POSSIBILITIES WELDING AIRCRAFT TUBULAR SPATIAL STRUCTURE OF CHROMIUM – MOLYBDENUM STEEL

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This text provides a brief overview of the methods used for welding, which are used for welding tubular structures of chrome - molybdenum steel, which method is most common in aviation in the production of these structures. The text also contains methods that are typically used in domestic production structures. Each method has different effects on different base material is therefore necessary to have knowledge about different methods of welding.

K e y w o r d s: construction, welding, steel, aviation, chromium – molybdenum

1 INTRODUCTION

Welded tubular steel construction of the previously used in the construction of aircraft. Although the welding of steels used for a long time, with the development of aviation and welding techniques, this problem becomes topical in today. In aviation aircraft is the construction placed great emphasis on whether the choice of material which will be made this construction, welding, or the way these structures. This article therefore contains the possibility of welding of chrome - molybdenum tubular structures. Each welding method has its advantages and disadvantages, so it is necessary to describe the various welding methods, what are the disadvantages of these structures by welding. Some methods are suitable for welding of pipes of steel and some are difficult, as the operation of welding equipment in the manufacture or construction of rather expensive. Therefore, it should be every welder who wants to weld these chrome - molybdenum steel with a familiar practice in the welding and which can cause ill-chosen procedure for welding of steel and how we should proceed in the welding, the weld quality was produced.

2 METHODS OF WELDING TUBULAR CHROMIUM - MOLYBDENUM STRUCTURES

2.1 Electron beam welding

Electron beam welding (Fig.1), welding or electron is part of the melting method of aggregation, in which the source of energy needed to melt bonded components at the contact of the kinetic energy of electrons at the point of impact on the solid is converted into heat. The application of electron optics makes it possible to focus in this way a high performance in a small volume of material. This brings a number of options, otherwise the laser heating except unattainable. [1]

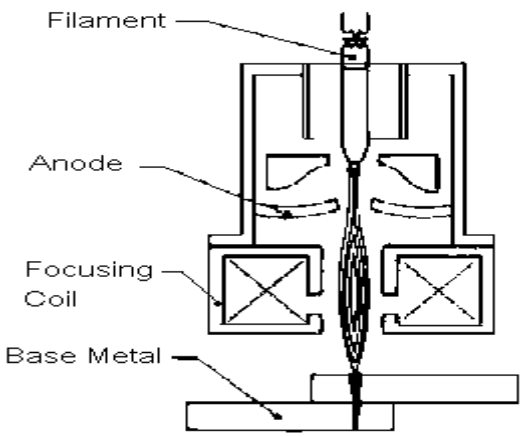

Fig. 1 Electron beam welding

2.2 Plasma welding

Plasma welding (Fig. 2) is one of the modern, highly productive method of arc welding in protective atmosphere. It is characterized by very high energy density and high temperature. Plasma Welding (PAW - Plasma Arc Welding) is a method that is very similar to TIG welding. This method was the development and TIG method ensures higher productivity during welding. Welding uses plasma concentration of heat and dynamic effects of the plasma, resulting in a narrowing of the arc that forms between the tungsten electrode and welding. Plasma gas, which

flows between the electrode and the arc due to heat rapidly expands, changes in plasma flow and hole at high speed. [4]

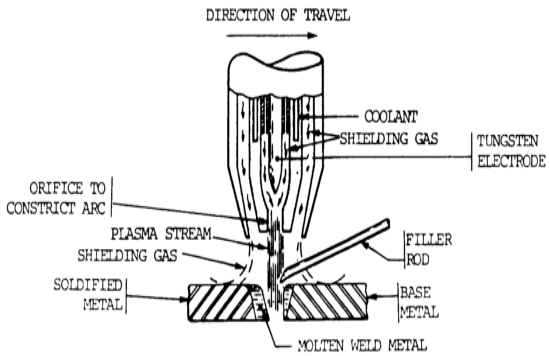

Fig. 2 Plasma welding

2.3 Laser welding

In fusion welding is to create joint very important that the minimum energy input. What is the energy entering below the lower seam is subject to distortions. The laser is capable of delivering an entrant in a very energy intensity focused form, which will create narrow and deep welds with minimum temperature influencing zone (Fig. 3). Because the volume of molten steel is very small, it can work well for larger thicknesses without additional material. Gases can emit coherent radiation when contained in an optical resonant cavity. Gas lasers can be operated continuously but originally only at low levels of power. Later developments allowed the gases in the laser to be cooled so that it could be operated continuously at higher power outputs. The gas lasers are pumped by high radio frequency generators which raise the gas atoms to sufficiently high energy level to cause lasing. Currently, 2000-watt carbon dioxide laser systems are in use. Higher powered systems are also being used for experimental and developmental work. A 6-kw laser is being used for automotive welding applications and a 10-kw laser has been built for research purposes. There are other types of lasers; however, the continuous carbon dioxide laser now available with 100 watts to 10 kw of power seems the most promising for metalworking applications. [5]

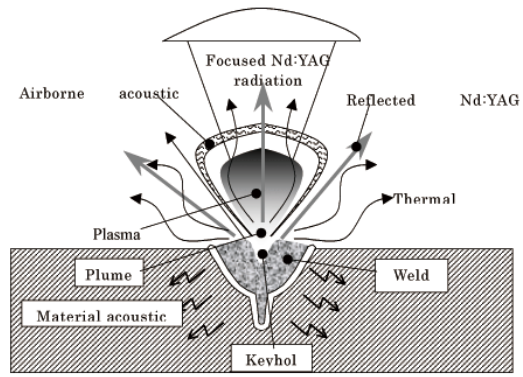

Fig. 3 Laser welding

2.4 MIG/MAG welding

MIG welding, Gas metal arc welding (GMAW) is an electric arc welding process which joins metals by heating them with an arc established between a continuous filler metal (consumable) electrode and the work (Fig. 4). Shielding of the arc and molten weld pool is obtained entirely from an externally supplied gas or gas mixture. The process is sometimes referred to as MIG or CO2 welding. Recent development in the process include operation at low current densities and pulsed direct current, application to a broader range of materials, and the use of reactive gases, particularly CO2, or gas mixtures. This latter development has led to the formal acceptance of the term gas metal arc welding (GMAW) for the process because both inert and reactive gases are used. The term MIG welding is still more commonly used. [6]

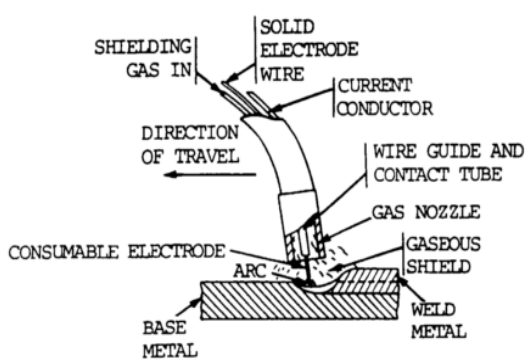

Fig. 4 MIG/MAG welding

2.5 TIG welding

Gas tungsten arc welding is a process in which the joining of metals is produced by heating therewith an arc between a tungsten (non-consumable) electrode and the work (Fig. 5). A shielding gas is used, normally argon. Normally done with a pure tungsten or tungsten alloy rod, but multiple electrodes are sometimes used. The heated weld zone, molten metal, and tungsten electrode are shielded from the atmosphere by a covering of inert gas fed through the electrode holder. Filler metal may or may not be added. A weld is made by applying the arc so that the touching workpiece and filler metal are melted and joined as the weld metal solidifies. This process is similar to other arc welding processes in that the heat is generated by an arc between a non-consumable electrode and the workpiece, but the equipment and electrode type distinguish it from other arc welding processes. [2]

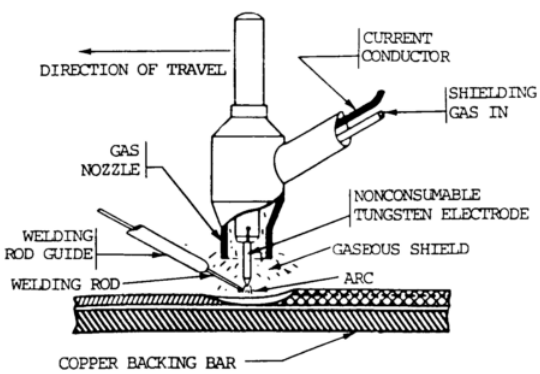

Fig. 5 TIG welding

3 COMPARISON OF METHODS FOR AIRCRAFT WELDING TUBULAR STRUCTURES OF CHROMIUM – MOLYBDENUM STEEL

Today, chrome - molybdenum steel welded by different methods, such as shielded welding consumable electrode MIG, non-consumable electrode welding in protective atmosphere of inert gas TIG, plasma welding, laser welding or electron beam welding.

In the past, chrome - molybdenum steel welding exclusively flame, but the emergence of new technologies is nowadays the welded steel and other methods. New methods make better weld joint design possibilities. Joints are better have better mechanical properties. All methods have their advantages and disadvantages.

Plasma welding is used in the aviation very often, one of the modern, highly productive method of arc welding in protective atmosphere. This method is similar to TIG. Plasma welding is characterized by very high energy density and high temperature. This method of welding the welding one great advantage, which is less thermally, affected area. Therefore, this method is suitable for welding chromium - molybdenum steels, because they do not like steel and heat, this method produces a small heat-affected area. Another advantage of the welding of aircraft structures is that this method has a high rate compared to TIG welding it is quite important in manufacturing because it actually increases productivity. When welding chrome - molybdenum steel construction TIG or MIG method is very important treatment of welded surfaces in welding, plasma welding has the advantage that it is not so difficult to weld surface treatment that also saves time. Plasma welding has excellent weld quality, so this method is used in aircraft and very popular. The disadvantage of welding is the high cost of equipment compared to the TIG or MIG welder but also must be better qualified.

Laser welding is also a new technology that is in the aviation began using recently. This method can weld most materials that are weldable by conventional methods, they can be welded and the laser, this method is often faster to weld appearance with better results. A very big advantage in that the welding, and plasma welding produces a small heat-affected area of the weld, so it is suitable for welding chromium - molybdenum steels that do not like the heat and the best is when these steels are used in the method which least affects the thermal material welding. Laser welding is also another great advantage that ensures high productivity and process control. The advantage of laser welding is that a sufficient working distance allows a focused beam, and to otherwise inaccessible areas where we are with other methods is difficult to get, or can be welded in a transparent environment This unit also has several disadvantages such as that before any welding, the weld must be space worked very well

when welding without filler metal during welding with additional material such places can be a bit more variation. The disadvantage is the same as for plasma welding the welder must be better qualified, and these devices are also much more expensive than equipment for MIG or TIG welding, but are less expensive than equipment for laser welding and electron. As with laser welding and plasma welding method is a method of electron beam similar benefits, which are very important when welding in aviation. Therefore, this method often used for welding in aviation technology, whether for repair of damaged welds or for the manufacture of various components and special materials. Chromium - Molybdenum welded structures by this method are also small heat-affected zone to favorably impact on the quality of these structures. Automation of welding also accelerate and improve the welding process. In this method, weld done in a vacuum, which protects the weld from air atmosphere, but also has the disadvantage that you need to create a vacuum if the vacuum chambers are needed to this more expensive method of welding. Only in some cases, the antics beam into the atmosphere, where it is welded according to the type of material or in inert or active gases. High demands are placed on clean weld surface, but also the entire surface of the material. The very fine layers of dirt, especially the organic nature of the material surface adsorbed gases under high vacuum released from material and contaminate the vacuum worse vacuum chamber and a vacuum system. The disadvantage is the relatively high investment costs for welding equipment, and today these devices are quite expensive, so that welding is used only in larger companies for the manufacture of aircraft and aviation equipment.

TIG and MIG method is very similar, the difference between them is that the TIG welding arc burns between the electrode no melting, typically tungsten and MIG welding arc burns between the additional metal and base material. The advantage of these methods is that they can be automated and thus accelerate and improve the production of such structures. Most used for welding chromium - molybdenum structures are TIG. This method can also be used in forced positions, such as welding pipes. TIG method has the advantage over the MIG welding for example at the start of chrome - molybdenum tube, we can weld pre-heat and add the additional material which ensures a better quality weld rather than the MIG method that will achieve as additional material to weld automatically added. These methods generate more heat-affected area, as in laser welding, plasma welding or electron beam. When MIG welding method for welding chromium - molybdenum tube, the weld joint preheated to a temperature in the TIG welding does not, but to improve the weld should be. In addition, facilities for TIG welding are smaller and lighter, so take up less space in the workplace and allows the welder to move better. They also have much more power efficient than older systems. In the aviation quality requirements and increasingly stringent standards for the safety and reliability, TIG inverters presented compelling arguments for those who perform welding and repair of aircraft. Another advantage is that these devices are much cheaper than other methods of welding.

Each method has its advantages and disadvantages, so the choice of method of welding CrMo tubular structures rather complicated, we must also take into account operating costs and the cost of the equipment. Some devices are very expensive for the small business would be uneconomical to buy such equipment, it would be overcharge price of the product. Nowadays, however with the development of techniques to reduce the prices of these devices, so what can sometimes be very costly nowadays is so expensive. Some welding methods are less expensive and are suitable for welding of aircraft structures, so it should be stressed that the selection of welding technology is up to the company that will produce those structures, because each company has different requirements and financial possibilities.

4 COMPARISON OF STEEL AND TITANIUM CONSTRCTIONS

The manufacture of aircraft structures are used, in addition to chrome - molybdenum steel, various other materials, the most used is titanium and aluminum. Titan is very prone to damage, which means that even small scratches may result in significantly reducing the resistance of the material. Even a small scratch can cause the

application of the load when it will distribute up to catastrophic damage can occur overall structural damage. Welds must be perfect, because it has a small error in the weld can cause the joint influence of the crack load. Therefore, the welding and the structure must have a welder necessary skill, but also the necessary knowledge of welding these alloys. Solid titanium rods are used for trucks. In this application, saving a few pounds, but the disadvantage is that the large costs of material and its treatment in comparison of chrome - molybdenum steel. One major disadvantage of steel is that they have greater weight than that of titanium and they are less resistant to weathering and corrosion. In short, titanium is about 45 percent lighter than steel, about 60 percent heavier than aluminum and more than three times stronger than aluminum alloys. While the production and processing of titanium is initially expensive, titanium reduces lifecycle costs, thanks to its long life and reduced costs for maintenance and repairs. Titanium belongs to the so-called reactive metals, which means that they have a strong affinity for oxygen. At room temperature, titanium reacts with oxygen to form titanium dioxide. This durable surface resists further interaction with the surrounding atmosphere, and it gives the corrosion resistance of titanium. Oxide layer must be removed prior to welding, because it melts at a much higher temperature than the base metal and because of this, the oxide can be added to the molten weld parts, create discontinuities and reduce the integrity of the weld.

5 CONCLUSION

This article is processed all the methods used in the welding of these steels, such as laser beam welding, plasma, electron beam, MIG / MAG arc welding, or TIG welding non-melting electrode in inert gas atmosphere. With the development of techniques and methods of welding these steels develop, therefore it is necessary to know all the possibilities of welding and the advantages and disadvantages of each method of welding. For example, plasma, electron and laser welding, there is the least affected by temperature range, but the disadvantage is that installation of these methods are very expensive. Methods such as TIG and MIG are widely used in domestic welding chromium - molybdenum tubular structures, because the equipment is less expensive than laser welding or electron beam. These methods are, but know how important and errors that may arise due to improper welding procedure.

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