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# ELECTRO-EROSIVE CUTTING OF METAL

Electro-erosive machining is one of the ways to change the dimensions and shapes of metal and alloy workpieces. Basically, during this treatment, a through or blind perforation is formed in the body of the workpiece.

The shape of the body can be from the classical circle to the complex polygon. Electro-erosive machining can also speed up the process of forming grooves under the key, slots of any shape, shaped planes and other elements that are extremely difficult (or impossible) to form by traditional cutting.

In a word, in some circumstances, electro-erosive machining of metals is the only possible and most accurate technology.

The essence of electro-erosive machining is to use the destructive energy of the arc "breakdown" between the cathode and the anode. Electric arc separates the crystal lattice of the processed preparation (in analogy with erosion). In this case, the frequency varies from 5 kHz to 0.5 MHz [1].

The process of electrical "erosion" is fully controlled by computers, which allows to guarantee both high productivity and high accuracy of such processing, since the part itself is one of the electrodes. However, the quality and productivity of the process of electro-erosive machining depends on the frequency and power of the pulses applied to a pair of electrodes.

Therefore, in the process of metal working, there are several variants:

1. Anodic-mechanical version of electric erosion, based on arc cutting with parallel removal of waste from the working area. With the help of this technology, it is possible not only to cut the workpiece, but also to grind its surface or to sharpen the edges under the required angle. This method of arc processing is used in the process of production of a classical metal-cutting tool.

2. Electropulse variety of arc erosion. This process is characterized by maximum productivity but does not guarantee high quality of the machining surface. Therefore, electrical and pulsed equipment is used only for roughing metals.

3. An electrocontact method of forming a new relief of a part that is realized in a liquid medium, which gives the technologists additional advantages associated with the ability to control the temperature in the zone of electroerosive destruction.

4. Electrospark technique is used in the process of high-precision erosion machining of the smallest metal parts.

In addition, all four processing methods give one more positive result – they increase the surface hardness of the processed billet without changing the other characteristics of the metal [2].

In the process of electro-erosion machining, two electrodes are involved – the metal part and the bar of a hard material that is not subject to the process of electrical erosion. In most cases, hard electrodes are made of tungsten, which is made with various

additives, or from commercially pure graphite. However, electrodes made of copper, brass and even aluminum are also used in work.

The polarity connection circuit in the pair "workpiece-cutting electrode" can be direct and reverse. In the first case (direct polarity), the charge is supplied with a positive charge, in the second case − with negative.

This selectivity is due to the uneven distribution of energy in the anode-cathode pair: the anode melts at lower frequencies, and the cathode at higher frequencies.

It is possible to achieve greater productivity with a sufficiently high quality of the machining surface by regulating the current connection scheme and the frequency characteristics of the pulse.

In addition, reverse or direct polarity allows to save the material of the cutting electrode, reducing the cost of the process of electro-erosion machining [3].

The first examples of EDM (electrical discharge machining) machines appeared in the mid-1940s in the USSR. The first numerical control machine tool was created in the early 1960s in Switzerland.

Modern machines allow solving both mass, and small-scale or single tasks as aesthetic (grinding, decorating, etc.) and practical (perforation of through and blind holes, grooving, sharpening of cutting tools). And with those, and with other purposes, the EDM machines are able to cope with the same efficiency [4].

The cost price of processing on such equipment is much lower than on classical metal-cutting machines. And the quality of the surface is sometimes simply unattainable for machines from the conventional group.

Therefore, EDM machines are used to create high-precision parts used in the aerospace, instrumentation, machine tool, automotive, and other industries [5].

Unfortunately, this technology is rarely used in industrial technologies, in addition to the aerospace industry, although it is more accurate and profitable at cost.

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