ASPECTS REGARDING THE CONTINUOUS CURRENT SUPPLY OF PRESSURE WELDING MACHINES

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***Abstract**. In the paper there are presents the most important aspects of pressure welding with continuous current and his production modes at pressure (electrical) welding machines. It is spotlight the welding with medium and high frequency, because her advantages: no off-time, thus eliminating the problems caused by cycling, as well as doubling the efficiency of the heat put into parts because it has no inductive losses, there is no off time or charge time needed between weld as in the capacitor discharge type, and because of the speed and accuracy to its' feedback system, it provides precise current wave form control.*

1. GENERAL ASPECTS

From actual and applied welding proceedings in entire world, a noting weight it has the electrical pressure welding through the belong proceeding respectively spot, seam, projection and butt welding and the most used is the spot pressure welding with his application at body car welding where it's realized about 5000-6000 welds for a single vehicle.

The main role to the development of pressure welding has the welding current, corroborate with apply of a pressure before and after of current apply. Beside, the current can perform a role to the thermal treatment of weld, that for improvement of joints quality.

The welding current is discharging by the power current supply. These has the role for the convert the alternative current form the industrial supply network (220-380 V and 50 (60) Hz) in current with reduced voltage (5-30 Volt) and high intensity (0,5-30 kA or even more).

The production mode of the current at pressure welding is very varied. The power supply can be a static AC welding transformer, a low frequency power supply, a continuous or redressed current power supply, a high frequency power supply, a capacitor bank.

There are presenting the most important aspects of the pressure welding with continuous current and his production mode at pressure (electrical) welding machines.

2. PRODUCTION OF CONTINOUS CURRENT AT PRESSURE WELDING

We are referring to the different types of current which are used at welding, always we are referring to the current which are arriving at welding electrodes, which will being correctly modified from the same machine for adjust to the wished caterings.

Most resistance welds are normally done with AC power supplies. These power supplies allow higher line voltage to be passed through a transformer. The transformer changes the high voltages and low currents into high currents and low voltages. Line voltages typically can vary from 3 to 30 percent. These line voltage fluctuations are amplified through the welding transformer. Thus, the welding currents that are generated can vary as much as 20 to 30 percent. This can result in poor welding conditions, especially when welding small thin parts.

Lately, it has used more frequent the welding with continuous current. For his production at pressure welding machines there are used the next modes:

Continuous current discharged by mono-phase adjustment (figure 1) with the diodes.

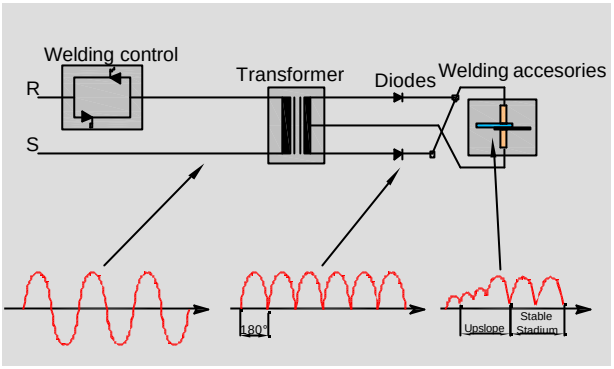

Figure 1 Continuous current by mono-phase adjustment

There is used at certain types of suspended guns and small static machines, but with reduce distribution because the advantages, the inconvenients and the price aren't present too convenient rapport, comparative with the others solutions.

Continuous current discharged by hex-phase adjustment (figure 2) with the diodes from the hex-phase output of three transformers connected at tree-phase network.

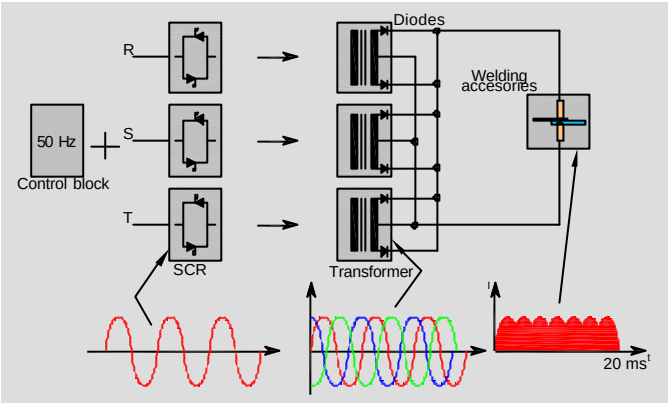

Figure 2 Continuous current by hex-phase adjustment

There is used at presses and static machines with high powers about 100 kVA are suspended guns without integrated transformers. There allow the attainment of high welding intensities with an equilibrated consumption on the three phase of the network, welding quality and electrodes lives are better. There is having an inconvenient: the price is high.

Continuous current discharged by the adjustment of alternative current at frequency of twenty times or more superior than the network: the proceeding which uses this type of current is named „medium frequency" or „inverter".

There is obtained trough a transformer output adjustment, alimented by an electronic equipment which multiplying the frequency, connected to the current network.

Because of high frequency of the current, which is rectified, the continuous current crimp is practically zero and there aren't oscillations in the energy contribution, which is an important advantage for the electrodes and the process of development of the nucleus. There is offering many advantages and lately there is very used with very good results to the aluminum welding and very advantageous to the galvanized materials. There is having also the big inconvenient, the price very high.

Continuous current checked after adjustment: the current is discharged with a hex-phase conventional rectifier and it is controlled in the welding circuit through a transistors; it can't use SCR electronics contactors which are capable for the alternative current control (figure 3).

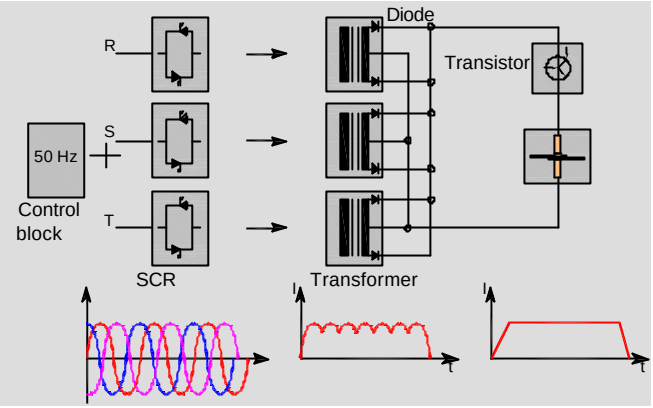

Figure 3 Power supply current with his control after adjustment

The upslope or the time which is passing until the efficient value is practically zero, inferior comparative with another systems, being possible the welding in very short time periods, until 1 m/s. Inconvenients: the actual technology is limiting the controllable intensity of the transistors and for very short times at intensities about 3000 A. Utilization: at micro-wedging machines. Because the welding current can be controlled quickly and precisely, it is possible to control expulsion and provide super-precision welding. This feature works very well to make welding by extra small wires like a filament of electric bulb and high resistance materials like molybdenum and tungsten.

Beside these, it can be exemplify the production mode by discharge of capacitors bank.

An electronic system is charging a capacitors bank to the adjustable necessary voltage for production of necessary energy at welding. The brusque discharge is producing a unique impulse with high energy and very short time (couple milliseconds) (figure 4).

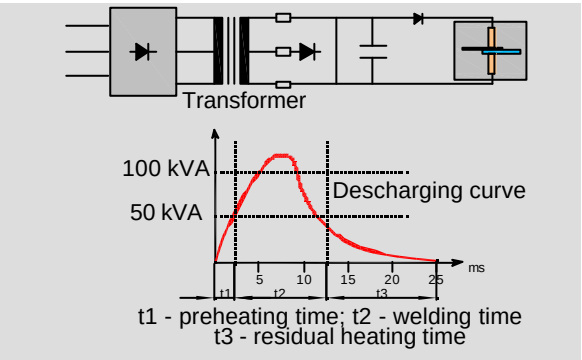

Figure 4 Power supply with capacitors bank

They are suitable for welding materials with high thermal conductivity like aluminum and copper. Because the system stores the energy in the capacitors, it does not require a big capacity for the primary power source. On the other hand, the current rise is very steep and can not be controlled, and it may cause an expulsion. In this case, higher squeeze force must be applied. Also, Peltier effect which must be controlled somehow because it is direct current. Like inconvenient it can be specified the big price and the small productivity.

Between all these production modes of electrical welding current for pressure welding machines it is spotlighting the medium and high fervency welding or welding with inverter power supply.

3. PRESSURE WELDING WITH MEDIUM AND HIGH FREQUENCY CURRENT

DC high frequency welding offers many advantages over both the AC and Capacitor Discharge type welders. It has the advantage over AC of no off-time, thus eliminating the problems caused by cycling, as well as doubling the efficiency of the heat put into parts because it has no inductive losses. It is at a higher frequency, thus the size and weight of the welding transformer can be smaller and lighter. There is no off time or charge time needed between weld as in the capacitor discharge type, and because of the speed and accuracy to it's' feedback system, it provides precise current wave form control. The accuracy and speed at which feedback can be used is one of its' greatest advantages.

Three tremens must be explained to high frequency welding: feedback, gain and rise time.

Feedback is a term used to describe a controls ability to start welding current flowing

Gain is the feedback response speed of the control for Constant Current, Constant Voltage, and Constant Power control.

Rise time is very similar to Upslope on most AC controls. It is used to "soften" a weld. The longer the rise time, the longer it takes the control to bring the current level up to the set value.

Gain and rise allow for the fine tuning of the Inverter Power Supply. These two functions, in conjunction with the fast feedback response of the control, can be used to find the actual time-temperature curve that allows the heat to be put into the pieces to be welded at exactly the correct current and time to achieve clean, splash free welds, especially in small thinner parts.

Current control for inverter power supply: the rectified current is controlled by two tiristors until two thousand many times per second. The AC current to 2 kHz is amplified by the welding transformer, rectified by the diodes and it is sending by the welding electrodes to the welding parts. (fig. 5).

Actually, it is more blocks which it accomplish the recovery and the current supply (fig. 5).

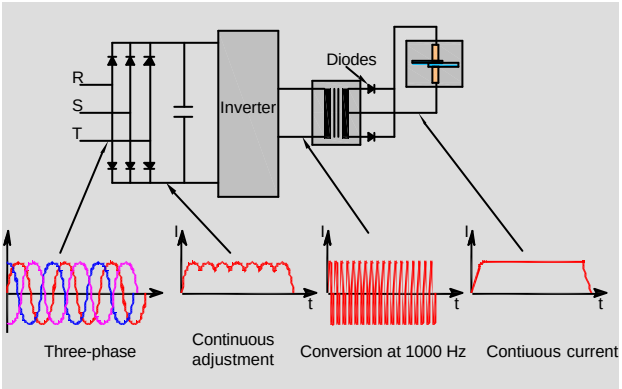

Figure 5 Inverter power supply

The first block is the AC power source. It follows the first adjustment with a continue voltage bridge with only positive pulses. The third stage it the filtering through the

capacitors. These don't have the function to charge themselves like welding by discharge of capacitors, al though a certain quantity stocks.

It is following the control process through the IGBT (Integrated Gate Bipolar Transistors), which generate positive and negative pulses. The followed wave is called "Bipolar square wave", the IGBT working to a certain frequency (usually 400, 600, 800, 1000. 2000 or 4000 de Hz).

It is following the transformer, which come down the voltage and enhance the current intensity. In the transformer, it is the second recovery block, again just to the positive pulses, issuing the continuous welding current.

These power supplies provide efficient and continuous heat generation because its current does not include a cool (zero current) time like as AC current does. With this feature, it is possible to make welding in very short time, control the heat affected deformation in minimum and reduce the electric power consumption. Because of high-speed feedback control system by inverter this power supply can control expulsion in minimum and maintain reliable welding quality and is suitable for super-precision welding. Also, with small inverter welding transformer, it is easy to install the power supply to automatic welding systems.

Inverter welding power supplies provide some benefits in comparison with other type of power supplies, which result from the restrictions of this proceeding. AC welding needs high time for heating, it offer small control on the proceeding, and without feedback it can't adapting to the dynamic resistance of the part during the welding. The welding with inverter power supplies needs a short time for heating, precise control of the time and current, better quality and small costs. The major benefits are as follows:

- precise control of welding;
- the rise of the accuracy of the force and current;
- the rise of life time of electrodes;
- reduced current consumptions;
- minimized expulsions and reliable welding; depending on the materials and shape of the work piece, welding time and current rise time can be adjusted properly and precisely. Therefore, it is possible to set the best welding condition to control expulsion.
- easy to install with smaller and lighter welding transformers; in comparison with other type of welding transformers, inverter welding transformers can be designed in smaller dimensions.

Owing to welding current, which has the principal role to the electrical pressure welding, the performances depend directly of the current wave. A comparison between the current wave forms is presented in the figure 6.

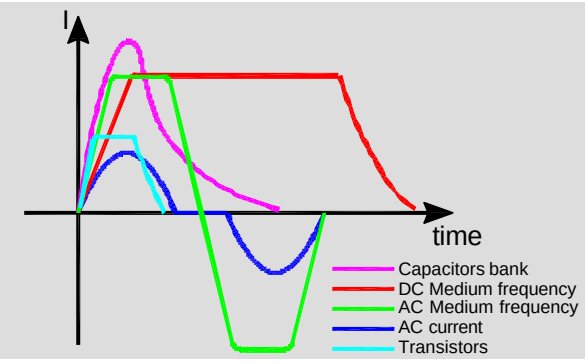

Figure 6 Comparison between the current wave forms for the resistance power supplies

4. CONCLUSIONS

- to compensate the negative effects of AC welding, was developed continuous power supplies; the production modes of current welding pressure welding is very varied, the principals modes being presented at paragraph 2;
- a special category and which is more utilized is the medium and high frequency transformers;
- these have the advantage over AC of no off-time, thus eliminating the problems caused by cycling, as well as doubling the efficiency of the heat put into parts because it has no inductive losses. It is at a higher frequency, thus the size and weight of the welding transformer can be smaller and lighter. There is no off time or charge time needed between weld as in the capacitor discharge type, and because of the speed and accuracy to it's' feedback system, it provides precise current wave form control. The accuracy and speed at which feedback can be used is one of its' greatest advantages;
- because of high-speed feedback control system by inverter this power supply can control expulsion in minimum and maintain reliable welding quality and is suitable for super-precision welding;
- the welding with inverter power supplies was founding an extended applicability at materials with high conductivity (Al, Cu) and precious materials (Au, Ag).

BIBLIOGRAPHY

[1] Claude Drouart – Soudage par resistance, Publicationa du Soudage et de ses Applications, Franta
[2] Francisco Abad Gomez, Jose Maria Bisbe Fabregas – Manual Abad-Bisbe para la Soldadura por Resistancia – Manual Abad-Bisbe, www.soldaduraporpuntos.com
[3] Iovanas,R.,s.a.– Sudarea prin presiune în puncte, Editura LuxLibris Brasov,1995
[4] Iovanas, R., s.a. – Echipamente pentru sudare în puncte, Editura LuxLibris, Brasov, 1999
[5] Iovanas, R. – Sudarea electrica prin presiune, Editura Sudura Timisoara, 2005
[6] * * * - Publicatii si prospecte ale unor firme de specialitate
[7] Site-uri ale firmelor de specialitate: MIYACHI CORP - <http://www.miyachi1.com/>, TRAFOFLUID - <http://www.trafofluid.it/>, MIYACHI - http://www.miyachi-gr.co.jp/e/indexe.html