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Fabrication of Portable Spot Welding Machine

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Abstract

This paper represents the portability of resistance spot welding machine and study of various factors like the thermo-effect of nugget growing in single-phase AC resistance spot welding and heating of electrodes during spot resistance welding. The designed welding machine is very less in weight with same strength of the regular spot welding machine with more degree of freedom to work with. 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 1.2KVA with output voltage 0 to 2volt with 2-gauge wire & power switch and second is the formation of body and arm mechanism of the machine. Also the study is on various the factors which come into light when process of spot welding takes place. One such factor is nugget formation. The nugget formed in the work piece plays a crucial role in joining structure. Nugget forming process is not visible and also hard to test.

Keywords: Fabrication of Portable Spot Welding Machine, Portable Spot Welding Machine

I. Introduction

In earlier studies, researchers have found the possibility of nugget growth mechanism analysis and weld quality calculation by various methods. Destructive test method was the commonly used method for spot weld quality, which was widely used in macrostructure or microstructure observation and mechanical characteristic testing [1–3]. Because of it's low efficiency and results in the invalidation of product, the non destructive test is necessary in manufacture. Engineers toward quality evaluation of spot welds have developed various non destructive test methods such as ultrasonic testing [4, 5] and ultrasonic C-scan detection [6]. All these are off-line test methods and still problematic in test efficiency. Currently, weld quality test on the basis of on-line technology are proposed, which can provide basis for technological development of non destructively test.

Heating of electrode is also a factor which has deep impact on the quality of the weld. During manufacturing of electrode materials and their operation, one tries to have a long electrode life. The electrode life, i.e. the number of welds produced depends on various factors which affects the behaviour of electrode material in not stabilised thermal conditions, with on-going recrystallisation and ageing. The most important factors affecting electrode life include:

1) Chemical composition of an alloy used in the electrode and thermo- mechanical treatment affecting the structure, alloy hardness, softening temperature and electric conductivity.
2) Settings of welding parameters (pressure force, value and time of welding current) depending on the type/grade and thickness of a material being welded,
3) Shape and working diameter of an electrode, heating temperature of the working area, electrode cooling medium and its flow rate, welding rate.

The impact of the above said factors on electrode life has been a subject of numerous researched works [2, 4–11].

Thus the electrodes are one of more important elements of a welding process, the impact of an electrode shape on the process of welding has been a subject of research [12,13]. Many researchers mainly had focused on distribution of temperature in welding area [15,16]. Researchers revealed that the use of numerical computational models could save time and reduce costs while developing new welding technologies [14,17].

Also, weld nugget size and welding residual stresses are two important parameters determining the mechanical behaviour of the spot weld joints. The residual stresses in welded parts could decrease fatigue and fracture strength of structures. This indicate that through selection of appropriate parameters, desired nugget sizes and minimum welding residual stresses could be achieved [18]. Also besides influencing the electrical resistance, electrode force imposes pressure on the weld zone during heating and cooling, and it affects the residual stresses, the welding time and current, electrode diameter, materials, pre- heating, post-heating cycles, and work piece thickness are other effective parameters [19-20]. Moreover a systematic approach from safety point of view was followed as per the research studies carried out by Irfan *et al.* [21].

II. FABRICATION OF PORTABLE SPOT WELDING MACHINE

A. *Phase 1: Formation of Basic Circuit*

The main circuit includes a transformer, 2-gauge copper wire, copper electrodes and connecting thimbles. Firstly, we have to convert the step up trans former which is shown in fig. 1 into a step down transformer which is shown in Fig.2 with output voltage of approx 2.1 volt & power 1.2 KW. For this purpose 2 gauge wires is required to make two turn winding which by electromagnetic law of induction produces 1.2 volt. A pair of copper wire electrode is connected to secondary voltage circuit. The created voltage is approx 2 volt giving a high current of 600 Amp.

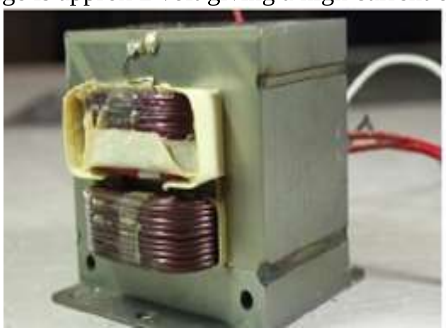

Fig. 1: Basic Circuit

Fig. 2: Basic Circuit

As shown in Fig.3 both the ends of 2 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.

Fig. 3: 2 Gauge copper wire

Now the basic circuit of the machine is formed which can spot weld two thin sheets.

B. *Phase 2: Formation of basic body structure of machine*

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, fig.4 represents the basic structure of machine and fig. 5 shows the arm of machine on which the electrode is fixed. The complete machine is shown in fig. 6 which is the complete working structure.

III. MEASUREMENTS

Wooden base = (65 x 13.7) cm
Covering box = (Length = 35cm); (Width = 16.2cm); (Height = 12.6cm)
Wooden Arm = (Length = 33cm); (Width = 3.9cm); (Height = 2cm)
Hinge Support = (Length = 7.5cm); (Height = 7.5cm)
Transformer = (Length = 9.6cm); (Height = 8.3cm)

Fig. 4: Wooden base

Fig. 5: Covering box

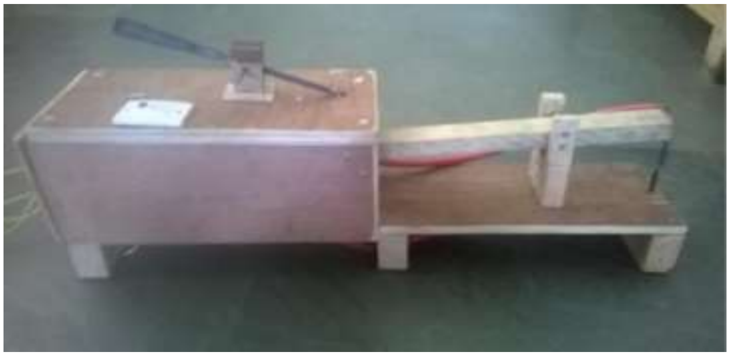

Fig. 6: Hinge Support

IV. COST OF THE MACHINE

Table – 1
Cost of the machine

Item	*Cost (Rs.)*
Transformer (LG microwave)	*1100*
Wood	*300*
Two gauge copper wire	*600*
Connecting wire	*100*
Spring	*20*
Two switches	*45*
Copper electrode (4 mm)	*20*
Extra (Nails, thimble)	*50*
Total	*2,235*

V. CONCLUSION

1) Portability of welding machine provide a crucial advantage to the user as it can be used at different places and working conditions like overhead work.
2) The market cost of portable spot welding machines ranges between Rs 4,500 to Rs 9,000 and weighs between 14 kg to 16 kg, but as a development the machine we fabricated costs only Rs 2,235 and weighs 12 kg. From this we can clearly conclude that the initial cost and weight of the machine is significantly reduced.
3) Due to absence of cooling system the life of the electrode is compromised.

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