The analysis of the map (Fig. 2) shows that there is a number of areas of POA where the nature of influence is considerable. First of all these are the areas of the Starobin deposit and the Pripyat Trough, which are seismically active.

The completed study allows to form the original scheme for engineering and geological forecasting of potential occurrence of accidents in underground linear constructions. Accordingly, the construction reliability and safety increase. Timely installed geodynamic monitoring of dangerous areas, identified by means of GIS project, will enable timely detection of dangerous changes in seismic activity and prevention of possible consequences.

The possibility of connecting new map material and new databases suggests that the layout of GIS project can be effectively developed and used to conduct a comprehensive geodynamic monitoring of the territory of Belarus.

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HIGH-SPEED MILLING OF SPHERES

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The basic tendencies of development of machine tool industry and tool management are determined in the article and possibilities with regard to machining of spherical surfaces of parts are considered. Comparative analysis of methods of machining of spherical surfaces is carried out. The process of high speed milling of spherical surfaces of parts is described. The formula of the customizing the process of high speed milling of spherical surfaces with high productivity and quality.

Machine building is a key industry, because any other industry can not do without the use of its facilities for manufacturing of the necessary parts, products, equipment, etc. For example, in industries such as petrochemical, automotive and machine tool building parts with spherical surfaces: spherical bearings, tube ball valves, lifters, crank, etc. are widely used. There is the problem of processing such parts with a given capacity and required quality at the lowest possible production costs. Depending on these requirements, the technical process of manufacturing is developed, the equipment and cutting tools are selected.

The analysis of tendencies of development of machine building shows [1 - 3] that companies aim to use machine tools and instruments consisting of interchangeable structural modules, allowing you to adapt them quickly to the production of new products and new technological processes. An important factor in increasing the efficiency of production is the cutting tool, which share in the cost of metal on the one hand rarely exceeds 5%, but on the other hand, the choice of which depends strongly on the technological process parameters.

Comparison of methods of machining spherical surfaces. The analysis [4-7] shows that during the treatment of spherical surfaces of mechanical parts the processing methods either at special machines or using a special tool are mainly used. In the case of processing a wide range and large scale processing of spherical surfaces it is necessary to use special machines or to design additional tooling or a large number of special cutting tools, resulting in increased cost of machining parts. Moreover, the processing by the means of copy devices is not sufficiently accurate. But in order to produce a spherical surface with specific geometric characteristics a tool is needed with the same fixed characteristics, which are difficult and labour-consuming.

Let's calculate the normal time in the processing of spherical surfaces of the detail "Ball pin" for such methods of processing a spherical surface, as:

– shaped cutter method of cutting on universal lathe;
– cutter method of combining two innings on lathes;
– cutter with rotary fixtures and special machines;
– cutter method two spins on lathes using a special device.

Detail "Ball pin ", material – steel 45, has a spherical surface to Ø $40_{-0.05}$ mm. Allowance for machining is 1 mm. The surface roughness is Ra 1,25 µm. The material of the cutting tools is T15K6. Cutting conditions for each type of treatment are assigned and presented in table.

Processing performance during cutting is determined by the number of parts produced per unit time and depends on the underlying time.

$$n_p = \frac{1\min}{T_o}, \text{ details;}$$

where To– underlying time.

Cutting conditions

№	Processing method	Cutting conditions			Underlying time To, min
		S, mm/rev	n, min^{-1}	V, m/min	
1	shaped cutter	0,04	1250	165	0,854
2	cutter method of combining two innings	0,2	700	87,9	0,27
3	cutter with rotary fixtures and special machines	0,2	700	87,9	0,305
	the mill on the basis of a combination of two spins	0,45*	1400	141	0,067

* – the number of teeth of the cutter is equal to 3.

The calculated performance of the methods of machining a spherical surface is presented in diagram in fig. 1.

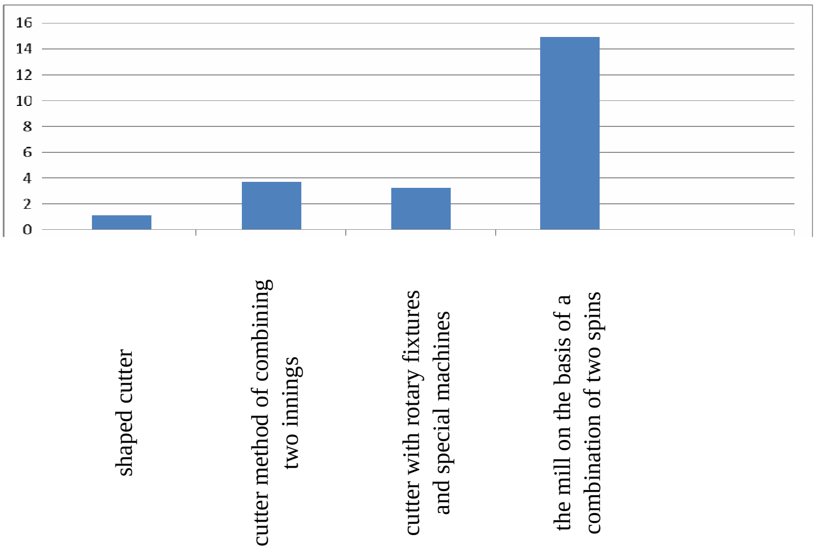

Fig. 1. Diagram of processing of the spherical surface

As it can be seen from the diagram (Fig. 1), the processing of cutting by the method of combining two rotations is the most productive. Taking into account the current direction of development of machine building production in the area of high-speed processing of metals by cutting, the method of machining of spherical surfaces may be more effective than existing methods. And one of the most important advantages of this method compared to the others is that the accuracy of shaping of the spherical surface is determined not by the profile tool and precision rotary fixture but by the accuracy of the path of movement of the workpiece and the tool, i.e. the kinematics of the process, which allows to obtain a spherical surface of high quality and precision.

The process of high speed milling of spherical surfaces. The scheme of processing of spherical surfaces by the way of covering high-speed milling is presented in figure 2. In this way of handling the tool is reported rotational motion with a rotational speed n1. After the installation movement of the work piece in the working position, in which the cutting blades in the tool, the work piece is reported rotational movement around its own axis with the rotation speed n2.

Due to using of high cutting speeds more detailed analysis of parameters covering and internal milling both in statics and in dynamics is required, as these parameters have a significant influence on the performance, accuracy and quality of processing.

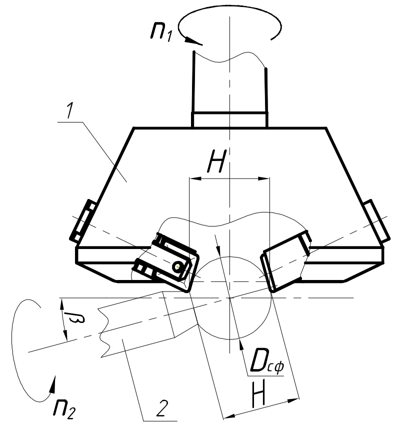

Fig. 2. The scheme of processing of the spherical surface by means of high-speed milling:
1 – cutting tool; 2 – the workpiece; n1 – rotational speed of the tool; n2 – rotational speed of the workpiece; $D_{сф}$ – diam spherical surface, H – height of the spherical surface; D – diameter of cutter setting; β – the angle of the axis of rotation of the workpiece

1. The angle of inclination of the axis of the workpiece β:

$$\beta = \arccos\left(\sqrt{\frac{H}{D_{сф}}}\right). \tag{1}$$

2. Feed tool So with a rounded top blades:

$$S_o = \sqrt{\frac{-1+\sqrt{1+64r^2a^2}}{2a^2}}, \tag{2}$$

where $a = \dfrac{4r + D_{сф}}{2D_{сф} \cdot Rz}$,

r – the radius of the tool tip,

Rz – the surface roughness.

3. The frequency of rotation of the workpiece:

$$n_2 = \frac{n_1 S_0}{\pi D_{сф}}. \tag{3}$$

4. The speed of movement of the tool V_1:

$$V_1 = \pi \cdot n_1 \cdot \sqrt{D_{сф} \cdot H}. \tag{4}$$

5. The speed of movement of the workpiece V_2:

$$V_2 = n_1 \cdot S_o \cdot \sin(2\beta + 2(\pi - 2\beta) \cdot n_1 \cdot t), \tag{5}$$

The dependences of the rotational velocities of the tool and workpiece from the milling parameters allow to do accurate calculations of quantities and to provide the required performance, accuracy and quality of machining of spherical surfaces of details.

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OIL-FREE PISTON COMPRESSORS

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This thesis describes the development on long lifetime and an efficient piston compressor operating in a clean environment where oil lubrication must be excluded. No oil lubricant and tight piston/cylinder fit leads to higher demands with respect to design specifications. The engineer is often confronted with various effects that occur during operation, e.g. tribology, material deformation, heat transfer, fluid flow. An accurate prediction of those processes is important to be able to analyze any newly invented design.

A lubricant can be defined as a substance, which introduced between sliding surfaces, reduces the friction between them, improves efficiency and reduces surface wear. Commonly used lubricants are different types of liquids, mainly oils. Such lubricants however, need to be avoided in this design. Other substances like gases or dry lubricants are acceptable in the analyzed system. In general, piston compressors must fulfill specific requirements due to their inherent use. First of all, lifetime and reliability requirements which are mainly related to material wear and the compressor design. A major challenge in the design is to reduce the potential of material wear in the critical components. The second requirement is an energy efficient gas compression [1].

1. Piston compressors technology

During the compression process, the piston should form a sliding seal so that the gas is compressed without any or with acceptable leakage. This means that a very close fit to the cylinder bore is needed. Because of temperature and other engineering and economical reasons this is not practical. Naturally, maximum piston leakage occurs as the piston approaches the end of its stroke because differential pressure across the piston is the highest at this point. This leakage causes both volumetric and power losses. Piston rings are therefore used. Piston rings have many variations, but all follow the same principle of a thin metallic ring, which tends to push out against the cylinder wall and make a tight sliding fit.

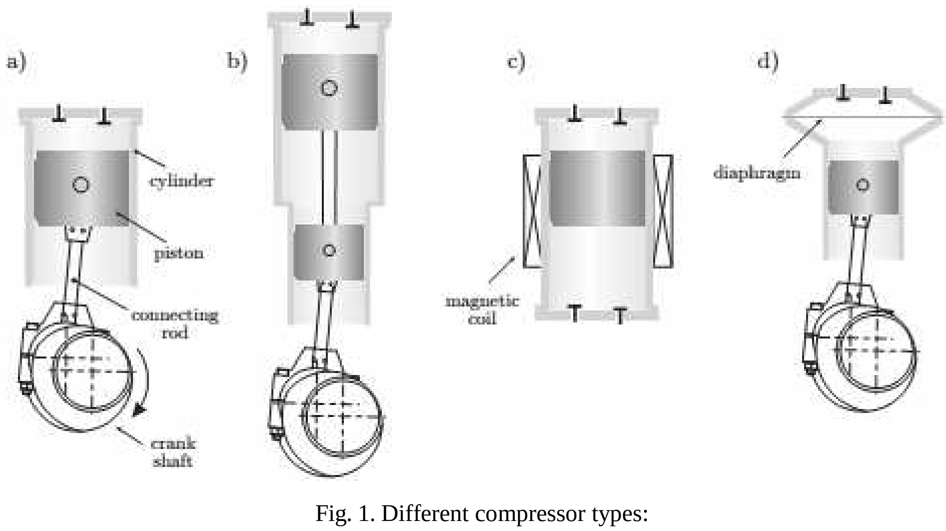

Fig. 1. Different compressor types:
a – crank driven, *b* – crosshead, *c* – free moving piston, *d* – diaphragm