



## Design and Fabrication of Portable spot-welding machine for sheet metal operation

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### ABSTRACT

Spot welding machine requires a lot of power, occupies large area and it is heavy to transport, restricted by height and does not weld all angle. On present work, we have tried to overcome the above problems by restructuring the design. Newly designed apparatus was simpler, lighter, portable, compact and flexible machine which will be able to weld at any angle and can be easily operated by even a non-skilled Labor with much ease and required accuracy. The first thing is the fabrication of the portable spot-welding machine which is divided into two phases, first is the formation of basic circuit of machine which includes small transformer of 1.2 kVA with output voltage 0 to 2.2 volt with 2.5-gauge wire & power switch and second is the formation of body and arm mechanism of the machine. For creating this machine, we used modelling software such as Autodesk Fusion 360 and created a prototype based on its design. In this project we made our own transformer according to requirements of specifications for welding as a general transformer used in electronic appliances was costly and as well a Bulky.

**Key words :** Welding, Spot-welding, Resistance Welding, Welding machine.

### 1. INTRODUCTION

Resistance welding is one of the oldest of the electric welding processes in use by industry today. The weld is made by a combination of heat, pressure and time. As the name resistance welding implies, it is the resistance of the material to welded, to current flow that causes a localized heating in the part. The pressure exerted by the tongs and electrode tips, through which the current flows, holds the parts to be welded in intimate contact before, during and after the welding current time cycle. The required amount of time current flows in the joints is determined by material thickness and types, the amount of the current flowing and the cross-sectional area of the welding tip contact surface. Resistance spot welding is

accomplished when current is caused to flow through the electrode tips and the separate pieces of metal to be joined. The resistance of the base metal to electric current flow causes localized heating in the joint and the weld is made. The resistance spot weld nugget is unique because the actual weld nugget is formed internally with relation to the surface of the base metal.

#### 1.1 Working Principle

The principle of the portable spot-welding machine is same as the conventional spot-welding machine I.e. “When the low voltage and the high ampere current is passed over the two thin metal plates at the particularly concentrated spot, then those two metals joined and form the welding”.

The literature review on “Experimental Investigation of Resistance Spot Welding” in 2014. The main emphasis of this review is to study the effect of different input parameter of resistance spot welding on the weld quality. The experimental studies have been conducted under varying welding current and welding time, squeeze and hold time. In this investigation the quality characteristic (tensile strength) has been considered using Grey Relational Analysis Method. Optimal parameters collection of the RSW operation was obtained via grey relational analysis. Dariusz Ulbricht. al.,[6] carried out “The analysis of spot-welding joints of steel sheets with closed profile by ultrasonic method” in 2015. The article presents the methodology and the results of non-destructive ultrasonic testing of resistance spot welded joints of thin steel sheet with closed profile. Non-destructive test results were verified on the basis of welded joint area after destructive testing. The obtained results were used to develop an assessment technique for spot welded joints of closed profile with steel sheet, which could be used in factories employing such joints. Zhang X. et al [16] investigated the strength of multiple spot weld joint. They also studied its automobile application i.e. vehicle chassis having many spot welds. Analyses of these structures are based on finite element study and experimental study. They have studied the finite element model for multiple spot weld joint under tensile shear load by experimental method. The effect of multiple spot weld joint strength is

analyzed considering spot weld spacing, edge distance, weld size and thickness using FEA. The conclusion of this study is weld parameters like weld size and thickness are primary factors affecting the strength of the joint of materials.

## 2. MATERIALS AND METHODOLOGY

The portable spot welding is designed and parts required are analysed. The main parts of a portable spot welding are making a cabin and base, Transformer, Electrical circuit and Design of offset lugs.

### 2.1 Materials of spot welding

The cabin is the main housing for the transformer and electrical circuit which we are going to do the next step. Our cabin is an L-shaped cross section from the front view. For the cabin only by doing some changes we are going to add the electrodes.

Wood is the material which we used for making of our cabin and base. We think that it is the only material which is reliable and also less cost. We know that wood is a bad conductor of electricity and also it can sustain under heat. It can hold the transformer very firmly and it is very good rough use. The main reason for selecting the wood is the it is a very low cost we already mentioned that we are fabricating this machine with very optimum cost and also, we joined the wood by using the nails only so it reduces the cost and weight. In future if any damage happens to the wood, we simply remove the nails and replace it easily.

We used wood not only for the cabin and base and also, we used wood for making the electrode because in our machine the electrodes because in our machine the operator has the direct contact with the electrodes so we must manufacture it as shock proof by this the operator can handle the electrode very easily while welding.

### 2.2 Transformer

A transformer is an electrical device that transfers electrical energy between two or more circuits through electromagnetic induction. Electromagnetic induction produces an electromotive force within a conductor which is exposed to time-varying magnetic fields.

Basically, the transformer consists of two windings they are primary and secondary windings. Generally, we give our power supply to the primary winding later the output depends on the secondary winding. So, the secondary winding plays the important role in the transformer [14-15].

Generally, there are two forms of transformer, they are Step-Up Transformer and Step-Down Transformer. Step-Up Transformer is defined as the “A Transformer which increases the voltage from primary winding to the secondary

winding and also decreases the current at the output” is called Step-Up Transformer.

Step-Down Transformer is defined as the “A Transformer which decreases the voltage from primary winding to the secondary winding and also increase the current at the output” is called Step-Down Transformer [16-17].



Figure 1: Micro wave oven Transformer

### 2.3 Electrical Circuit

Transformer which is the heart of our project used for welding but only with metal Melter we cannot do the welding and also, we cannot supply the power directly to the transformer it is very dangerous it may cause death to the operator.



Figure 2: Electrical Circuit

## 3. FABRICATION

There is a typical problem that how the electrodes have to be installed to our electrode holders for that we have designed an offset lug which will hold our electrodes. For the making of

offset lugs, it was decided to use the copper buss bar of 1 cm thickness.

In present study, one buss bar of 10cm of long and made into two pieces for the purpose of making the Z-shaped lugs in that Z-shaped every straight piece of 2cm length and we use 1\2 cm for the purpose of the curvature [12]. Like this, we have made two lugs and made an internal tapping on one side of each lug because by this tapping only we attach these to the electrode holders.

Now another buss bar of 14cm long this one also, we made it into two halves and made them into square sections of length 2cm at the end we use a brass welding for the joining purpose for this one we do the internal tapping for this it has to lock the electrodes [9-10]. Here we use a copper electrode that's why we copper buss bar for making of offset lugs.

### 3.1 Fabrication of portable spot-welding machine

The main circuit includes a transformer, 2.5-gauge copper wire, copper electrodes and connecting thimbles, Firstly, we have to convert the step-up transformer into a step-down transformer with output voltage of approx. 2.2 V & power 1.2 KW. For this purpose, 2.5-gauge wires are required to make five turn winding by electromagnetic law of induction produces 1.2 V. A pair of copper wire electrode is connected to secondary voltage circuit. The created voltage is approx. 2.2 V giving a high current of 550 Amp [11,13]. Both the ends 2.5-gauge copper wire are peeled out and attached with two thimbles which hold the copper electrodes. These electrodes can be changed with time and also different diameters of electrodes can be used according to the need. Now the basic circuit of the machine is formed which can spot weld two thin sheets. The body of the machine is simply made by wood which makes the machine light in weight. The wood used in the body of the machine is plywood and soft wood. The arm mechanism includes a liver and a spring which provide correct amount of force required to spot weld the metal sheets. An excellent style manual and source of information for science writers is [9].



**Figure 3:** Fabricated Spot-Welding Machine

When the switch is opened, the electrical current will flow through an electrical cable into the electrical components in the welding machine. Electrical power will flow directly through an electrical cable to the “transformer”. Production of the high current with a transformer, which changes high voltage low current from the wall outlet into low voltage high current in the work piece. The heat comes from electrical resistance. To create heat, copper electrodes pass an electric current through the work pieces. The current from the electrodes is then applied briefly to the metal and produce weld nugget that will join the metal together. After the switch is closed, electric current will stop flowing. The portable spot-welding machine is very fast, economical, efficient, flexible, consistency and it gives cleaner look than. Arc welding. it is much more cost effective in production line. it is much more energy efficient process utilizing electricity more effectively than other types of welding processes. Environment friendly process use less resources. Very safe process compare to other conventional process. The process use less resources and true environment friendly process-no release of any toxic gases or require any hazardous material for process completion. It does not require high skill operator.

Present work was tested by ASTM Standard ASTM E751 – 17 portable spot welding which works conforming to ASTM Standards. Our project is tested with ASTM Standard and then they get approval. Our project constraints are economical constraints previous product, and parts of the portable spot welding has a high cost but we modified the components and reduce the cost of the product.

### 4. CONCLUSION

The we fabricated a portable spot-welding machine at a very low cost. By this machine, we can fulfil all our domestic spot-welding purpose and also, we can fulfil some workshop purpose also. We manufactured this machine with the very low cost so even a small workshop also can accommodate. Due to financial constraints, we have used a half kV transformer if we use the more capacity transformer, we get the more efficient welding if we increase the power the time of weld will be decreased. For our machine, there is no need of separate cooling the air cooling is enough. If we want to increase the capacity of our machine then better provide a sufficient cooling by using an exhaust fan.

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