the centre. 4. Index plate swivels on a large bearing which is cast integral with the index, thus giving added stiffness to the index and providing the most rigid construction for resisting the cutting strains. 5. All controls are so completely centralized that the operator can run the entire machine, except for the left-hand side-head, without moving from his normal working position at the end of the cross-rail.

VIII. Make up questions to which the italicized words are the answers:

1. The planer is a machine *for producing flat surfaces on a work*. 2. The entire drive from motor to work consists *of three gears and one rack*. 3. *The bed* is the strongest construction of the planer. 4. Cross-ribs tie *the housings* together. 5. The design *of the table ways* is of great importance. 6. The table is made *of alloy iron*. 7. The rack is set *in a groove machined in the table*.

IX. (a) Read and translate the following text without using a dictionary:

The entire drive from motor to work consists of only three gears and one rack. Helical gears are steel, and the spiral gear and rack are both made of high strength alloy iron but of different analysis and hardness so as to provide a combination of materials unsurpassed for strength and wearing qualities. Spiral gear is an involute gear, while the table rack is an involute rack, and the action between them is equivalent to the action of an infinite number of spur gears and racks. This is the reason why it is the smoothest of all planer drives and it never wears out but always wears in.[1] The rack teeth are cut at an angle so that the resultant tool pressures are parallel to the line of motion of the table. This entirely eliminates driving side thrust on the table.

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1. it never wears out but always wears in — никогда не изнашивается, но всегда прирабатывается

(b) Make up some questions on the basis of the text and answer them.

X. Using the following words and word combinations describe the principle of operation and construction of the double-housing planer shown in Fig. 53:

the double-housing planer, two vertical housings, to be used, rapid roughing and finishing, such work, engine and lathe beds, strength and support, the housings, to be provided, internal bracing, to be keyed and bolted, the bed, to form, a rigid unit, two cutting heads, to be mounted, the cross-rail, to hold tools, to cut material simultaneously, the work, to be planed, to be secured, the table, to be made, alloy iron, to have, top and bottom plates, to be tied together, side walls, centre rib, cross-ribs, the upper part, three or more tee slots running lengthwise, numerous holes, to insert stops and clamping blocks, the under side, two accurately machined guides, to slide, guide ways, to move, against one or more cutting tools, to be held, the cross-rail and side-heads, the return stroke, to be constant, no cutting, to take place

5. SHAPERS AND SLOTTERS

Shapers and *slotters* are machine tools in which the work is fed to a reciprocating tool, while in planers the tool is fed to the work. The shaper is mainly designed to plane horizontal surfaces, but it is also possible to finish vertical and angular surfaces, and, with the application of the proper tools, even curved surfaces of workpieces of small and medium sizes. The slotter, which may be called a "vertical shaper", since its tool moves in a vertical direction past the stationary work, is used for machining flat surfaces which are difficult or inconvenient to machine beeause they are at right angles to the main dimensions of the part. The slotter is also employed for cutting internal *keyways*, square holes and die openings. Both the shapers and slotters are not used in mass production[1] since they are rather slow in operation.

The size of the shaper is determined by the maximum stroke of its *ram*. The largest standard shaper has a stroke of 36 in. That is why the shaper is employed to perform planing operations on comparatively small work, the planer being used on large work. Shapers are driven by belt from a countershaft, by direct connected motor, or by hydraulic power. When driven by motor, the power from the motor is transmitted by a belt or silent chain to the *speed box drive* shaft.

Shapers (Fig. 54) are subdivided into several classes such as *crank-driven shapers*, *gear shapers*, *universal shapers*, etc. The crank-driven shaper or *crank shaper* derives its cutting motion from a pivoted lever, which is driven by an adjustable crank. The shaper has a hollow column rising from a base placed on the floor. The column houses a part of the drive

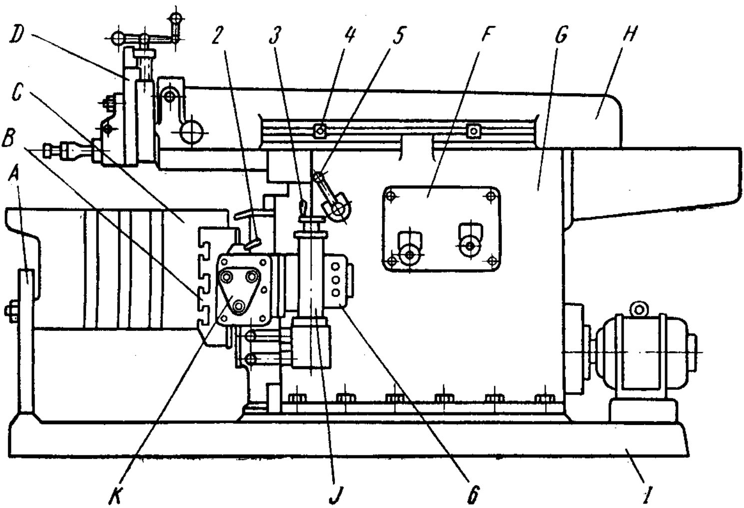

Fig. 54. Shaper:

A — column; *B* — cross-rail; *C* — table; *D* — tool rest; *F* — tool rest drive; *G* — bed; *H* — ram; *I* — base; *J* — feed drive; *K* — table feed mechanism; *1* — tool rest lever, *2* — table feed change lever; *3* — feed change handwheel; *4* — longitudinal feed ram clamp; *5* — ram feed change lever; *6* — pendant control

mechanism for the machine. Mounted on the front of the column, which is machined so as to provide vertical bearing surfaces, is the cross-rail. The cross-rail, together with the saddle and the table which it supports, may be adjusted up or down for various heights on the face of the column with an elevating screw. The box-section table which is designed to carry the work is fastened to the front of the saddle, and feeds in a direction perpendicular to the tool motion. The table is provided with *T*-slots on the top and sides for clamping the work. The work may be clamped either by means of bolts, or in a vice which are held in the *T*-slots.

A swivel-base vice being mounted on the top of the shaper table, the vice may be rotated about a vertical axis to set workpieces at an angle in the horizontal plane. The top of the shaper column is machined to form ways for supporting and guiding a ram which can slide along these ways forward and backward both in a cutting and return stroke cycle.

The ram supports a *tool head* mounted on the front end of the ram, and a *toolslide* with a swivel base. The tool head carries the *downfeed* mechanism for the tool. The downfeed mechanism consists of a lead screw and a handle for feeding the *clapper box*, mounted on the toolslide, and the tool up and down by hand. In addition to the hand downfeed, most shapers are equipped with a power downfeed. The tool head can swivel about the centre of the ram to enable the tool to be fed at an angle.

Owing to the swivelling of the clapper box on the tool head the tool may be inclined at an angle with the head in any position, the angular adjustment of the clapper box being smaller than that for the tool head. A tool post for holding the cutting tool is mounted in the clapper box. Shaper tools are similar to solid or inserted-bit lathe tools; *extension tools* are used for cutting keyways and square and *splined holes*. Since the shaper tool acts only during the forward stroke of the ram and is idle during the return stroke, it is necessary to minimize this idle time by using a *quick-return mechanism*. The mechanism represents a variation of a driving chain, which is one of the most common of linkages. A pinion engages a large gear to which is affixed a *crank arm*. The outer end of the crank is *pinned* to a *slide block*, which is free to slide on a long swinging arm. As the crank revolves, this arm *oscillates* back and forth, and by means of *yoke* reciprocates a table on suitable ways. The work to be shaped is clamped to this table. The point at which the oscillating arm is *tangent* on either side to the *crank pin* circle separates the cutting from the return stroke. Since the crank arm turns uniformly, time is proportional to *crank angle*. The return stroke is accomplished in a much smaller crank angle than the cutting stroke, and consequently consumes less time. *Gear shapers* are special machine tools used for machining gear teeth. *Universal shapers* are equipped with tilting or adjustable tables which may be set at an angle toward either side of the machine.

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1. mass production — поточное (или серийное) производство

Exercises

I. Use the following words and phrases in sentences of your own:

shaper, slotter, to machine, speed-box, ram, swivel-base vice, tool slide, clapper box, downfeed mechanism, to incline, splined holes, to pin, slide block, to oscillate, quick-return mechanism

II. Answer the following questions:

1. What are shapers and slotters? 2. What are they used for? 3. Why are shapers and slotters not used in mass production? 4. What is the size of the shaper determined by? 5. By what means are shapers driven? 6. What classes are shapers subdivided into? 7. What is housed in the shaper column? 8. What part of the column is the cross-rail mounted on? 9. How does the table move? 10. What is the table provided with? 11. What is the function of the ram? 12. Describe the features that characterize the downfeed mechanism. 13. During which stroke of the ram is the shaper cutting tool idle? 14. What mechanism is used to reduce the idle time to minimum? 15. How are universal shapers distinguished from crank shapers?

III. Give derivatives from the following words and translate them into Russian:

to reciprocate, to apply, to shape, to direct, to rotate, hydraulic, to subdivide, high, to oscillate, point, proportion, horizon

IV. Find in the text English equivalents of:

поперечно-строгальный станок, установочный винт, ползун, ход ползуна, салазки, перпендикулярный, приводить в движение, резцедержатель, механизм вертикальной подачи

V. Make up as many questions as possible to the following sentences:

1. By means of shapers it is possible to machine flat surfaces of work. 2. Tool heads are clamped in any angular position by means of single control head locks. 3. Circulatory pressure system continuously lubricates ram guides. 4. A steel safety guard for ram is attached to the rear of the frame. 5. The cross feed to the table is actuated by a single cam.

VI. Describe the principle of operation and construction of the shaper shown in Fig. 54 using the following words and word combinations:

shapers, to be designed, to plane horizontal surfaces, the application, proper tools, to be employed, to finish vertical and angular surfaces, the crank shaper, to be shown, to consist, the following main parts, a hollow column, to house a part of the drive, mechanism, a cross-rail, to be mounted, the front of the column, a saddle, a table, the latter, to be provided, T-slots, to clamp the work, the top of the shaper column, to be machined, to form, ways, to support, to guide, a ram, tool head, toolslide with a swivel base, a tool post, to hold the cutting tool, to be clamped, the clapper box

6. GRINDING AND GRINDING MACHINES

A surface finishing process, that is removal of irregularities from machined surfaces, may be performed either by employing hardened steel tools in such operations as filing, *scraping* and *burnishing*, or by employing *abrasives* for surface *refinement* in *grinding*, *lapping*, *honing*, *superfinishing* and *polishing* operations.

Grinding is the process of removing metal very accurately and economically by means of solid or sectional *abrasive wheels* rotating at a comparatively high speed. Originally employed for sharpening tools, grinding has become a useful and accurate finishing process for both hardened and unhardened metal parts, especially in the mass production of precision parts. By means of grinding, articles made of hard material, can be brought to a *true finish* with very *close tolerances*. Surface finishing operations involving the application of abrasives of smaller size than those used in grinding are known as lapping, honing, superfinishing and polishing. In all these operations only a small amount of metal is removed in surface finishing.

Lapping is used for accurate fitting many machine tools' and mating parts. The process consists of rubbing their surfaces together under load, a very fine abrasive material being placed between them. The surfaces are rubbed until all their irregularities are removed and the surfaces fit closely.

Honing is employed for producing a very fine finish by using a tool referred to as a *hone*. Hones of special shapes used for finishing internal surfaces of cylindrical work may contain several abrasive blocks, which can be moved out from the axis thus giving the tool any desired diameter.

Superfinishing is a finishing process which brings metal to an extremely smooth surface by using a bonded abrasive stone held in contact with the work under low pressure. The work rotates against the stone at low speed, at the same time the stone being given a *random motion*. Grinding is performed on machine tools known as *grinding machines*, which use rotating grinding or abrasive wheels for producing cylindrical, conical, or flat surfaces.

Many different types of grinding machines have been developed for grinding various kinds of work. The grinding machines are generally classified into several groups: *bench grinders* used for tool sharpening and general *off-hand grinding* usually consist of a motor with a two-wheel spindle replacing the motor shaft; *cylindrical* grinders are used for grinding cylindrical and conical work. They are essentially similar to engine lathes, but the carriage and tool post are replaced by a *wheel stand* carrying a *grinding wheel*. *Internal grinders* are grinding machines used for finishing internal surfaces of cylindrical or conical shape.

Centreless grinding machines used for external cylindrical grinding have no centres to support the work, and the part to be ground is held on a *work rest* between the grinding wheel and a suitable regulating or *feed wheel* which imparts axial motion to the part. *Internal centreless grinders* are employed for finishing roller bearing races and bushings. *Disk grinders* used for plane surfacing operations are similar to bench grinders, but are equipped with metal disks to which abrasive disks are connected.

Universal grinders can perform both internal and external grinding of cylindrical and conical surfaces.

Surface grinders (Fig. 55) are designed for grinding flat surfaces. Machines of this type are divided into two groups: planer-type surface grinders whose table is rectangular in shape and traverses under the wheel, and rotary type surface grinders whose table is circular in shape and rotates under the wheel.

The surface grinder has a 18 by $11\frac{1}{4}$-in. work table with a maximum travel of $19\frac{1}{4}$ in. on vee and flat guideways. Steplessly-variable traversing speeds from 3.3 ft per min are provided hydraulically. There is no handwheel for lon-

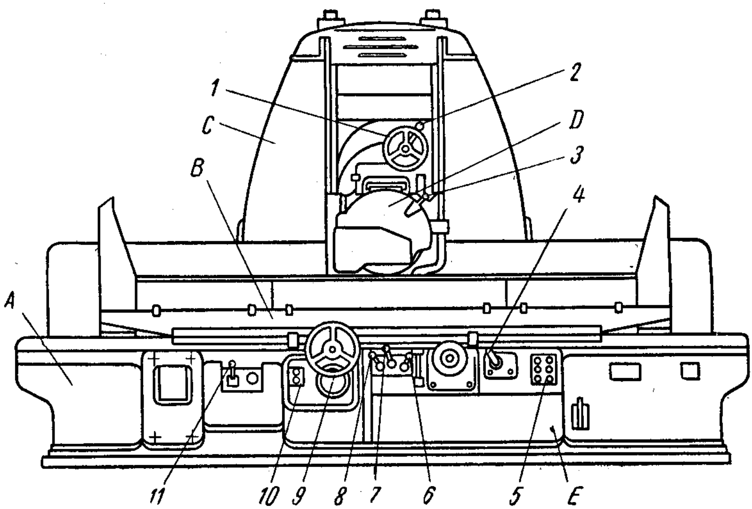

Fig. 55. Surface Grinder:

A — bed; *B* — table; *C* — post; *D* — grinding head; *E* — hydraulic drive; *1* — head transverse feed handwheel; *2* — head transverse feed lever; *3* — diamond grinding wheel lever; *4* — head cross feed lever; *5* — pendant control; *6* — table speed lever; *7* — table reverse feed lever; *8* — table traverse-reverse lever; *9* — head vertical eed handwheel; *10* — head vertical feed knob; *11* — magnetic plate lever

gitudinal movement, but the table can be traversed slowly under the control of a separate lever or handwheel, for example, when wheel *dressing* is to be carried out. A cross travel of $12\frac{3}{4}$ in. is provided for the saddle, which is guided by central and outer bed-ways, and feed can be applied continuously at rates ranging from 8 to 96 in. per min, or intermittently at the ends of the table movement. Lubricant is delivered to the central bed-way by a built-in pump, and to the other ways by means of rollers. Drive to the wheel spindle, which runs at 2950 rpm, is taken from a 3-h.p. motor through a flexible coupling, and the bearings are lubricated by a built-in pump. The *wheel-head* can be swivelled on the saddle by a pinion and *segment gear*, and may be set in the horizontal or vertical position, or at any intermediate angle. It can be secured to the saddle in required position, by means of a clamp, and is provided with a sine bar attachment to facilitate accurate setting for angle. Disk-shaped grinding wheels up to 8-in. diameter can be mounted on the spindle. Alternatively, a 6-in. diameter segment-type wheel may be employed. Work up to $11\frac{1}{4}$ in. diameter high may be ground with a disk-shaped wheel, and up to $9\frac{1}{4}$ in. high with a segment wheel. The handwheel for traversing the wheel-head saddle on the column ways can be set in two positions on its shaft to give coarse and fine adjustment, and provision can be made for down feed to be applied automatically, in increments ranging from 0.0002 to 0.0008 in. per table stroke. Alternatively, hydraulic equipment can be provided, which enables the wheel-head saddle to be continuously traversed on the column ways for a pre-set distance under the control of upper and lower stops.

Grinding wheels consist of abrasive grains held together by some bond such as *clay*, *shellac*, or rubber. The hardness of the abrasive, the shape and form of the grain structure and the *tenacity* of the bond are each important in grinding operations. The grade of a grinding wheel denotes its hardness, which cannot be accurately determined by bond mixture or the method of manufacture. Wheel grade is often indicated by letters, running from *E*, soft, to *Z*, extremely hard. Grinding wheels are dressed or trued by metal "star" wheels or by mounted diamonds[1] to remove metal particles or *dull grains* of abrasive, and to restore their original shape and accuracy.

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1. grinding wheels are dressed or trued by metal "star" wheels or by mounted diamonds — шлифовальные колеса правятся металлическими звездочками или установленными алмазами

Exercises

I. Use the following words and phrases in sentences of your own:

honing, superfinishing, lapping, wheel stand, grinding wheel, surface grinder, internal grinder, refinement, hone, abrasive wheel, to refine, to grind, to dress, to bind, to impart, work rest, lever, handwheel

II. Answer the following questions:

1. What is grinding? 2. Why is grinding widely used in the mass production of precision parts? 3. What is lapping? 4. What finishing operations can be performed by employing abrasives? 5. What is honing and what tools are used in honing operations? 6. What is superfinishing? 7. What is the main feature of grinding machines? 8. What are bench grinders used for? 9. For what type of work is the cylindrical grinder used? 10. What types of grinding machines are used for finishing internal surfaces of cylindrical or conical shape? 11. Why are centreless grinding machines called so? 12. For what kind of work is the internal centreless grinder adapted? 13. What are disk grinders equipped with? 14. What operations can be performed on the universal grinder? 15. What type of work is the surface grinder designed for?

III. Supply synonyms for the following words:

to mount, to rotate, to equip, to finish, circular, to deliver

IV. Supply antonyms for the following words:

to clamp, to stop, high, hardened, coarse, continuously, accurate

V. State the kinds of sentences and subordinate clauses, find the predicates and translate the sentences into Russian:

1. In the case of surface grinding where the work is ground dry it is necessary to keep the wheel sharp and true if the grinding operation is to be done efficiently. 2. The ground diameter of the work is determined by the distance between the surfaces of the two wheels, while the work support acts as a third point of contact. 3. Since the work done on internal grinders in tool rooms is generally ground dry, these machines have to be built more accurately than other

grinders, because it is harder to protect the most important parts from ever present abrasive dust and because the wheel and work speeds are much faster. 4. Lapping is a cutting process, while polishing consists of producing a kind of plastic flow of the surface crystals. 5. The abrasive particles are so hard that they will cut even hardened steel.

VI. Make up questions to which the italicized words are the answers:

1. Surface grinding machines are divided *into two groups.* 2. *In the surface grinders* grinding wheels of different shape are used. 3. A precision grinding machine comprises a *wheel, a wheel spindle, a work head and a work table.* 4. The upper part of the work table can be swivelled about a vertical axis relative to *the power part.* 5. An abrasive wheel is composed of a *large number of abrasive particles* held together *by a bonding material.* 6. *Surface grinding* is the process of producing and finishing flat surfaces *by means of a grinding machine* using *a revolving abrasive wheel.*

VII. Translate the following text in written form without using a dictionary:

The wheel-slide plate control permits the grinding of straight, taper or irregular-shaped holes to a high degree of accuracy. The control plate or bar is set parallel to the work axis for straight-hole grinding, and adjusted to the desired angle for taper grinding. For grinding curved or irregular shapes, the plate is adjusted to suit the contour of the work. To traverse the wheel, the slide bar is moved longitudinally in its bearings, the path through which the wheel travels being controlled by the position and outline of the control plate. The control bar is carried in an adjustable bracket graduated in degrees. For taper grinding the clamping screws are released and the bracket is set at the desired angle. The wheel slide is attached to the slide bar and the latter is reciprocated by a double-acting hydraulic cylinder integral with the overhead slide bar.

VIII. (a) Read and translate this text without using a dictionary:

THE HYDRAULIC INTERNAL GRINDER

Machines of this type are of extremely massive construction but are so designed that they can be operated as easily as machines of smaller sizes. They are hydraulically operated, and controlled by a single lever conveniently located at the front of the machine. This single lever controls all functions of the machine, including all movements of the wheel slide, cross feed, and starting and stopping the work-spindle. The wheel slide can be swung to the rear through the medium of the hydraulic lifter, thus giving easy and rapid access to the work. The wheel-spindle is driven by V-belts from a motor on an adjustable bracket on the wheel slide. Idlers are provided to give a maximum of belt contact and to maintain proper belt tension. The cross feed for the wheel slide is also operated by a hydraulic unit and can be set automatically.

(b) Make up some questions on the basis of this text and answer them.

IX. Describe the surface grinder shown in Fig. 55.

CHAPTER V

TEXTS FOR HOME READING

1. THE RUSSIAN METALLURGIST D. K. CHERNOV

The father of the branch of science concerned with the changes in structure of steels was the Russian metallurgist Dmitry Konstantinovich Chernov (1839-1921). Investigating the properties of steel after heating to various temperatures, Chernov first established that at definite temperatures steel undergoes certain changes altering its structure and properties. These "critical temperatures" characterized by internal changes in the steel are now known all over the world as the "Chernov points". One of these points called by Chernov point *a*, is notable for the fact that steel heated below this point (about 700°C) cannot be hardened no matter how rapidly it is cooled. Another point, *b*, is characterized by the fact that as soon as the temperature of the steel reaches it (800 to 850°C), the steel rapidly passes from the coarse crystalline into the fine crystalline state, in which it possesses the best mechanical properties. If the temperature is raised still further, the metal crystals begin to increase again in size, and the higher the temperature, the more rapidly they grow.

The discovery of the critical points of steel was of very great importance for metallurgical theory and practice. Explaining the phenomena of tempering and hardening of steel and the structural changes taking place in steel when heated, it enabled accurate determination of the hardening temperatures and selection of favourable conditions of forging and other types of steel treatment, promoting improvement of its mechanical properties.

2. OXYGEN IN THE BESSEMER CONVERTER

Fundamentally, the addition of oxygen to the Bessemer air blast should have two major effects: (1) to increase the rate of oxidation because of the higher partial pressure of oxygen in the system; (2) to increase the amount of heat available to melt cold materials. The use of oxygen for enriching the blast of the basic Bessemer converter or for changing the nature of the converter blast altogether, became a very important development in steel works. Reduction of nitrogen content in Bessemer steel by oxygen enrichment alone reaches a limit at about .006 per cent nitrogen. Further it is necessary to remove all nitrogen from the blast but, at the same time, maintain a blast composition which will oxidize metalloids in the steel without generating so much heat that the converter tuyeres are burned out. This can be done by a mixed blast of oxygen and superheated steam. By this method steel containing less than .003 per cent nitrogen is produced.

One potential source of difficulty in the oxygen-steam mixed blast process is the danger that condensate from the steam may attack the dolomite bottom of the converter. To avoid this, some designers recommend the use of thin copper tubes embedded in the bottom plate to act as protective liners for the tuyeres. Quite recently some experiments were made with the so-called "dual-blast" converter in which air is blown upward through ordinary tuyeres in the bottom while high-purity oxygen from the top is directed downward at low impact pressure onto the surface of the bath. This oxygen is intended not so much to penetrate the metal as to flood the whole atmosphere above the converter bath with oxygen, thus promoting high concentration and reactivity of iron oxide in the basic slag.

By changing the number of open tuyeres in the bottom of the converter the ratio of oxygen going down to air going up can be varied within wide limits. The object of this departure is to develop a conversion process that will remove phosphorus from Thomas pig-iron before decarburization is complete. By passing oxygen downward onto the surface of the metal and the lime which are being agitated by the rising air blast, the necessary early liquefying of the lime is achieved and early dephosphorization takes place.

3. OXYGEN ENRICHMENT IN THE BLAST FURNACE

Oxygen enrichment by itself has been considered of marginal advantage in the blast furnace except in the production of ferro-alloys. This is because a greatly increased tuyere zone temperature upsets the thermal balance and leads to some difficulty in avoiding the production of high silicon iron. It has been found, however, that oxygen-enriched blast combined with steam injection serves to drive the furnace faster and generate a gas of greater reducing power with no significant change in hearth zone temperature.

Some plants currently practice routine oxygen enrichment of blast furnace air for the production of steelmaking iron. Approximately 65 tons of oxygen per day per furnace are required for each 1 per cent of enrichment. With an available oxygen supply of about 400 tons per day, it has been found advantageous to spread this amount over four operating furnaces rather than to concentrate it on one furnace.

The economic attractiveness of oxygen enrichment in the blast furnace is greatest under conditions of capacity operation when there is a strong demand for the additional iron which can be produced. The most promising use of blast furnace oxygen enrichment lies in ferro-alloy smelting. The high hearth temperature produced with oxygen favours the reduction of non-ferrous metal oxides and formation of their high melting point slag.

4. OXYGEN FOR DIRECT REDUCTION OF IRON ORE

Basically the industry is still dependent on the units of production that characterized it in the early years of this century by-product coke ovens, blast furnaces, open hearths, blooming and secondary mills. Direct ore reduction processes may change this since they provide a potential replacement for the coke oven-blast furnace complex. The *H*-iron process is a typical example. This process consists in bringing into intimate contact, at about 900°F and 400 pounds per square inch, finely divided iron ore and preheated hydrogen gas.

Pressurized hydrogen enters a large cylindrical reducing vessel at the bottom and in passing upward keeps the fine ore particles in a state of turbulent motion. In the reducer, hydrogen reacts with the preheated iron oxide to form reduced iron and water:

$$Fe_2O_3+3H_2=2Fe+3H_2O.$$

The gas leaving the top of the reactor consists of unreacted hydrogen and water vapour.

Regenerated hydrogen, as well as fresh hydrogen to take the place of the hydrogen converted to water, is recycled to the reducer. The reduced iron product is briquetted, thermally passivated, and can then be charged directly to open hearth or electric furnaces to replace the scrap. The production of hydrogen for such a process may be accomplished by exothermic partial oxidation of natural gas of fuel oil.

5. CRUCIBLE FURNACE

The crucible furnace is one of the oldest furnaces for melting non-ferrous metals, and it is being used a great deal at the present time. High carbon steel is made by melting scrap steel in a crucible too. The construction of a crucible furnace consists of a shell which is made of a steel plate about $\frac{3}{16}$ in. thick. It rests on a plate made of cast iron. The legs support the furnace high enough from the floor to allow for draft and ashes. The grate works on hinges so that it can be raised and dropped. The grate is turned by the handle. The cover holds down the flame. The furnace should be connected by the flue with a chimney. The melting capacities of the crucible in one heat are from 20 to 300 lbs of brass or from 10 to 100 lbs of aluminium. The linings are made of brick and are applied about the same as in the cupola furnace.

Sometimes the furnaces are set on the floor, but, in most cases, they are set in a pit because they are more easily operated in such a setting. Shavings and kindling are placed on the grate with about 50 lbs of coke on the kindling. After the coke bed is well lighted, one should build up the coke bed so that the top of the crucible, when put in, will be even with the top of the flue. The bottom of the furnace and grates should be kept free from ashes and cinders, or the draft will not get through, causing much trouble in getting the metal enough to run the castings.

The crucible way is used for making high carbon steel and special steels. The percentage of carbon the scrap steel contains must be known.

6. PORTABLE HARDNESS TESTER

In use, the portable tester is applied to the work, as shown in Fig. 56, and a handpiece is depressed, with the result that a diamond indentor is brought into contact with the surface. Continued movement of the handpiece causes the indentor to be pressed into the work under a pre-determined load for a maximum depth of 0.005 in. A reading which corresponds to the hardness value is then obtained on a large-diameter dial-type indicator. Scales of different colours are provided which give direct readings in Vickers pyramid, Brinell, and Rockwell values. The instrument is available in different types, one of which gives full scale readings for Vickers pyramid numbers from 80 to 1200, Brinell from 80 to 630, and Rockwell from 30 to 70. A second instrument gives full scale readings in Vickers pyramid numbers from 35 to 300. Another type provides readings of Rockwell A, B, and C values from 30 to 90, 40 to 100, and to 70. On the fourth hardness tester the full scale readings obtainable range from 80 to 1200 Vickers pyramid, 80 to 420 Brinell, 35 to 99 Rockwell B, and 20 to 70 Rockwell C.

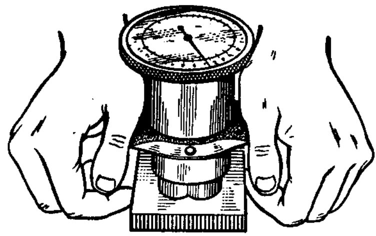

Fig. 56. Portable Tester

7. HIGH-SPEED PRECISION BALL BEARING TESTING MACHINES

Investigation has been carried out for several years on the performance of precision ball bearings of small diameter, as employed, for example, in instrument gyroscopes, and, machines have been developed for the measurement of frictional torque and vibrations in bearings of 5 to 15 mm bore, running at speeds as high as 60,000 rpm. Machines have now been built for torque measurement. A machine consists of a high-speed driving unit, arrangements for applying variable radial and axial loads, and a sensitive recording torque meter. Because of the high speeds involved, and the need for great sensitivity, air bearings, specially developed for the purpose, are used throughout. These bearings have proved entirely satisfactory and have given some thousands of hours service without attention.[1]

Drive to the main spindle, whereon the test bearing is mounted, is provided by a high-frequency motor, which is mounted above, and supplied by a variable-speed motor-alternator set housed in the machine base. An endless belt made from pure silk, impregnated with linseed oil dressing, is used to transmit the drive from the crowned motor pulley to the main spindle. The inner race of the ball bearing under test is held in position on the end of the high-speed spindle by means of a nut, and the outer race is clamped axially in a housing which floats freely in a secondary air bearing and serves as a virtually frictionless support.

Radial loads can be applied by dead weights acting through the air film of the secondary bearing. Axial loads are applied pneumatically, so that no rotational constraint is imposed on the test bearing, and provision is made for lubricating the bearing with oil mist while tests are being carried out. Friction in the bearing is detected and measured with the aid of a torque arm fixed to the housing carrying the outer race.

A photocell is arranged at one end of the arm to detect any movement due to frictional torque, and the resulting electrical signal is amplified and fed back to a moving coil wound on a copper former fixed to the torque arm, the coil being arranged to move in the field of a permanent magnet.

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1. have given some thousands of hours service without attention — работают несколько тысяч часов без обслуживания

Составные предлоги

according to [ə'kɔ:dıŋ tə] согласно

as to, as for [əz tə, əz fɔ:] относительно

because of [bı'kɔz əv] из-за

by means of [baı 'mi:nz əv] посредством

by virtue of [baı 'və:tju: əv] в силу, благодаря

due to ['dju: tə] благодаря, в силу, из-за

in accordance with [ın ə'kɔ:dəns wıð] в соответствии с

in addition to [ın ə'dıʃn tə] кроме того, к тому же

in front of [ın 'frʌnt əv] перед, напротив

in spite of [ın 'spaıt əv] несмотря на

in respect of [ın rıs'pekt əv] относительно

instead of [ın'sted əv] вместо

on account of [ɔn ə'kaunt əv] по причине, из-за

out of ['aut əv] из, изнутри, вне

owing to ['ouıŋ tə] из-за, благодаря

with regard to [wıð rı'gɑ:d tə], as regards of [əz rı'gɑ:dz əv] относительно, по отношению

with respect to [wıð rıs'pekt tə], with reference to [wıð 'refrəns tə] — к, в отношении к

Сокращения

h.p. — horse power ['hɔ:s 'pauə] лошадиная сила

ft per min — foot per minute ['fut pə 'mınıt] фут в минуту

gal. — gallon ['gælən] галлон

i.e. — id est ['ıd 'est] то есть

in. — inch [ıntʃ] дюйм

in. per min — inch per minute ['ıntʃ pə 'mınıt] дюйм в минуту

in. per rev — inch per revolution ['ıntʃ pə ˌrevə'lu:ʃn] дюйм за один оборот

kw — kilowatt ['kılowɔt] киловатт

kv — kilovolt ['kılovoult] киловольт

lb. — pound [paund] (англ. фунт равен 453,6 г)

p.s.f. — pounds per square foot [pə 'skwɛə 'fut] фунты на квадратный фут

r.p.m. — revolutions per minute [ˌrevə'lu:ʃnz pə 'mınıt] оборотов в минуту

АНГЛО-РУССКИЙ СЛОВАРЬ

А

abrasive [ə'breɪzɪv] абразив; абразивный материал; абразивный, шлифующий, иститирающий

acetylene [ə'setɪli:n] ацетилен

action ['ækʃən]: **capillary a.** [kə'pɪlərɪ] капиллярное действие

activated ['æktɪveɪtɪd] активированный

actuate ['æktjueɪt] приводить в движение

adapter [ə'dæptə] держатель, приспособление, приставка

additive ['ædɪtɪv] присадка

adequate ['ædɪkwɪt] соразмерный соответствующий

adjacent [ə'dʒeɪsənt] смежный

adjust [ə'dʒʌst] регулировать, налаживать, прилаживать

adjustable [ə'dʒʌstəbl] регулируемый

adjustment [ə'dʒʌstmənt] регулировка

advance [əd'vɑn:s] движение подачи (поступательное)

align [ə'laɪn] выпрямлять, центрировать, выверять

alignement [ə'laɪnmənt] центровка; совпадение осей

alkali ['ælkəlaɪ] щелочь

alloy ['ælɔɪ] сплавлять, легировать (сталь); сплав; сплавляемый

angle ['æŋgl] угол

- **acute a.** [ə'kju:t-] острый угол
- **clearance a.** ['klɪərəns-] задний угол
- **crank a.** [kræŋk-] угол поворота кривошипа
- **cutting a.** ['kʌtɪŋ-] угол резания
- **lip a.** [lɪp-] угол заострения
- **obtuse a.** [əb'tju:s-] тупой угол
- **right a.** [raɪt-] прямой угол

anneal [ə'ni:l] отжигать, отпускать

anvil ['ænvɪl] наковальня, наковаленка (вставной штифт в мерительных инструментах)

apex ['eɪpeks] вершина, пик

arbor ['ɑ:bə] оправка

arm [ɑ:m] плечо, траверса

- **crank a.** [kræŋk-] плечо кривошипа
- **radial a.** ['reɪdɪəl-] радиальная траверса

assembly [ə'semblɪ] агрегат, узел, сборка

attachment [ə'tætʃmənt] приспособление

automatic [ˌɔ:tə'mætɪk] автоматический

- **semi-a.** ['semɪ-] полуавтоматический

available [ə'veɪləbl] доступный, имеющийся в распоряжении

B

backlash ['bækləʃ] обратный ход; игра; боковой зазор между зубьями колес
bar [bɑ:] брусок, направляющая станка, заготовка, стержень, штанга
boring b. ['bɔ:rɪŋ-] расточная скалка, оправка для расточки
guide b. [ɡaɪd-] направляющая
sine b. [saɪn-] синусная линейка
slide b. [slaɪd-] направляющая
beam [bi:m] балка, брус, луч
bearing ['bɛərɪŋ] подшипник, вкладыш (подшипника), опора, опорная поверхность
antifriction b. ['æntɪ'frɪkʃn-] подшипник качения
ball b. [bɔ:l-] шарикоподшипник
ball thrust b. [bɔ:l 'θrʌst-] упорный шарикоподшипник
journal b. ['dʒə:nəl-] опорный подшипник
one-row-ball b. [wʌn 'rou 'bɔ:l-] однорядный шарикоподшипник
plain b. [pleɪn-] подшипник скольжения
radial b. ['reɪdɪəl-] опорный или радиальный подшипник
radial thrust b. ['reɪdɪəl 'θrʌst-] радиально-упорный подшипник
roller b. ['roulə-] роликовый подшипник
single-row-ball b. ['sɪŋgl'rou 'bɔ:l-] однорядный шарикоподшипник
thrust b. [θrʌst-] упорный шарикоподшипник
bed [bed] станина
clamp b. [klæmp-] удерживающая плита
bed-plate [-pleɪt] опорная плита
belt [belt] ремень, лента
flat b. [flæt-] плоский ремень
V-b. [vi:-] клиновидный ремень
bench [bentʃ] верстак
bevel ['bevəl] малка, конус; скашивать, снимать фаску
bit [bɪt] вставной резец, лезвие
blade [bleɪd] лезвие
blank [blæŋk] заготовка
blast [blɑ:st] дутье, дуть
body ['bɔdɪ] корпус, станина
bore [bɔ:] расточенное отверстие; растачивать, сверлить
box [bɔks]:
clapper b. ['klæpə-] резцедержатель
speed b. [spi:d-] коробка подач; коробка скоростей
brace [breɪs] крепление, стойка, подставка; связывать; придавать жесткость
bracket ['brækɪt] консоль, кронштейн, консольный подшипник
brake [breɪk] тормозное устройство
plate b. [pleɪt-] пластинчатый тормоз, дисковый тормоз
brass [brɑ:s] латунь
braze [breɪz] паять твердым припоем
brazing ['breɪzɪŋ] пайка твердым припоем
induction b. [ɪn'dʌkʃn-] пайка индуктированным током
sequential b. [sɪ'kwenʃəl-] последовательная пайка
bronze [brɔnz] бронза
straight b. (tin bronze) [streɪt-] ([tɪn-]) оловянистая бронза
burn out ['bə:n aut] перегорать
burnishing ['bə:nɪʃɪŋ] полировка, шлифовка
bushing ['buʃɪŋ] втулка, вкладыш, проходной изолятор
button ['bʌtn] кнопка
push b. [puʃ-] кнопка; кнопочное управление; нажимная кнопка

C

cage [keɪdʒ] сепаратор (подшипника)

calipers ['kælıpəz] кронциркуль, штангенциркуль
inside c. ['ın'saıd-] нутромер
outside c. ['aut'saıd-] кронциркуль для внешних обмеров
vernier c. ['vǝ:nıǝ-] штангенциркуль с нониусом
cam [kæm] кулачок, кулачный диск, эксцентрик
carriage ['kærıdʒ] суппорт, каретка, салазки
casting ['kɑ:stıŋ] отливка
cause [kɔ:z] причина, вызывать, заставлять
centre ['sentǝ] центр
back c. [bæk-] упорный центр
dead c. [ded-] мертвая точка; неподвижный центр
live c. [laıv-] вращающийся центр, передний центр
running c. ['rʌnıŋ-] вращающийся центр
chain [tʃeın] цепь
driving ch. ['draıvıŋ-] приводная цепь
link-belt silent ch. ['lıŋk'belt 'saılǝnt-] шарнирная бесшумная цепь
chamber ['tʃeımbǝ]:
gas mixing ch. ['gæs 'mıksıŋ-] газосмешивающая камера
chamfer ['tʃæmfǝ] фаска
chip [tʃıp] стружка; рубить зубилом
chipping ['tʃıpıŋ] рубка
chisel ['tʃızǝl] зубило
cape c. [keıp-] крейцмейсель
flat c. [flæt-] плоское зубило
chuck [tʃʌk] патрон (зажимной)
collet c. ['kɔlıt-] цанговый патрон
concentric c. [kǝn'sentrık-] самоцентрирующий патрон
contracting c. [kǝn'træktıŋ-] цанговый патрон
independent jaw c. [,ındı'pendǝnt 'dʒɔ:-] патрон с независимыми кулачками
self-centering c. ['self'sentǝrıŋ-] самоцентрирующий патрон
universal c. [,ju:nı'vǝ:sǝl-] универсальный зажимной патрон
circuit ['sǝ:kıt] цепь
clad [klæd] покрытый
clamp [klæmp] зажим, зажимать
longitudinal feed ram c. [,lɔndʒı'tju:dınǝl 'fi:d 'ræm-] упор для установки места хода и длины хода ползуна
clay [kleı] глина
clearance ['klıǝrǝns] зазор, просвет, допуск
clutch [klʌtʃ] сцепление, муфта сцепления
axial c. ['æksıǝl-] осевая муфта
band c. [bænd-] дисковая муфта
block c. [blɔk-] муфта с раздвижными колодками
cone c. [koun-] коническая фрикционная муфта
disc c. [dısk-] дисковая муфта, тарельчатая муфта
disengaging c. ['dısın'geıdʒıŋ-] расцепная муфта
fixed c. [fıkst-] постоянная муфта
friction c. [frıkʃn-] фрикционная муфта, фрикцион
jaw c. [dʒɔ:-] кулачковая муфта
multi-disc c. [,mʌltı'dısk-] многодисковая муфта
rim c. [rım-] обгонная муфта
safety c. ['seıftı-] предохранительная муфта
semi c. ['semı-] полумуфта
coat [kout] облицовывать, наносить покрытие, облицовка
coaxial [kou'æksıǝl] коаксиальный, соосный
collar ['kɔlǝ] кольцо, муфта, втулка
collet ['kɔlıt] патрон, цанга, конусная втулка
column ['kɔlǝm] опорная стойка; колонна
swivel c. ['swıvl-] поворотная колонна

conduction [kən'dʌkʃn] проводность
thermal c. ['θə:məl-] теплопроводность
conductive [kən'dʌktıv] проводимый
conductivity [,kɔndʌk'tıvıtı] удельная проводимость
thermal c. [θə:məl-] теплопроводность, коэффициент теплопроводимости
conductor [kən'dʌktə] проводник
cone [koun] конус; деталь конической формы; ступенчатый шкив
cone of gears ['koun əv 'gıəz] ступенчатая зубчатая передача
contact pressure ['kɔntækt 'preʃə контактное (удельное) давление
contract [kən'trækt] сжимать
control [kən'troul] управление, управлять
pendant c. ['pendənt-] подвесной пульт управления
converge [kən'və:dʒ] сходиться
converter [kən'və:tə] конвертер
coplanar [kou'pleınə] копланарный, находящийся в одной плоскости
core [kɔ:] сердечник, стержень
counterboring ['kauntə'bɔ:rıŋ] развертывание
countersink ['kauntə'sıŋk] зенковка, зенковать
countersinking ['kauntə'sıŋkıŋ] зенкование
coupling ['kʌplıŋ] муфта сцепления
rigid c. ['rıdʒıd-] жесткая муфта
crank [kræŋk] кривошип, коленчатый рычаг
crankshaft ['kræŋkʃa:ft] коленчатый вал
crest [krest] вершина
cross-key ['krɔs'ki:] закреплять шпонкой
cross-slide ['krɔs'slaıd] поперечный суппорт
cutter ['kʌtə] фреза
pipe c. [paıp-] труборез

D

deliver [dı'lıvə] подавать, нагнетать
design [dı'zaın] проектный план, проектировать
detachable [dı'tætʃəbl] съемный
dial ['daıəl] круговая шкала
direct-reading d. [dı'rekt'ri:dıŋ-] индикатор прямого отсчета
diameter [daı'æmıtə] диаметр
core d. [kɔ:-] внутренний диаметр
major d. ['meıdʒə-] наружный диаметр
minor d. ['maınə-] внутренний диаметр
pitch d. [pıtʃ-] средний диаметр, диаметр делительной окружности
root d. [ru:t-] внутренний диаметр
die [daı] штамп; винторезная головка
threading d. ['θredıŋ-] плашка
diffuse [dı'fju:z] распространяться, распылять
disable [dıs'eıbl] повреждать
discolo(u)ration [dıs,kʌlə'reıʃn] обесцвечивание
dovetail ['dʌvteıl] направляющая в виде «ласточкина хвоста»
downfeed ['daunfi:d] вертикальная подача
dragging ['drægıŋ] трение
dress [dres] отделывать, затачивать
drill [drıl] сверло; сверлить
deep d. [di:p-] сверло глубокого сверления
four-lipped hollow core d. ['fɔ:'lıpt 'hɔlou 'kɔ:-] крестовое полое сверло
oil hole d. ['ɔıl 'houl-] сверло со смазочными канавками
oil tube d. ['ɔıl 'tju:b-] сверло со смазочными канавками
straight-shank d. ['streıt

'ʃæŋk-] сверло с прямым хвостовиком
tapered shank d. ['teɪpəd 'ʃæŋk-] сверло с коническим хвостовиком
twist d. [twɪst-] спиральное сверло
single-lipped twist d. ['sɪŋgl 'lɪpt 'twɪst-] спиральное сверло с одной режущей кромкой
two-lipped hollow type deep d. ['tu:'lɪpt 'hɔlou 'taɪp 'di:p-] полое сверло с двумя режущими кромками для глубокого сверления
drive [draɪv] привод, передача; двигать; приводить во вращение
belt d. [belt-] ременная передача
chain d. [tʃeɪn-] цепная передача
cutting d. ['kʌtɪŋ-] привод резания
feed d. [fi:d-] привод подачи
pulley d. ['pulɪ-] передача при помощи шкива
driving ['draɪvɪŋ] передача, привод
ductile ['dʌktaɪl] пластичный, вязкий
duty ['dju:tɪ] режим работы

E

eccentric [ɪk'sentrɪk] эксцентрик; эксцентричный
edge [edʒ] острие, лезвие; ребро; грань, край, кромка
cutting e. ['kʌtɪŋ-] режущая кромка
effective cutting e. [ɪ'fektɪv 'kʌtɪŋ-] рабочая режущая кромка
electrician [ɪlek'trɪʃn] электрик
electrode [ɪ'lektroud] электрод
carbon e. ['kɑ:ben-] угольный электрод
eliminator [ɪ'lɪmɪneɪtə] отделитель
elongate ['i:lɔŋgeɪt] удлинять(ся), растягивать(ся)
engage [ɪn'geɪdʒ] зацеплять(ся), включать
engagement [ɪn'geɪdʒmənt] зацепление
ensure [ɪn'ʃuə] обеспечивать
equip [ɪ'kwɪp] оборудовать
essential [ɪ'senʃəl] неотъемлемый, необходимый, ценный
evaluate [ɪ'væljueɪt] оценивать
exhaust [ɪg'zɔ:st] выпускать; выпускной, выхлопной
expand [ɪks'pænd] растягивать, распространять, расширять
exposure [ɪks'pouʒə] выдержка
extend [ɪks'tend] расширять(ся), растягивать(ся)
extension [ɪks'tenʃn] растяжение
exterior [eks'tɪərɪə] внешний, наружный

F

fabrication [ˌfæbrɪ'keɪʃn] производство; заводское изготовление
face [feɪs] лицевая сторона; вид спереди; грань; наружная поверхность; грань резца; венец шестерни
faceplate ['feɪsˌpleɪ] планшайба, разметочная плита, круглый стол
facing ['feɪsɪŋ] обработка торца, обточка торца
failure ['feɪljə] повреждение
feature ['fi:tʃə] конструктивная особенность
feed [fi:d] подача
coarse f. [kɔ:s-] крупная подача
fine f. [faɪn-] мелкая подача, точная подача
power f. [pauə-] механическая подача, автоматическая подача
table f. [teɪbl-] продольная подача стола
file [faɪl] напильник; обрабатывать напильником
diamond f. ['daɪəmənd-] алмазный напильник
flat f. [flæt-] плоский остроносый напильник

half-round f. ['hɑ:f'raund-] полукруглый напильник
knife f. [naɪf-] ножевой напильник
rasp f. [rɑ:sp-] рашпиль
rhombic f. ['rɔmbɪk-] ромбовидный напильник
round f. [rɑund-] круглый напильник
square f. [skwɛə-] квадратный напильник
triangular f. [traɪ'æŋgulə-] трехгранный напильник
filler ['fɪlə] наплавочный материал
fillet ['fɪlɪt] округление, утолщение
fine [faɪn] тонкий; мелкий (о резьбе); высокопробный, высокого качества
finish ['fɪnɪʃ] чистовая обработка, обрабатывать начисто
true f. [tru:-] точная обработка, правильная обработка, чистовая обработка, обработка начисто
fit [fɪt] посадка, пригонка; точно соответствовать; подходить
fitter ['fɪtə] сборщик, слесарь-монтажник
fitting ['fɪtɪŋ] пригонка, монтаж
fix [fɪks] укреплять, устанавливать, зажимать
fixture ['fɪkstʃə] зажимное приспособление
flange [flændʒ] закраина, установочный фланец; загибать кромку, отбортовывать
flexibility ['fleksə,bɪlɪtɪ] гибкость
fluid ['flu:ɪd]:
cutting f. ['kʌtɪŋ-] смазывающе-охлаждающая жидкость, эмульсия
fluoride ['fluəri:d] фтористое соединение
flute [flu:t] канавка, желобок
flux [flʌks] флюс, поток, течение
fluxing ['flʌksɪŋ] разжижение, офлюсование
force [fɔ:s] сила, усилие
external f. [eks'tə:nəl-] внешняя сила
internal f. [ɪn'tə:nəl-] внутренняя сила
pressing f. ['presɪŋ-] прижимающая сила
forge [fɔ:dʒ] ковать; кузница
foundry ['faundrɪ] литейная, литейный завод
fracture ['fræktʃə] трещина; образовывать трещину
friction ['frɪkʃn] трение
rolling f. ['roulɪŋ-] трение качения
furnace ['fə:nɪs] печь
blast f. [blɑ:st-] доменная печь
crucible f. ['kru:sɪbl-] тигельная печь
cupola f. ['kju:pələ-] вагранка
open-hearth f. ['oupn'hɑ:θ-] мартеновская печь
furnish ['fə:nɪʃ] поставлять, снабжать
fuse [fju:z] плавить, сплавлять
fusion ['fju:ʒn] плавка

G

gash [gæʃ] паз, канавка, надрез
gauge [geɪdʒ] калибр; шаблон; измерять
clearance g. ['klɪərəns-] щуп
depth g. [depθ-] глубиномер, глубомер
go g. [gou-] проходной калибр
internal g. [ɪn'tə:nəl-] калибр-пробка
no-go g. ['nou'gou-] непроходной калибр
plug g. [plʌg-] калибр-пробка
slide g. [slaɪd-] штангенциркуль, раздвижной калибр
thread-plug g. [θred'plʌg-] резьбовой калибр
gear [gɪə] шестерня, зубчатое колесо; сцепляться
bevel g. ['bevəl-] коническая передача, коническое зубчатое колесо

chain g. [tʃeɪn-] цепная передача, цепное колесо, звездочка
change g. [tʃeɪndʒ-] сменная шестерня
eccentric g. [ɪk'sentrɪk-] эксцентрическая зубчатая передача, механизм эксцентрика
helical g. ['helɪkl-] геликоидальное (винтовое) колесо; косозубое колесо
herringbone g. ['herɪŋ'boun-] шевронное зубчатое колесо
hypoid g. ['haɪpɔɪd-] гипоидное зубчатое колесо
main g. [meɪn-] главная передача
pick-off g. [pɪk əv-] сменная шестерня
screw g. [skru:-] винтовое зубчатое колесо
segment g. ['segmənt-] зубчатый сегмент; колесо с неполным зубчатым венцом
sliding g. ['slaɪdɪŋ-] передвижное зубчатое колесо, скользящее вдоль вала зубчатое колесо
spur g. [spə:-] цилиндрическое прямозубное колесо
tumbler g. ['tʌmblə-] накидная шестерня
worm g. [wə:m-] червячное колесо
gearbox ['gɪəbɔks] коробка скоростей
change g. [tʃeɪndʒ-] коробка перемены скоростей
feed g. [fi:d-] коробка подач
knee with feed g. ['ni: wɪð 'fi:d-] консоль с коробкой подач
slide rest feed g. ['slaɪd 'rest 'fi:d-) коробка подач бокового суппорта
tool head feed g. ['tu:l 'hed 'fi:d-] коробка подач суппорта
gearing ('gɪərɪŋ] зубчатая передача, зубчатое зацепление
bevel g. ['bevəl-] коническое зубчатое зацепление
external g. [eks 'tə:nəl-] внешнее зацепление, передача зубчатыми солесами с внешним зацеплением
friction g. [frɪkʃn-] фрикционная передача
internal g. [ɪn'tə:nəl-] внутреннее зацепление
rack-and-pinion g. ['ræk ənd 'pɪnjən-] передача шестерней и зубчатой рейкой
screw g. [skru:-] винтовая передача
spur g. [spə:-] цилиндрическая передача
toothed g. [tu:θt-] зубчатая передача
worm g. [wə:m-] червячная передача
generate ['dʒenəreɪt] изготовлять (обрабатывать) зубчатые колеса способом обкатки
grade [greɪd] градус; качество; сорт
graduate ['grædjueɪt] градуировать
grain [greɪn] крупинка, гранула
grained [greɪnd] зернистый
open g. ['oupən-] крупнозернистый
grinder ['graɪndə] шлифовальный станок
bench g. [bentʃ-] верстачно-шлифовальный станок
cylinder g. [sɪ'lɪndə] цилиндрошлифовальный станок
disk g. [dɪsk-] дисковый шлифовальный станок
internal centreless g. [ɪn'tə:nəl 'sentəlɪs-] внутришлифовальный бесцентровый станок
internal g. [ɪn'tə:nəl-] внутришлифовальный станок
surface g. ['sə:fɪs-] плоскошлифовальный станок
grinding ['graɪndɪŋ] шлифование
dry g. [draɪ-] шлифовка всухую
off-hand g. ['ɔ:f'hænd-] ручное шлифование

wet g. [wet-] мокрое шлифование, шлифование с охлаждением
groove [gru:v] паз, канавка; делать пазы, канавки
guide [gaɪd] направляющая; направлять
guideway ['gʌɪdweɪ] направляющая

H

hammer ['hæmə] молот, молоток
power h. ['pauə-] механический молот
handle ['hændl] ручка, рукоятка; грузить, управлять, ухаживать (за машиной)
reverse h. [rɪ'və:s-] ручка перемены хода
handling ['hændlɪŋ] погрузка; транспортировка; разгружать
handwheel ['hændwi:l] маховичок
cross feed table h. ['krɔs 'fi:d 'teɪbl-] маховичок ручного поперечного перемещения стола
feed change h. ['fi:d 'tʃeɪndʒ-] маховичок для изменения величины подачи
feed gearbox h. ['fi:d 'gɪəbɔks-] маховичок для перемещения подач
idle travel h. ['aɪdl 'trævl-] маховичок для установки холостого хода
longitudinal feed table h. [ˌlɔndʒɪ'tju:dɪnəl'fi:d 'teɪbl-] маховичок ручного продольного перемещения стола
transverse feed h. ['trænzvə:s 'fi:d-] маховичок ручного поперечного перемещения (*зд.* шлифовальной бабки)
vertical feed h. ['və:tɪkəl 'fi:d-] маховичок ручного вертикального перемещения (*зд.* шлифовальной бабки)
harden ['hɑ:dn] закаливать(ся)
head [hed] головка, резцовая головка
cutter h. ['kʌtə-] режущая головка
dividing h. [dɪ'vaɪdɪŋ-] делительная головка
side h. [saɪd-] боковая головка
tool h. [tu:l-] суппорт, резцедержатель
wheel h. [wi:l-] бабка или головка шлифовального круга; шлифовальный суппорт; шлифовальная бабка
headstock ['hedstɔk] передняя бабка токарного станка
heat up ['hi:t ʌp] подогревать
helical ['helɪkl] спиральный, винтовой
hob [hɔb] червячная фреза
hobbing ['hɔbɪŋ] нарезание зубчатых колес (червячных) при помощи червячной фрезы
holder ['houldə] держатель, державка
tool h. [tu:l-] резцедержатель
die h. [daɪ-] клупп
hole [houl] отверстие
spindle h. ['spɪndl-] шпиндельное отверстие
tapered h. ['teɪpəd-] конусное отверстие
hone [houn] хон, хонинг-головка; хонинговать
honing ['hounɪŋ] хонингование
house [haus] заключать во что-л., вставлять в корпус
housing ['hauzɪŋ] стойка, корпус

I

ignite [ɪg'naɪt] воспламенять, прокаливать
impart [ɪm'pɑ:t] сообщать
implement ['ɪmplɪmənt] инструмент
inch [ɪntʃ] дюйм (=25,4 мм)
inching ['ɪntʃɪŋ] строжка короткими подачами
incorporate [ɪn'kɔ:pəreɪt] помещать, монтировать, включать

index [ˈɪndeks] указатель, метка, индекс; поворачивать (на определенный угол)
indicator [ˈɪndɪkeɪtə] индикатор, стрелочный измерительный прибор
dial i. [daɪəl-] циферблатный индикатор, индикатор с круговой шкалой
induction [ɪnˈdʌkʃn] индукция
industry [ˈɪndəstrɪ] промышленность
machine-building i. [məˈʃi:n ˈbɪldɪŋ-] машиностроение
inertia [ɪˈnə:ʃɪə] инерция
insert [ɪnˈsə:t] вкладыш, прокладка; вставлять
integral [ˈɪntɪgrəl] цельный; неотделимая часть
intermittent [ˌɪntə:ˈmɪtənt] прерывистый
iron [ˈaɪən] железо
alloy cast i. [ˈælɔɪ ˈkɑ:st-] легированный чугун
alloy grey i. [ˈælɔɪ ˈgreɪ-] специальный легированный чугун
cast i. [kɑ:st-] чугун
grained i. [ˈgreɪnd-] зернистый чугун
grey i. [greɪ-] серый чугун
malleable i. [ˈmælɪəbl-] ковкий чугун
pig i. [pɪg-] чугун в чушках

J

jaw [dʒɔ:] кулачок (патрона), губка, щека (например, тисков)
movable j. [ˈmu:vəbl-] подвижная губка
solid j. [ˈsɔlɪd-] неподвижная губка
join [dʒɔɪn] соединять
joining [ˈdʒɔɪnɪŋ] соединение
non-detachable j. [ˈnɔndɪˈtætʃəbl-] неразъемное соединение
joint [dʒɔɪnt] соединение, стык
journal [ˈdʒə:nəl] цапфа

K

key [ki:] шпонка; закреплять шпонкой; заклинивать
adjusting k. [əˈdʒʌstɪŋ-] установочный клин
chuck k. [tʃʌk-] торцовый ключ патрона
inserted k. [ɪnˈsə:tɪd-] закладная шпонка
keyway [ˈki:weɪ] шпоночная канавка
knee [ni:] колено, кронштейн, консоль (фрезерного станка)
knob [nɔb] кнопка, маховичок
vertical feed k. [ˈvə:tɪkəl ˈfi:d-] кнопка включения быстрого вертикального перемещения (шлифовальной бабки)

L

lapping [ˈlæpɪŋ] нахлестка, притирка
lateral [ˈlætərəl] боковой
lathe [leɪð] токарный станок
bench l. [bentʃ-] верстачный, настольный станок
chucking l. [ˈtʃʌkɪŋ-] патронный токарный станок
crankshaft l. [ˈkræŋkʃɑ:ft-] станок для обточки коренных шеек коленчатых валов
engine l. [ˈendʒɪn-] универсальный токарно-винторезный станок
screw l. [skru:-] токарно-винторезный станок
turret l. [ˈtʌrɪt-] револьверный станок
wheel l. [wi:l-] колесотокарный станок
lead [led] свинец
lead [li:d] шаг (винта, спирали)
lever [ˈli:və] рычаг, рукоятка, балансир
control l. [kənˈtroul-] рычаг управления, рычаг переключения передач
diamond grinding wheel l. [ˈdaɪəmənd ˈgraɪndɪŋ ˈwi:l-]

рукоятка алмазной правки шлифовального круга
feed change l. ['fi:d 'tʃeɪndʒ-] рычаг переключения коробки подач
feed change rest hand l. ['fi:d 'tʃeɪndʒ 'rest 'hænd-] рукоятка для изменения скорости подачи (здесь) верхнего суппорта
feed selection l. ['fi:d sɪ'lekʃn-] рукоятка управления коробкой подач
feed slide rest l. ['fi:d 'slaɪd 'rest-] рукоятка для перемещения бокового суппорта
gearbox change l. ['gɪəbɔks 'tʃeɪndʒ-] рукоятка переключения коробки скоростей
gear train l. ['gɪə 'treɪn-] рукоятка переключения перебора коробки подач
longitudinal feed table l. [,lɔndʒɪ'tju:dɪnəl 'fi:d 'teɪbl-] рукоятка включения продольной подачи стола
magnetic plate l. [mæg'netɪk 'pleɪt-] рукоятка включения магнитной плиты
ratchet l. ['rætʃɪt-] храповой рычаг
side rest feed l. ['saɪd 'rest 'fi:d-] рукоятка для включения подачи и перемещения бокового суппорта
speed change l. ['spi:d 'tʃeɪndʒ-] рукоятка управления коробки скоростей
speed change ram l. ['spi:d 'tʃeɪndʒ 'ræm-] рукоятка для изменения скоростей хода ползуна
spindle feed change l. ['spɪndl 'fi:d 'tʃeɪndʒ-] рукоятка перемещения шпинделя и включения подачи
spindle traverse l. ['spɪndl 'trævə:s-] рукоятка реверсирования вращения шпинделя
table reverse feed l. ['teɪbl rɪ'və:s 'fi:d-] рукоятка реверсирования стола
table speed l. ['teɪbl 'spi:d-] рукоятка настройки скорости стола
table traverse l. ['teɪbl 'trævə:s-] рукоятка перемещения стола
transverse feed l. ['trænzvə:s 'fi:d-] рукоятка включения и выключения поперечного перемещения (*эд.* шлифовальной бабки)
traverse-reverse l. ['trævə:s rɪ'və:s-] рукоятка пуска и остановки (здесь) стола
vertical cross feed table l. ['və:tɪkəl 'krɔs 'fi:d 'teɪbl-] рукоятка для включения и реверсирования поперечной и вертикальной подач стола
vertical feed change side rest l. ['və:tɪkəl 'fi:d 'tʃeɪndʒ 'saɪd 'rest-] рукоятка для изменения направления вертикальной подачи бокового суппорта
vertical feed knee hand l. ['və:tɪkəl 'fi:d 'ni: 'hænd-] рукоятка ручного вертикального перемещения консоли
life [laɪf] долговечность, срок службы
line [laɪn] облицовывать
linear ['lɪnɪə] линейный
linkage ['lɪŋkɪdʒ] связь, рычажный механизм
lip [lɪp] режущая кромка
load [loud] нагрузка, нагружать
axial l. ['æksɪəl-] осевая нагрузка
bending l. ['bendɪŋ-] нагрузка на сгиб
compression l. [kəm'preʃn-] нагрузка на сжатие
impact l. ['ɪmpækt-] динамическая (ударная) нагрузка
radial l. ['reɪdɪəl-] радиальная нагрузка
shearing l. ['ʃɪərɪŋ-] нагруз-

ка на срез; срезывающее усилие

tensile l. ['tensaıl-] нагрузка при испытании на разрыв, растягивающее усилие

thrust l. [θrʌst-] осевое давление, осевая нагрузка

locate [lou'keıt] размещать, устанавливать

loosen ['lu:sn] ослаблять

lubricate ['lu:brıkeıt] смазывать

lug [lʌg] зажим, выступ

M

machine [mə'ʃi:n] машина, станок; подвергать механической обработке

bed type of m. ['bed 'taıp əv-] верстачный, фрезерный станок

boring m. ['bɔrıŋ-] расточный станок

centreless grinding m. ['sentəlıs 'graındıŋ-] бесцентрово-шлифовальный станок

column knee m. ['kɔləm 'ni:-] консольнофрезерный станок

cutting m. ['kʌtıŋ-] металлорежущий станок

drilling m. ['drılıŋ-] сверлильный станок

grinding m. ['graındıŋ-] шлифовальный станок

heavy duty m. ['hevı 'dju:tı-] станок для тяжелых работ; мощный станок

milling m. ['mılıŋ-] фрезерный станок

multiple-spindle m. ['mʌltıpl 'spındl-] многошпиндельный станок

plain drilling m. ['pleın 'drılıŋ-] простой (горизонтально-) сверлильный станок

plain milling m. ['pleın 'mılıŋ-] простой (горизонтально-) фрезерный станок

planer milling m. ['pleınə 'mılıŋ-] продольно-фрезерный станок

planer surface grinding m. ['pleınə 'sə:fıs 'graındıŋ-] продольно-шлифовальный станок

radial drilling m. ['reıdıəl 'drılıŋ-] радиально-сверлильный станок

rupture m. ['rʌptʃə-] машина для испытания на разрыв

sensitive drilling m. ['sensıtıv 'drılıŋ-] сверлильный станок повышенной точности

vertical spindle drilling m. ['və:tıkəl 'spındl 'drılıŋ-] вертикально-сверлильный станок на колонне

maintenance ['meıntınəns] эксплуатация, уход, ремонт

make-up ['meıkʌp] состав, структура

male [meıl] входящий в другую деталь

malleable ['mælıəbl] ковкий

mandrel ['mændrıl] оправка для закрепления изделия

manganese [,mæŋgə'ni:z] марганец

manufacture [,mænju'fæktʃə] производство, изготовление; изготовлять

mating ['meıtıŋ] сопряженный с другой деталью, парный

material [mə'tıərıəl] материал

engineering m.(s) [,endʒı'nıərıŋ-(s)] машиностроительные материалы

mechanism ['mekənızm] механизм, устройство

down feed m. ['daun 'fi:d-] механизм вертикальной подачи

drive m. [draıv-] приводной механизм, привод

feed m. [fi:d-] механизм подачи

return m. [rı'tə:n-] реверсивный (реверсирующий) механизм

mesh [meʃ] зацепление, зацеплять(ся), сцеплять(ся)

metal ['metl] металл

engineering m. [,endʒı'nıərıŋ-] технический металл

ferrous m. ['ferəs-] черный металл

non-ferrous m. ['nɔn 'ferəs-] цветной металл
mill [mɪl] обрабатывать фрезерованием
milling ['mɪlɪŋ) фрезерование; фрезерный
climb m. [klaɪm-] фрезерование по подаче
conventional m. [kən'venʃənəl-] фрезерование против подачи
pendulum m. ['pendjuləm-] возвратно-поступательное фрезерование
molten ['moultən] расплавленный
motion ['mouʃn] движение
forward m. ['fɔ:wəd-] поступательное движение
intermittent m. [,ɪntə'mɪtənt-] прерывистое движение
reciprocating m. [rɪ'sɪprəkeɪtɪŋ-] возвратно-поступательное движение
rocking m. ['rɔkɪŋ-] качательное движение
motor ['moutə] двигатель, мотор
drive m. [draɪv-] приводной двигатель, привод
reversing m. [rɪ'və:sɪŋ-] реверсивный двигатель
mould [mould] литейная форма; отливать формы
green m. [gri:n-] сырая литейная форма
mount [maunt] устанавливать, монтировать
multi-turn [,mʌltɪ'tə:n] многовитковый (*эл.*), многозаходный

N

nose [nouz] нос; выступ; передний конец шпинделя
nozzle ['nɔzl] сопло, форсунка, наконечник
nut [nʌt] гайка
fixed n. [fɪkst-] закрепленная гайка
lock n. [lɔk-] контргайка
safety n. ['seɪftɪ-] предохранительная гайка

O

oblique [ə'bli:k] косой
operation [,ɔpə'reɪʃn] операция, работа
heavy-duty o. ['hevɪ 'dju:tɪ-] работа при тяжелых условиях
fitting o. ['fɪtɪŋ-] слесарная операция
oscillate ['ɔsɪleɪt] колебаться, вибрировать, качаться
outlet ['autlet] выпускное или выходное отверстие
overarm ['ouvərɑ:m] поддерживающий рукав фрезерного станка, рукав хобота
additional link between knee and o. [ə'dɪʃənəl 'lɪŋk bɪ'twi:n 'ni: ənd-] дополнительная связь консоли с хоботом
ram-type o. ['ræm'taɪp-] хобот с подвеской
oxide ['ɔksaɪd] окись
iron o. ['aɪən-] окись железа
oxygen ['ɔksɪdʒən] кислород

P

pad [pæd] подушка, прокладка, монтажная площадка
part [pɑ:t] деталь
spare p. [spεə-] запасная деталь
pattern ['pætən] модель
paste [peɪst] паста
penetrate ['penɪtreɪt] проникать внутрь
pig [pɪg] болванка, чушка, чугун
pillow ['pɪlou] подкладка
pilot ['paɪlət] направляющая цапфа; центрировать при помощи направляющей цапфы, вставляемой в отверстие
pin [pɪn] шпилька, штифт; заштифтовывать, зашплинтовывать
crank p. [kræŋk-] палец кривошипа; шейка коленчатого вала
pinion ['pɪnjən] малое зубчатое колесо пары, зубчатый валик

pitch [pɪtʃ] шаг (например, зубчатого зацепления)
pivot ['pɪvət] свободно вращаться вокруг оси, качаться, поворачиваться, надеть на что-л.
plain [pleɪn] ровный, гладкий
plane [pleɪn] плоский; плоскость
planer ['pleɪnə] продольно-строгальный станок
double housing p. ['dʌbl 'hauzɪŋ-] двухколонный продольно-строгальный станок
open side p. ['oupən 'saɪd-] одноколонный продольно-строгальный станок
rail p. [reɪl-] строгальный станок для строгания рельс
tandem p. ['tændəm-] продольно-строгальный станок с двумя рабочими столами
planing ['pleɪnɪŋ]:
string p. [strɪŋ-] одновременное строгание партии изделий
plate [pleɪt] пластинка, плита; покрывать
index p. ['ɪndeks-] индексная пластинка, делительный диск
mounting p. ['mauntɪŋ-] монтажная плита
swivel p. ['swɪvl-] поворотная доска, круг
platen ['plætn] стол (станка)
plating ['pleɪtɪŋ] гальваническое покрытие
pliers ['plaɪəz] клещи, плоскогубцы, кусачки
needle-(nosed) p. ['ni:dl (nouzd)-] игольные щипцы
round-(nosed) p. [raund (nouzd)-] круглогубцы
point [pɔɪnt] точка; наконечник; острый конец циркуля; стрелка
pointer ['pɔɪntə] стрелка, указатель
polishing ['pɔlɪʃɪŋ] полирование, шлифование
poppet ['pɔpɪt] задняя бабка
portal ['pɔ:tl] портал
positive [pɔzɪtɪv] принудительный (о движении)
post [poust] стойка, подпорка, колонка
tool p. [tu:l-] резцедержатель, верхняя часть суппорта, поворотный круг суппорта (строгального станка)
drive tool p. ['draɪv 'tu:l-] привод движения резания
potassium [pə'tæsjəm] калий
pour [pɔ:] литник; лить, отливать
precision-made [prɪ'sɪʒn'meɪd] прецизионный, высокоточный
press [pres] пресс; выдавливать, прижимать
primary ['praɪmərɪ] первоначальный, основной
prior (to) ['praɪə] предшествовать, предшествующий
projection [prə'dʒekʃn] выступ
promote [prə'mout] способствовать
protractor [prə'træktə] транспортир, угломер
universal p. [,ju:nɪ'və:səl-] универсальный угломер
provide [prə'vaɪd] снабжать, обеспечивать
provided [prə'vaɪdɪd] при условии
pulley ['pulɪ] шкив
driven p. ['drɪvn-] ведомый шкив
driving p. ['draɪvɪŋ-] ведущий шкив
idle p. ['aɪdl-] натяжной ролик
idler p. ['aɪdlə-] натяжной ролик
pump [pʌmp] насос
coolant p. ['ku:lənt-] насос для подачи смазочно-охлаждающей жидкости
purify ['pjuərɪfaɪ] очищать

Q

quadrant ['kwɔdrənt] дуга (на циркуле), квадрант, большой трензель
quality ['kwɔlɪtɪ] качество

non-magnetic q. ['nɔnmæg-'netɪk-] немагнитное свойство
quill [kwɪl] втулка, полый вал

R

race [reɪs] канавка качения, обойма (подшипника)
raceway ['reɪsweɪ] беговая дорожка (подшипника), направляющий паз
rack [ræk] зубчатая рейка
rack-and-pinion ['rækənd'pɪnjən] реечная передача, кремальера
rail [reɪl] рельс, поперечина, направляющая
cross r. [krɔs-] траверса, поперечина
rake [reɪk] передний угол резца, главная или вспомогательная задняя поверхность резца, скос
front r. [frʌnt-] передний угол (резца)
side r. [saɪd-] вспомогательная задняя поверхность резца
true r. [tru:-] передняя поверхность резца
ram [ræm] ползун
range [reɪndʒ] ряд, предел, степень; ставить в ряд
rasp [rɑ:sp] рашпиль
rate [reɪt] степень; скорость; величина
feed r. [fi:d-] скорость подачи
reading ['rɪ:dɪŋ] показание прибора
ream [ri:m] развертывать, обрабатывать отверстие разверткой
reamer ['ri:mə] развертка
recess [rɪ'ses] углубление
reciprocate [rɪ'sɪprəkeɪt] двигаться взад и вперед, двигаться возвратно-поступательно
rectilinear [,rektɪ'lɪnɪə] прямолинейный
reduction [rɪ'dʌkʃn] уменьшение, сокращение
refinement [rɪ'faɪnmənt] очистка; рафинирование; отделка; повышение качества
refractory [rɪ'fræktərɪ] огнеупорный материал
release [ri:'li:z] разъединение; ослабление; разъединять; освобождать
residue ['rezɪdju:] остаток
resistance [rɪ'zɪstəns] сопротивление
corrosion r. [kə'rouʒn-] устойчивость против коррозии
resistant [rɪ'zɪstənt] стойкий
rest [rest] опора, подставка, суппорт; приводить в состояние покоя
compound r. ['kɔmpaund-] крестовый (сложный) суппорт
side r. [saɪd-] боковой суппорт
tool r. [tu:l-] поворотная часть крестового суппорта; верхний суппорт
work r. [wə:k-] опора, подставка
resultant [rɪ'zʌltənt] равнодействующий; результирующая сила
retainer [rɪ'teɪnə] сепаратор подшипника
retract [rɪ'trækt] отводить назад
retraction [rɪ'trækʃn] обратный ход; отводить назад
reverse [rɪ'və:s] обратная (задняя) сторона; реверсировать, давать обратный ход; обратный ход
table r. ['teɪbl-] реверсионный механизм стола
revolution [,revə'lu:ʃn] круговое вращение; оборот
rib [rɪb] ребро
rigid ['rɪdʒɪd] жесткий; неподвижно закрепленный
rigidity [rɪ'dʒɪdɪtɪ] жесткость, устойчивость, стойкость
rivet ['rɪvɪt] заклепка; клепать
rod [rɔd] стержень, шток, тяга

feed r. [fi:d-] тяга механизма подачи

roll [roul] прокатывать; ролик, вал

rosin ['rɔzɪn] канифоль, смола

roughing ['rʌfɪŋ] обдирка, черновая обработка

rubberize ['rʌbə'raɪz] прорезинивать

rugged ['rʌgɪd] особо прочной конструкции

run [rʌn] работать, эксплуатировать

S

saddle ['sædl] салазки

sand [sænd] песок

  moulding s. ['mouldɪŋ-] формовочная смесь

saw [sɔ:] пила; пилить, распиливать

  hack s. [hæk-] ножовка для металла

scale ['skeɪl] шкала; масштаб; окалина

scrap [skræp] металлический лом

scrapping ['skræpɪŋ] соскабливать; шабровка

screw [skru:] винт; ввинчивать, скреплять винтами или болтами

  adjusting s. [ə'dʒʌstɪŋ-] установочный или регулирующий винт

  elevating s. ['elɪveɪtɪŋ-] подъемный винт

  feed s. [fi:d-] ходовой винт поперечной подачи

  lead s. [li:d-] ходовой винт

seamless ['si:mlɪs] цельнотянутый

section ['sekʃn] сечение, профиль

  box s. [bɔks-] коробчатый профиль или сечение

  cross-s. [krɔs-] поперечное сечение или профиль

secure [sɪ'kjuə] закреплять, соединять

set [set] комплект; устанавливать; пригонять

shaft [ʃɑ:ft] вал

  drive s. [draɪv-] ведущий вал

  driven s. ['drɪvn-] ведомый вал

  driving s. ['draɪvɪŋ-] ведущий вал

  feed s. [fi:d-] ходовой валик, валик подачи

  hollow s. ['hɔlou-] пустотелый (полый) вал

  intermediate s. [,ɪntə'mi:djət-] промежуточный или передаточный вал

  intersecting s. [,ɪntə'sektɪŋ-] пересекающий вал

  spline s. [splaɪn-] шлицевой вал

shank [ʃæŋk] хвостовик (инструмента)

shaper ['ʃeɪpə] поперечно-строгальный станок

  crank s. [kræŋk-] поперечно-строгальный станок с кулисным приводом ползуна

  gear s. [gɪə-] зубодолбежный станок, зубострогальный станок

shear [ʃɪə] срез; срезать

shears [ʃɪəz] ножницы

  alligator s. ['ælɪgeɪtə-] рычажные или аллигаторные ножницы

  bench s. [bentʃ-] стуловые ножницы

sheet [ʃi:t] лист (металла)

shellac [ʃe'læk] шеллак

shifter ['ʃɪftə] механизм переключения

  change s. [tʃeɪndʒ-] механизм переключения

shop [ʃɔp] цех; мастерская

shoulder ['ʃouldə] закраина, уступ, кромка, буртик

silicon ['sɪlɪkən] кремний

slack [slæk] ненатянутый; провисание

slag [slæg] шлак

sleeve [sli:v] рукав; втулка; пиноль

slide [slaɪd] салазки; суппорт; скользить

  cross s. [krɔs-] поперечный суппорт; поперечные салазки

head s. [hed-] головка суппорта

tool s. [tu:l-] резцовые салазки; инструментальные салазки

slotter ['slɔtə] долбежный станок

socket ['sɔkɪt] муфта, зажимной патрон

solder ['sɔldə] припой; паять

soldering ['sɔldərɪŋ] пайка

hard s. [hɑ:d-] пайка твердым сплавом

soft s. [sɔft-] пайка мягким сплавом

solid ['sɔlɪd] сплошной; твердый; твердое тело

solidification [sə'lɪdɪfɪ'keɪʃn] затвердевание

solidify [sə'lɪdɪfaɪ] затвердевать

span [spæn] зев (гаечного ключа); раствор (губок тисков)

specimen ['spesɪmɪn] образец

speed [spi:d] скорость

spindle ['spɪndl] шпиндель

tail s. [teɪl-] пиноль

wheel s. [wi:l-] шпиндель шлифовального колеса

square [skwɛə] квадрат; квадратный

stamping ['stæmpɪŋ] штамповка

stand [stænd] державка, подставка

stationary ['steɪʃnərɪ] неподвижный, стационарный

steel [sti:l] сталь

alloy s. ['ælɔɪ-] специальная сталь, легированная сталь

carbon s. ['kɑ:bən-] углеродистая сталь

high-speed s. [haɪ'spi:d-] быстрорежущая сталь

machine s. [mə'ʃi:n-] конструкционная (машиностроительная) сталь

self-hardening s. ['self'hɑ:dnɪŋ-] самозакаляющаяся сталь

stainless s. ['steɪnlɪs-] нержавеющая сталь

tool s. [tu:l-] инструментальная сталь

stock [stɔk] исходное сырье; шихта; заготовка

bar s. [bɑ:-] заготовка в форме прутка

stop [stɔp] стопор, упор, упорный штифт; застопоривать

strain [streɪn] напряжение; деформация

strength [streŋθ] сила; прочность

tensile s. ['tensaɪl-] сопротивление на разрыв, прочность на разрыв

ultimate s. ['ʌltɪmɪt-] предел прочности

stress [stres] напряжение, усилие

impact s. ['ɪmpækt-] ударная нагрузка

tensile s. ['tensaɪl-] растягивающее напряжение

unit s. ['ju:nɪt-] удельное напряжение

strip [strɪp] планка

terminal s. ['tə:mɪnəl-] полоска с контактами

stroke [strouk] ход

subject [səb'dʒekt] подвергнуть чему-л.

successive [sək'sesɪv] последовательный

suit [sju:t] подходить, соответствовать

sulphur ['sʌlfə] сера

superfinish ['sju:pə'fɪnɪʃ] суперфиниш; суперфинишировать

support [sə'pɔ:t] опора, станина, суппорт; поддерживать

surface ['sə:fɪs] поверхность; обрабатывать поверхность

bearing s. ['bɛərɪŋ-] несущая (опорная) поверхность; направляющая поверхность

mating s. ['meɪtɪŋ-] сопряженная поверхность

concave s. ['kɔn'keɪv-] вогнутая поверхность

convex s. ['kɔn'veks-] выпуклая поверхность

swarf [swɔ:f] стружка

swing [swɪŋ] поворачиваться

swivel [swɪvl] вращаться

T

table ['teɪbl] стол
tailstock ['teɪlstɔk] задняя бабка (станка)
tangent ['tændʒənt] касательная (кривой), тангенс
tank [tæŋk] бак
tap [tæp] метчик; нарезать резьбу метчиком; кран
  nut t. [nʌt-] гаечный метчик
taper ['teɪpə] конус, конусообразный
tapered ['teɪpəd] конический, конусный, конусообразный
temper ['tempə] отпуск (стали)
tenacity [tɪ'næsɪtɪ] вязкость, липкость, клейкость; прочность на разрыв; сопротивление разрыву
term [tə:m] называть; термин; срок
ternary ['tə:nərɪ] трехкомпонентный
thermal ['θə:məl] тепловой, термический
thimble ['θɪmbl] барабан микрометра; ковш
  ratchet t. ['rætʃɪt-] храповой механизм; трещетка
thread [θred] винтовая резьба, нарезка; нарезать резьбу
  acme t. ['ækmɪ-] трапецеидальная резьба
  buttress t. ['bʌtrɪs-] упорная резьба
  double t. [dʌbl-] двухзаходная резьба
  external t. [eks'tə:nəl-] наружная резьба
  female t. ['fi:meɪl-] внутренняя резьба
  flat t. [flæt-] прямоугольная резьба с малой высотой профиля
  inch t. [ɪntʃ-] дюймовая резьба
  internal [ɪn'tə:nəl-] внутренняя резьба
  left-hand(ed) t. ['left'hænd(ɪd)-] левая резьба
  male t. [meɪl-] наружная резьба
  metric t. ['metrɪk-] метрическая резьба
  pipe t. [paɪp-] трубная резьба
  right-hand(ed) t. ['raɪt'hænd(ɪd)-] правая резьба
  round t. [raund-] круглая резьба
  screw t. [skru:-] резьба, винтовая резьба
  single (-start) t. ['sɪŋgl(stɑ:t)-] однозаходная резьба
  square t. [skwɛə-] квадратная резьба
  trapezoidal t. [trə'pi:zɔɪdəl-] трапецеидальная резьба
  triangular t. [traɪ'æŋgjulə-] треугольная резьба
  triple t. ['trɪpl-] трехзаходная резьба
  Vee-t. [vi:-] треугольная резьба
threading ['θredɪŋ-] резьба, нарезание резьбы
thrust [θrʌst] давление
tin [tɪn] олово
tip [tɪp] наконечник, кончик, вершина (головки зуба)
tolerance ['tɔlərəns] допуск
  close t. [klouz-] допуск в узких пределах
tool [tu:l] режущий инструмент, резец, резать инструментом
  angular cutting t. ['æŋgjulə 'kʌtɪŋ-] угловой резец
  boring t. ['bɔ:rɪŋ-] расточной резец
  cutting t. ['kʌtɪŋ-] режущий инструмент, резец
  cutting-off t. ['kʌtɪŋ'ɔf-] отрезной резец
  finishing t. ['fɪnɪʃɪŋ-] резец для чистовой обработки
  gang t. [gæŋ-] многорезцовая державка, набор фрез на одной оправке
  inserted t. [ɪn'sə:tɪd-] державка со вставным резцом
  multiple-point cutting t. ['mʌltɪpl 'pɔɪnt 'kʌtɪŋ-] резец с несколькими режущими кромками

necking t. ['nekiŋ-] прорезной резец, канавочный резец
planing t. ['pleiniŋ-] строгальный резец
roughing t. ['rʌfiŋ-] черновой резец, обдирочный резец
shaper t. ['ʃeipə-] строгальный резец
side t. [said-] подрезной (токарный) резец
single-point cutting t. ['siŋgl 'pɔint 'kʌtiŋ-] резец с очень узким режущим лезвием
solid t. ['sɔlid-] цельный резец
thread t. [θred-] резьбонарезной инструмент
turning t. [tə:niŋ-] токарный резец
torch [tɔ:tʃ] сварочная горелка
torque [tɔ:k] крутящий момент, вращающий момент
torsion ['tɔ:ʃn] кручение
train [trein] зубчатая передача
transmission t. [trænz'miʃn-] система зубчатых передач
transverse [trænz'və:s] поперечный
traverse ['trævə:z] поперечная траверса, поперечная подача; двигаться, перемещаться; силовая поперечина; траверса
spindle hand t. ['spindl 'hænd-] маховичок ручного перемещения суппорта
treadle ['tredl] педаль, ножной привод
treat [tri:t] обрабатывать
triangle ['traiæŋgl] треугольник
true [tru:] точный, правильный; править шлифовальный круг
tubular ['tju:bjulə] трубчатый
tungsten ['tʌŋstən] вольфрам
turn [tə:n] точить, обрабатывать на токарном станке, повертывать
turret ['tʌrit] револьверная головка, револьверный суппорт
twist [twist] крутить, скручивать

U

ultimate ['ʌltimit] крайний, предельный
ultrasonic ['ʌltrə'sɔnik] ультразвуковой, сверхзвуковой
unit ['ju:nit] единица измерения; прибор; узел; блок; агрегат

V

valve ['vælv] клапан, задвижка, вентиль
velocity [vi'lɔsiti] скорость
angular v. ['æŋgjulə-] угловая скорость
vernier ['və:niə] нониус
vice [vais] тиски
bench v. [bentʃ-] стуловые тиски, слесарные тиски
parallel v. ['pærəlel-] параллельные тиски
plain v. [plein-] неподвижные тиски
swivel v. [swivl-] поворотные тиски
view [vju:] вид, проекция
cross-sectional v. [krɔs'sekʃənəl-] поперечный разрез
front v. [frʌnt-] вид спереди

W

wash out ['wɔʃ aut] промывать, вымывать
washer ['wɔʃə] шайба
ways [weiz] направляющие станка
wear [wɛə] изнашиваться, износ
wearing ['wɛəriŋ] изнашивание
web [web] перемычка
wedge [wedʒ] клин
weld [weld] сварной шов, сваривать
welding ['weldiŋ] сварка; сварочный
autogenous w. [ɔ:'tɔdʒinəs-] автогенная сварка, газовая сварка
butt w. [bʌt-] сварка встык
electric w. ['ilektrik-] электросварка

electric arc w. [ɪ'lektrɪk 'ɑ:k-] электродуговая сварка
electric resistance w. [ɪ'lektrɪk rɪ'zɪstəns-] контактная сварка
gas w. [gæs-] газовая сварка
hammer w. ['hæmə-] кузнечная сварка
leftward w. ['leftwəd-] левая сварка
rightward w. ['raɪtwəd-] правая сварка
spot w. [spɔt-] точечная сварка
thermit w. ['θə:mɪt-] термитная сварка

wheel [wi:l] колесо, зубчатое колесо
abrasive w. [ə'breɪzɪv-] абразивный круг, шлифовальный круг; точильный камень
feed w. [fi:d-] зубчатое колесо механизма подачи
grinding w. ['graɪndɪŋ-] шлифовальный круг
toothed w. [tu:θt-] зубчатое колесо
worm w. [wə:m-] червячное колесо

wobble ['wɔbl] колебаться, качаться; биение

work [wə:k] обрабатывать; обрабатываемая заготовка (деталь)

workpiece ['wə:k,pi:s] обрабатываемое изделие (деталь)

worm [wə:m] червяк, червячный винт

wrench [rentʃ] гаечный ключ, рукоятка, рычаг
adjustable w. [ə'dʒʌstəbl-] разводный (гаечный) ключ
double-end(ed) w. ['dʌbl'end-(ɪd)-] двусторонний ключ
nut w. [nʌt-] гаечный ключ
single-end(ed) w. ['sɪŋgl'end-(ɪd)-] односторонний ключ
socket w. ['sɔkɪt-] торцовый ключ
tap w. [tæp-] вороток, клупп

Y

yoke [jouk] обойма, хомут, зажим

Z

zinc [zɪŋk] цинк
sheet z. [ʃi:t-] рольный (листовой) цинк