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THE PRINCIPLE OF PLASMA CUTTING TECHNOLOGY AND SIX FOLD PLASMA CUTTING

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Abstract: *Plasma cutting is very interesting and progressive technology. By cutting thermical and dynamic effects of the plasma's beam are utilize. The cut is smooth and accurate. This article presents formation of the accounts of plasma and practical its employment in industrial process and it presents new technology in plasma cutting.*
Key words: *plasma, plasma jet, plasma arc, plasma beam*

1. INTRODUCTION

Plasma is a thermally highly heated up, electrically conductive gas, which consists of positive and negative ions, electrons as well as of excited and neutral atoms and molecules. At the physics they often speak of the 4th state of aggregation [3].

As plasma gas i. e. the monatomic argon and/or the bi-atomic gases hydrogen, nitrogen, oxygen and air are used. These plasma gases ionize and dissociate by the energy of the plasma arc. By recombination of the atoms and molecules outside the nozzle-cathode-system the received energy is suddenly set free and intensifies the thermal impact of the plasma beam on the workpiece.

Fig. 1. Plasma cutting

2. THE MAIN AREAS OF THE APPLICATION PLASMAS BEAM

- application of covers with plasmas beam, for example: high quality metal and ceramic covers with thickness 0,1 mm which are steady against corrosion, temperature and wear out,
- welding, which is covering the wide area of plasma application,

- cutting and dividing the materials, for example: cutting the thin tins, cutting the aluminum plates, cutting the highest quality steels with thickness to 25 mm,
- turning with plasmas beam as of the local heating source of material, before cut of chip [2].

3. THE PRINCIPLE OF THE PLASMA CUTTING

The plasma is additionally tied up by a water-cooled nozzle. With this energy densities up to $2x10^6$ W/cm^2 inside of the plasma beam can be achieved. Because of the high temperature the plasma expands and flows with supersonic velocity speed to the workpiece (anode). Inside the plasma arc temperatures of 30 000^{o}C can arise, that realize in connection with the high kinetic energy of the plasma beam and depending on the material thickness very high cutting speeds on all electrically conductive materials.

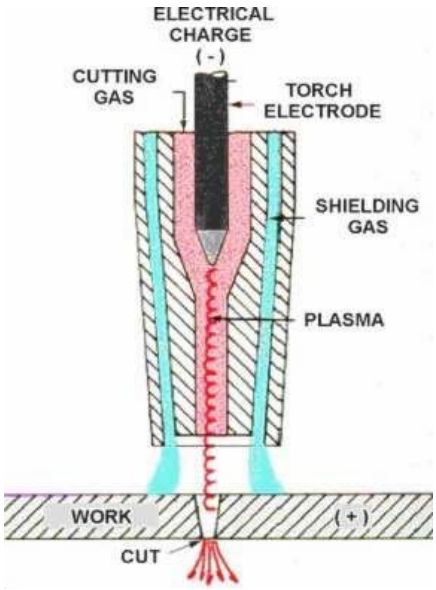

Fig.2. The principle of the plasma cutting

The term for advisable state of plasma arc is called stability of arc too. The stability of arc is keeping the plasma jet in desired form. It is possible to be provided by [4]:

- shape of plasma torch,
- streaming jet,
- water.

We must monitor these parameters:

- temperature and electrical conducting,
- density of plasma jet,
- diameter of plasma beam,
- degree of the plasma beam focusing in out put from nozzle.

For the cutting process first of all a pilot arc ignition by high voltage between nozzle and cathode takes place. This low- energy pilot arc prepares by ionization in parts the way between plasma torch and workpiece. When the pilot arc touches the workpiece (flying cutting, flying piercing), the main arc will start by an automatic increase in power [8].

4 . SIX – FOLD PLASMA CUTTING UNIT

In a cutting shop besides various other cutting operations strip cutting for trailer fabrication was requested. The 12m long plates of structural steel St-52 with a thickness range of 6.0 to 30.0mm, favourably 8.0 to 15.0mm, have to be separated in 5 stripes each. A high productive and cost saving cutting technology was required. The specification of the material was favouring the plasma cutting. The solution was found in a six- fold plasma cutting installation, consisting of six Plasma Cutting Units PA-S47CNC (forerunner of the FineFocus 450) with swirl-gas torches, installed on a profile cutting machine with a downdraft cutting table. With this configuration up to six parallel cuts can be completed in one movement. Hose parcels of a total length of 30m permit a flexible movement of the plasma torches. Special adapted ignition units ensuring a safe arc ignition. For the cutting process following gases were selected: Nitrogen for the ignition, Oxygen for the cutting process and Air for the swirl gas.

Continuous cutting up to four hours can be performed before the consumables have to be changed.

Fig. 3. Six fold plasma cutting

5. ADVANTAGES AND DISADVANTAGES OF PLASMA CUTTING

Application Oxy-fuel - Laser - Water jet - Plasma **Evaluation of quality, productivity and effectivity (1 = best technology, 4 = most unfavorable technology)**					
Requirements	**Tolerance**	**Oxy-fuel**	**Laser**	**Water jet**	**Plasma**
Mild steel < 5 mm	up ± 0,5 mm	3	2	4	1
Mild steel < 5 mm	up ± 0,1 mm	No	1	2	2
Mild steel 5 - 20 mm	up ± 0,5 mm	2	3	4	1
Mild steel 5 - 15 mm	up ± 0,2 mm	2	1	3	1
Mild steel 15 - 25 mm	up ± 0,5 mm	2	3	3	1
Mild steel 25 - 45 mm		1	No	3	1 (O_2)
Mild steel > 45 mm		1	No	2	2

High alloyed steels		No	Yes	yes	yes
Aluminium		No	(yes)	yes	yes
Plastics		No	Yes	yes	no

Table.1. Application Oxy-fuel - Laser - Water jet - Plasma technologies

6. CONCLUSION

Plasma cutting, whether conventional or precision, is a fast, economical way to produce parts. Manufacturers should first understand the process, and then determine if this or another process produces the parts more effectively.

With advantages of plasma arc, for example: high speed of cutting, cutting of all materials, the quality of cut, is this technology often utilized in mechanical engineering.

Despite of the development trends in the area of computer aided manufacturing new knowledge and methods are still upcoming into the area of progressive technologies, and thus the options of solving the topical problems are appearing in this area.

7. REFERENCES

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