New electrode-tool for the combined kerf of electrically conductive materials

IOP Conf. Series: Materials Science and Engineering **240** (2017) 012003 doi:10.1088/1757-899X/240/1/012003

New electrode-tool for the combined kerf of electrically conductive materials

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Abstract. The article explains the choice of combination electrodiamond cutting as the most suitable method for separating solid, hard-processing deficient alloys. When processing by this method, the electrode-tool comes into electrical contact with the side surfaces of the cut channel, giving rise to excessive metal removal is not controllable. To solve this problem, it introduced a new electrode-tool.

Introduction

Rapid development of mechanical engineering, instrument making, the aviation, space-rocket industry, caused broad use of hard-processing, natural scarce materials and their alloys, such as a tungsten, molybdenum, niobium, etc. As original materials in production of load-bearing frames of products where it is necessary to provide high requirements for accuracy and quality of the processed surfaces at the acceptable efficiency of processes. Use of these materials allows to increase strength and production characteristics of products that, in turn, allows to create more functional mechanisms possessing small dimensions at higher functionality.

Despite the advantages of using a super-hard materials in engineering, processing is often complicated. In modern industry, for cutting natural and scarce, hard metals are used as traditional, such as machining, cutting and new species, such as ultrasound, laser, plasma, and others. Laser and plasma cutting materials are the most modern and advanced methods and more in practical use in the manufacture of hard-processing materials.

These methods provide high performance of the production process and the possibility of cutting the curved contour of the workpiece, but have some drawbacks that prevent their use in case of stringent requirements on the quality of processing. For example, these techniques have a thermal effect on the workpiece, disrupt its structure in the affected area. There is also the likelihood of the modified layer in the material at a considerable depth, there is a likelihood of a grid of cracks due to the stress-strain state in the thermal strain. To eliminate the effects of the above laser and plasma cutting requires additional surgery to remove the altered layer, resulting in the loss of scarce material increases the complexity and labor-intensive process.

Benefits of the combined electrodiamond method of cutting

The most acceptable from the point of view of cost savings is the use of a scarce material combined electrodiamond cutting method, since the cutting is carried out with a thin disc with a diamond coating. The main advantages of the combined electrodiamond treatment over other types of

processing are: the ability to process the conductive material, regardless of their hardness, high precision machining, high quality machined surfaces.

At kerf the problem caused by an electrical link between an electrode tool and lateral areas channels of a cut exists a diamond disk. There is excessive not controlled removal of material of preparation from groove sidewalls that results in defects of the planes of a cut. [1].

Now for cutting hard-processing materials diamond disk tool where lateral areas of disks follow-up cover with an insulant, except surfaces with diamond grains are manufactured. Diamond grains are fixed by a conducting nickel covering. However, in processing the nickel covering comes into an electrical link to the processed preparation that leads to receiving a V-shaped groove, instead of the required P-shaped groove.

For elimination of a problem of excessive not controlled removal of metal from preparation authors of the patent No. 142793 "The device for the combined cutting of electrically conductive materials" suggest to apply follow-up on lateral and face areas of disks of a combined electrode tool the electro isolating material which thickness decreases from the periphery to the center. This offer yielded a particular positive take, but completely did not solve problem [2].

The reason in design feature of these disks as they are made of whole thin-sheet material owing to what the possibility of an electrical link between an electrode tool and sidewalls of the channel of cutting remains. Disks with such design do not allow to localize process of electric removal to dot and to carry out process on minimum gaps [1, 2].

New solution of the problem of uncontrollable removal of metal at electrodiamond processing

Authors propose in essence new solution of the problem of uncontrollable removal of metal from lateral areas of the channel of a cut. In the offered option there is no constant electrical link between an electrode tool and the processed preparation owing to what lateral areas of the channel of a cut turn out plane-parallel (patent no. 2597843 "An electrode tool for the combined kerf of electrically conductive materials").

The essence of the offer consists in manufacture an electrode tool from the composites of a carbon fiber 1 (Figure 1) located in the radial direction from the center of a circle. Carbon fibers go beyond edges of a circle and provide the current distributor. From two parties the carbon layer is covered with an organic silicon layer 2 which in the course of manufacture of a circle bakes. The face surface of a circle and a part of lateral areas are covered with a diamondiferous layer 3. Thickness of a diamondiferous layer of external lateral areas of an electrode tool makes from 0,1R to 0,2R.

The fundamental difference of our method from existing is that side etching which is present at all previous works is excluded. The electrical link between an electrode tool and the processed preparation 4 occurs in essence according to the new scheme. In the method offered by us electric current moves pointwise, on a microgap, i.e. processing on more weak modes is provided (on microcurrents). Transfer of current is carried out through nanocarbon fibers. Thus, the way of management of power transmission immediately on the processed area where there has to be a removal is found.

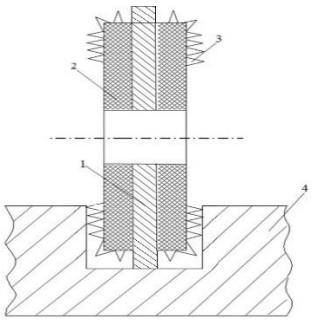

Figure 1 New electrode tool (a look in section)

Conclusions

For example, cutting a high-clear tungsten core (a tungsten falls into to a class of the hard-processing materials having high hardness and a brittleness) with a diameter of 6 mm and 120mm long on plates (tablets) with a diameter of 6 mm with a length of 1,2mm is considered. All process of kerf happens in the environment of flowing electrolyte, as electrolyte use a 15% aqueous solution of Sodium nitritum ($NaNO_3$). To the processed preparation and the rotating electrode tool give tension from a source of technological current. The rotation frequency of an electrode tool of 2800 rpm, tension 8V, diameter of a disk is 100mm, thickness is 1mm. At rotation of an electrode tool and its giving on incision in preparation processing is carried out owing to electrochemical disolution of material of preparation, electroerosive and cavitational destruction, mechanical cutting and removal of products of processing.

After cutting by this electrode tool receive the following results: not the ploskoparallelnost of lateral areas of the channel of a cut in limits of tolerance of 0,01mm, a roughness of the processed surfaces makes 0,03–0,05mm.

Thus, in a new electrode tool a parallelism of lateral areas of the channel of a cut is reached by an exception of an electrical link between an electrode tool and lateral areas of the channel of a cut. A positive take of a new electrode tool is the exception of padding operations of processing for elimination not of a parallelism of canal surfaces of a cut that excludes loss of scarce material and does not demand padding expenses [3].

References

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