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PLASMA METAL PROCESSING: PROSPECTS FOR USE IN MECHANICAL ENGINEERING

The use of plasma metal processing is a progressive area in mechanical engineering that has gained significant development in recent years. Plasma metal processing has great prospects in modern mechanical engineering due to its unique properties and wide range of applications.

The relevance of studying the plasma processing method is due to the need to improve the efficiency of metal part processing, especially those requiring high precision and minimal thermal effects.

Plasma processing is a technological method of processing in which a jet of ionized gas (plasma) is used to remove material. The main properties of plasma are high electrical conductivity, which allows the plasma to be controlled by magnetic fields; high velocity of plasma-forming particles; and high plasma temperature.

Plasma is used primarily in processes that require high-temperature concentrated heating of large areas of the workpiece material. As a result of the plasma jet's impact on the processed material, the latter is heated in the processing area, then melts and partially evaporates. The molten material is removed from the processing area by the kinetic energy of the plasma jet. Plasma processing changes the shape and dimensions of the workpiece, the structure of the processed material, or the state of its surface.

Plasma processing includes: plasma turning, isolation and gouging cutting, coating, cladding, spraying, welding, planing, rock destruction (boring), and plasma surface activation [2].

Plasma processing has such significant technological advantages as: the possibility of application for processing any metals; the cutting speed for metals of small and medium thickness is several times higher than the speed of gas-flame cutting; small and local heating of materials, which eliminates thermal deformation; high purity and quality of the cut surface; cutting process safety; and the possibility of contour cutting.

However, the plasma method of material processing also has its disadvantages, such as: the need for relatively complex, bulky equipment and higher loads than in conventional arc processing; fairly rapid electrode wear; and the need to use special gases during processing, which increases the cost of the process [1, p. 194].

Plasma metal cutting is carried out using a plasmatron. A plasmatron (plasma generator, plasma head) is a gas-discharge device for producing low-temperature plasma. Arc and high-frequency plasmatrons are the most widely used.

In arc plasmatrons, gas is heated to the required temperature by an arc electric discharge. There are two types of arc plasmatrons: 1) direct-acting plasmatrons (for creating an external plasma arc); 2) indirect-acting plasmatrons (for creating a plasma jet).

High-frequency plasmatrons include inductive, capacitive, torch plasmatrons, corona discharge plasmatrons, high-frequency corona plasmatrons, and microwave plasmatrons.

A plasmatron consists of a body with a small cylindrical arc chamber inside. The channel forming the compressed arc is located at one end of the chamber, and a welding rod is located on the other side [3].

The principle of operation of plasma cutting machines is based on melting the material due to the heat generated by the compressed plasma arc, followed by intensive removal of the melt by the plasma jet.

Arc formation between the electrode and the surface is achieved by igniting a preliminary arc between the tip and the electrode. It comes out of the plasmatron nozzle and turns into a working stream. After that, the plasma arc column completely fills the channel. The gas passes through the plasmatron chamber, heats up and increases in volume. Chemically active plasma is used to intensify metal cutting. The high productivity of plasma cutting allows it to be used in continuous production processes [4].

Thus, the study of the plasma metal cutting process is extremely important for improving material processing technologies in industrial mechanical engineering, which will help to improve product quality, reduce waste, and optimize production processes.

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