

## **NEW WELDING EQUIPMENT TECHNIQUES BY INVERTER POWER SOURCES FOR IMPROVEMENT OF WELDING PRODUCTIVITY & QUALITY**

**G. Viswanathan**

**Product Specialist (Equipment,) Advani Oerlikon Ltd., Madras**

In all welding industry the demands put on welding arc constantly growing and there are two specific directions for demands; Increase in productivity of work and improvement of quality.

This has necessitated, in the recent years a very, rapid development in the field of welding, power sources, automation and robotics.

The new generation of inverter power sources are an ideal for the above needs, because of the inherent advantages of very high speed of response, excellent adaptability to various welding processes, good power to weight ratio and phenomenal compactness. These machines also provide an energy efficient operation by cutting down substantially on the losses in the welding power source. Apart from all the excellent attributes the inverter power source has come to stay because of its high reliability and also its suitability to all welding processes.

### **INTRODUCTION**

Traditional welding power source designs are usually based on main transformers or transformers-rectifiers with electro-magnetic output control. This approach produces robust, low cost of units which have proved to be acceptable for a wide range of manual and semiautomatic welding operations. The limitations of this design approach are susceptibility to line voltage variations, slow response rate (e.g. for pulsed operation) and the possibilities of continuous output variation and remote control are restricted. These limitations tend to restrict the usefulness of these designs, particularly for automation or when more sophisticated control techniques are required.

Thyristorised controlled welding power source designs has been developed to overcome these problems. Although they overcome many of above mentioned limitations, their speed of response is limited by the supply frequency and amount of smooth-

ing as thyristorised power sources produced higher ripple which can only be limited by use of smoothing inductor. These equipments although are lighter than traditional equipments, are still bulky and heavy to be carried & are not portable. The most essential limitation is handling of electric power at main frequency (50 Hz / 60 Hz). As the size and weight of the transformer and choke is inversely proportional to the frequency of operation, the size of power source is large. The problem due to these limitations can be removed with the help of frequency converting techniques i.e. operating transformer, chokes at a higher frequency which will give a faster response of operation and a light weight power source. These kind of power sources are called inverter controlled power sources.

### **Principle of operation**

The main AC voltage with a frequency of 50/60Hz is rectified by means of diode bridge rectifier

and smoothed with the help of filter capacitor "C". This rectified DC voltage is inverted with the help of inverter, the output of which is a high frequency, pulsating signal. The high frequency signal is then fed to a primary of a step down transformer. The low voltage high frequency signal at the secondary of the step down transformer is then rectified by a rectifier. The rectified signal is then filtered through a filter choke & the resultant signal is available at the output of inverter power source.

The size of the transformer and choke is dependent on frequency of operation. The thyristor controlled inverters are capable of operating at a frequency of 5 KHz whereas transistor controlled inverters are capable of operating at a frequency of 20 KHz. On account of this high frequency signal, the weight and volume of transformer and choke in an inverter power source are considerably less than that of conventional power sources.

The control circuit measures the output voltage / current signal, compares the same with the set value (Reference value) and provides an error signal which is then fed to the inverter control circuit so as to keep the desired voltage / current close to the set value.

### **Salient Features of the Inverter**

In addition to giving all the advantages of an electronically controlled welding power source, the welding inverter has an edge over this power source as described below :

#### **□ Good and Versatile Characteristics**

In the conventional power source the arc characteristics are mainly dependent on the characteristics of main circuit components i.e. transformer and choke, In the inverter power sources, due to very high adjustment speed (100 - 400 times that of conventional power source) the arc characteristics are controlled electronically. Here the static and dynamic characteristics required for different welding power processes can be achieved in reality with the same power source.

#### **□ Complete Controllability**

The welding inverter is completely controllable e.g. stepless current adjustment from minimum current as low as 5 Amps to the maximum current in one single range in CC mode and the voltage adjustment from min. Voltage i.e. 14 volts to the maximum voltage in one single range in CP mode.

It is possible to control both those from front panel of the power sources and remote control devices. The control voltage is generally standardised as 0-10V which makes it easy to connect this power source to a robot or an automat.

#### **□ Energy Saving**

Reduced no-load power consumption, very high power factor (generally above 0.9), high operating efficiency (above 85%) and the power consumption is smaller than that of conventional power source.

#### **□ Portability**

The size and weight of the welding inverter is small because of reduction in size and weight of magnetic components. This makes the welding inverter portable.

### **Applications of inverter power source portable welding equipment :**

Due to extreme low volume and weight phenomenon of inverter power sources, portable welding machines for DC MMA/TIG/PULSE TIG welding applications are made available in the market, typical application areas being repair and maintenance welding at shipyards, power plants, chemical plants, fertilizer plants, railways, pipelines & project sites. The fact that the inverter, Portable power sources are available to operate with 230V - single phase & 415V - Three phase input supply voltage, makes them useful anywhere. Due to the fact switching capability of semiconductor

power components, TIG welding pulse cycle time can be as low as 20 milliseconds, for thin sheet welding.

### **Square Wave AC Equipment**

The inverter power source makes easy to choose optimal welding parameters in AC square wave welding from the front panel or by the remote control unit.

The wave from balance control adjusts the width of the positive or negative component of the square wave without changing the current amplitude or frequency, allowing the welder to control weld penetration and the cleaning action of the arc.

### **Synergic Pulse - MIG Equipment**

In the last few years the share of MIG welding has grown considerably on cost of MMA welding. However, in industry there are still many objects which are not welded with MIG due to quality demands but with MMA or TIG, though the productivity of MIG can be clearly seen, especially when stainless steel & aluminium arc as construction materials. The inverter based equipments will still accelerate the move from the MMA & TIG welding to the more productive MIG welding.

The synergic pulse MIG process demands fast response and stepless control range of the power source that the short pulses & stepless frequency control (output frequency of 35 - 350Hz) for precise droplet transfer.

This can be realised easily with inverter power sources. In the synergic control the pulsing of power source is controlled by pre-programming according to the wire feed speed. Thus the amount of the adjustments, done by the welder is considerably reduced. In principle the welder has to use only one control knob, with which he selects the desired current level. The dependence of the pulse values on the wire feed speed with various wire materials and diameters can be pre programmed to the inverter power sources & the operator just tells the equipment which material he will be welding and the equipment will select the optimal pulse parameters.

**Welding Technical Advantages of Synergic Pulse MIG**

- The pulse - MIG is a considerably more productive method than MMA and TIG welding.
- In the certain region more productive than normal MIG welding. e.g. with aluminium A 20% higher output.
- Welding Arc, which is spatter free.
- Excellent characteristics for positional welding with thin and thick materials.
  - It is easy to get a weld which is free from faults (Porosity lack of fusion).
- Smooth shape of the bead.
- It is easy to join thin and thick

material.

Typical welding current ranges which can be reached with the synergic pulse - MIG equipment are given below :

Due to the extreme versatility of inverter power source, universal MMA/TIG/MIG power sources are made available in the market. With this a quite new welding

**It increases the productivity of work**

For the improvement of the productivity of work it is possible to select in the MULTISYSTEM the most productive method and most effective equipment for each welding job. The MULTISYSTEM increases the effective working time due to its complete remote control system, possibility of pre-

ALUMINIUM			
WIRE DIAMETER MM	MIN. AVERAGE CURRENT AMPS.	MIN. PLATE THICKNESS MM	MAX. AVERAGE CURRENT AMPS.
1.0	35	1.0	305
1.2	40	1.0	360
1.6	45	1.0	435
STAINLESS STEEL			
1.0	45	1.0	300
1.2	50	1.0	360
1.6	65	1.5	500
STEEL			
1.0	50	0.75	320
1.2	55	0.75	430
1.6	95	1.5	500

equipment thinking has been enabled, this is called as "THE SYSTEM THINKING" where the multi purpose power source is the core of the system. The power source as it is can be used as a MMA power source. When connected to TIG Control units it can be used as a TIG welding system and when connected to wire feeder as a CO<sub>2</sub> /MIG welding system.

**This "MULTISYSTEM" gives following advantages :**

programming mobility and ergonomic construction.

**It Improves the Quality of Welding Work**

The quality of welding work improves, because due to better controllability, the welding characteristics are better. Due to the remote control the amount of welding defects will be small and the quality costs will be lower. In the same way, it is possible to select the qualitative best method for each welding purpose.

### **It reduces the Investment Costs Today and in the Future**

The investment costs can be reduced with the multi-purpose equipment, because the total amount of machines of the company will be smaller. The lower power consumption reduces the installation costs and saves the energy. The small size and the light weight enable ergonomic arrangements in the planning of working place. Also the floor space can be used more effectively. The Multisystem reduces the investments of the future, because the system can be easily modified and completed to meet the welding requirements of time. In addition MULTISYSTEM reduces the amount of different types of machines & thus the need of spare parts will be smaller & the service easier.

### **It is ready for Mechanised and Robot Welding**

The MULTISYSTEM is ready for mechanised and robot welding. The standardised control system makes the communication with all kinds of computer controls pos-

sible. The welding parameters can be adjusted with the control device of the robot. Correspondingly the multisystem is able to give the control information about the welding processes to the robot. Due to small space requirements the MULTISYSTEM equipment is easy to place with the automate or robot.

### **It reduces the Transport and Transfer Costs**

The small size and light weight of the MULTISYSTEM reduce decisively the transport costs, if the welding equipment needs a lot of transporting.

### **Future**

After the development of semi-conductor technology, the development of welding power sources has been rather rapid & the same development seems to continue further. At the moment it seems that the welding power source of the future is the inverter. The weight & size will still reduce to some extent, though there won't probably be such big change as it happened from the conventional

power sources to the inverters of today. The most important improvements will take place in the system techniques of welding, where the good controllability and feasibility of the power source will be of great importance.

### **Indian Scenario**

In Europe and America the inverter is more economical than conventional electronically controlled power sources owing to the reduction in the material content of the power sources. However, the production and development of the inverter power source has yet to be commenced in India due to the constraint in the availability of the semi-conductor devices and the core laminations for the transformer and choke. The import of these components entails a large quantum of customs tariff making the inverter economically unviable in comparison with the existing power sources. However, with the liberalised regime it is hoped that a further reduction in duties would definitely spur the development of these power sources in India also.

## **ISPATH TEST HOUSE**

142, New Okhla Industrial Complex, Phase - I, New Delhi - 110 020

Phone : (O) 681 6584 (11 am to 3 pm) (R) 752 9031 (24 Hours)

**Dealing in  
ALL N.D.T. JOBS & CROSS COUNTRY PIPE LINE CONSULTANCY**