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STUDY OF THE BASIC PROCESSES OF PRODUCTION OF BALLS FROM NATURAL STONE

Natural stone is widely used both in construction and in manufacture of ritual purpose products. Monuments from granite look aesthetically and mournfully. Perfect addition to them are vases, balls, and lamps, which are currently in great demand. Ball is one of the most popular natural stone products. It is widely used in decoration of tombstones, monuments, memorials, fences. Balls of large shapes are often used as elements of fountains, where a perfectly round granite ball rotates under water pressure. Balls are also used for decoration of flower beds, premises or public places, gardens and parks. They can be used as decorative elements on fences as well. Structurally, they can be made both in the form of a classical ball, and in the form of a ball with a leg - a support. The second type of such products is more common and popular. Every year the volume of production of complex geometry products increases, therefore, the question arises in a more in-depth study of the process of manufacturing such products and optimizing certain parameters.

Complex profiling is performed by special machine tools. Most often they are turning-screw-type machines of type 1M63, 1E61M, DIP 200 and others, which are transformed from metal-working on stone-processing, where the working body is not a cutter, but a diamond cutter, less often a cutting disk. Such machines correspond to the artisan production conditions.

In this work, an example of production of the ball from gabbro with a height of 150 mm and a diameter of Ø120 mm is considered. The production of the ball begins with the marking of the end pieces of the workpiece. It is necessary to find the center at the intersection of the workpiece diagonals or midpoints of the sides. After that, in the planned centers a hole with a depth of 6 - 10 mm is drilled with a hammer drill with diameter 6 - 8 mm. After verifying the serviceability of the machine and all its working elements, the workpiece is fixed for further processing. The technology of manufacturing a ball from natural stone can be divided into 3 stages:

Stage of cutting - this stage includes preparatory operations (placing a copy template in accordance with the maximum diameter of the future product: for a ball of Ø 120 mm with a polishing tolerance of 1 ... 2 mm, and one end of the workpiece) and cutting the ball all over the length of the workpiece with a cutting step of 5 mm (the step is chosen depending on the chosen cutting method); (Fig.1)

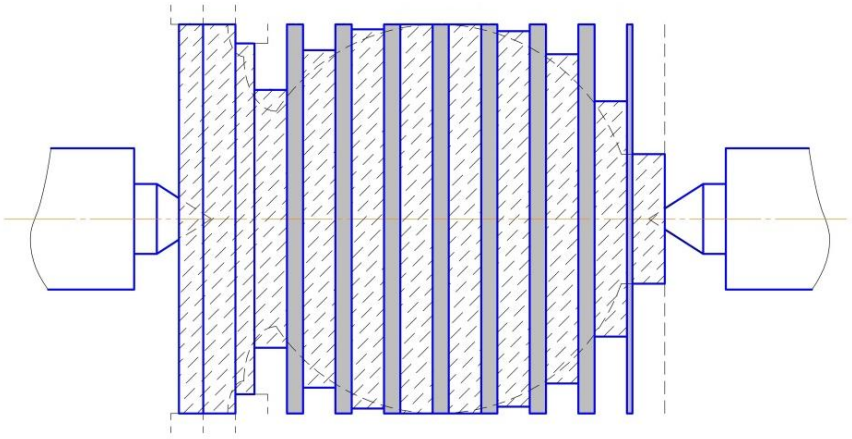

Fig.1 Ball view during cutting

1. Whipping and pre-cleaning - this stage involves whipping and pre-cleaning, the operator performs hammer whipping. For effective knocking, the direction of the chip and the applied force must be taken into account. These factors influence the height of the unevenness of the slotted grooves. Therefore, they are carried in the direction of reducing the diameter of the product. For example, in a convex section (in the middle), the diameter is the largest, and at the leg - the smallest, meaning they should be whipped from right to the left. In this case, we get a smaller height of the inequalities without breaking the shape and the integrity of the workpiece. Otherwise, when the whipping is from left to right, the height of the irregularities is larger, and there is also a chance that during the whipping the pieces of the rock will break off with the groove. Also, the width of the grooves influences on the height of the inequalities of the whipped grooves. Fig. 2 shows the recommended directions for chipping. Fig. 3 shows the shape of the ball after the ribs have been cut. Fig. 4 shows the shape of the ball after the previous cleaning.

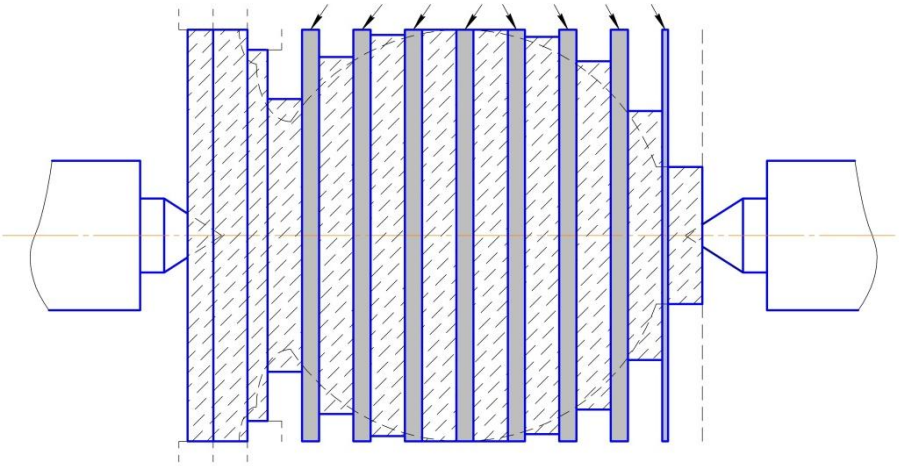

Fig. 2. Recommended directions for whipping

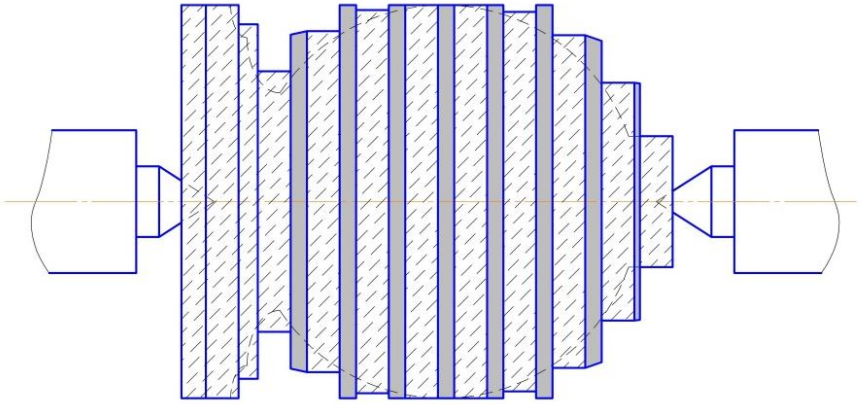

Fig. 3. The look of the ball after whipping.

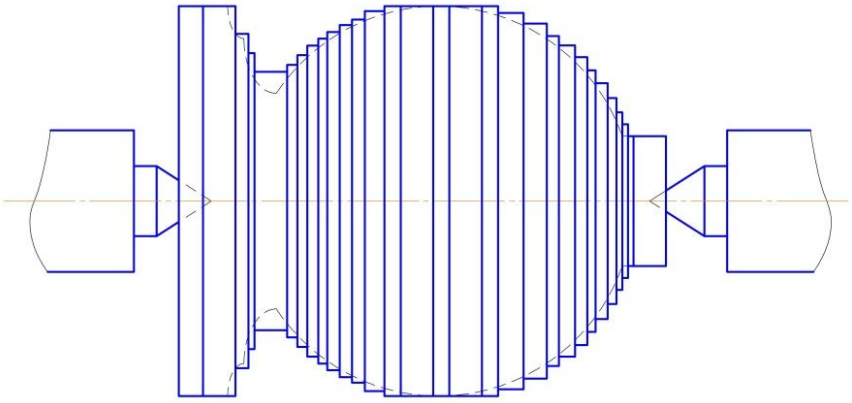

Fig. 4. Ball appearance after preliminary cleaning.

2. The *main cleaning* step is to clean up the ball at 1 … 2 mm intervals and to provide the final shape of the product before polishing. Therefore, we get the inequality of the surface of the ball, which will wear out fewer tools while polishing. When one step more is made than 2 mm when stripped, the tool wear, the time spent on polishing and grinding increase almost twofold. Fig. 5 shows a sample of the ball after the main cleaning with a step of 1 ... 2 mm.

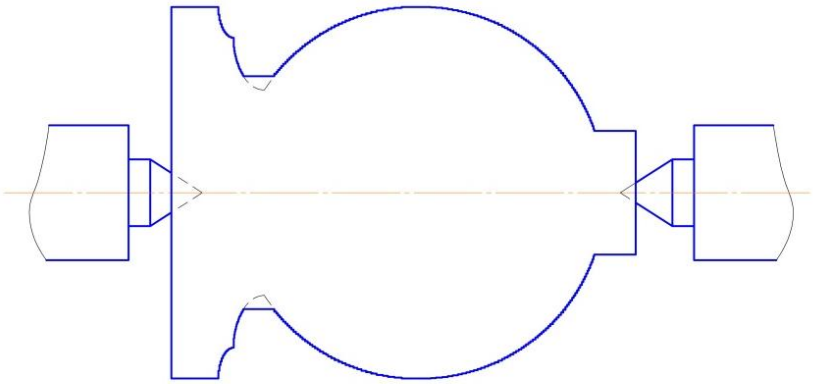

Fig. 5. Ball appearance after the main cleaning

For ball milling the operator must:

1. Soak the workpiece in the water to detect defects in the form of cracks, inclusions, etc.;
2. After selecting the suitable (appropriate) workpiece, attach it to the machine;

3. Choose the right method of cutting a vase, which includes the width of the ribs and a tolerance of 3 ... 10 mm when cutting, proceeding from the physical and mechanical properties of the selected breed;
4. During the second stage of making the ball - *whipping and pre-cleaning* - to choose the direction of the cleavage of the ribs correctly to obtain the minimum height of the roughness without compromising the integrity of the workpiece. Calculate the force of impact by hammer on ribs;
5. Observe the width of the step of 1 ... 2 mm during the *main cleaning*.