



FABRICATION AND ANALYSIS OF PORTABLE SPOT WELDING MACHINE

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Abstract

Spot welding machine requires a lot of space requires a lot of space, is heavy, restricted by height and does not weld at any angle. In this project, we have tried to overcome the above problems by recreating the design. We made it a 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. We studied various research papers and concluded that a portable spot welding machine is required. For creating this machine we used modeling software such as solid works 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 as Bulky. **Key-words:** Portable Spot welding machine, Fabrication, Working Analysis,

I. 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 joint is determined by material thickness and

type, the amount of time current flowing and the cross-sectional area of the welding tip contact surfaces.

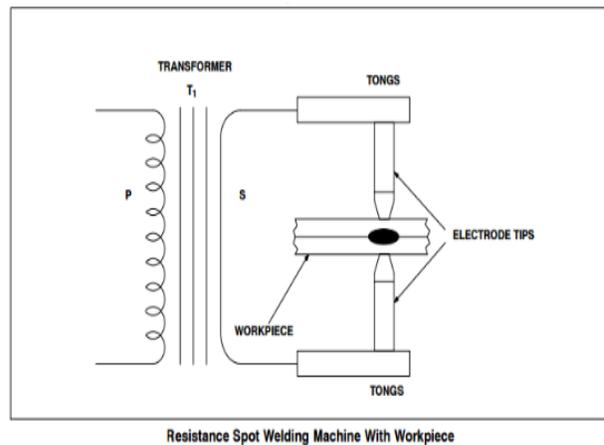


Fig.1. Spot welding machine line diagram

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.

II. FABRICATION OF PORTABLE SPOT WELDING MACHINE 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” .

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 .

Generally, there are two forms of transformers, They are

- 1) Step-Up Transformer
- 2) 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 increases the current at the output” is called Step-Down Transformer .

III. CONVERSION OF STEP UP TRANSFORMER INTO STEP DOWN TRANSFORMER

For our project purpose, we need a step-down transformer but in markets, it is very difficult to find the step-down transformer at our requirements . For our project, we need a step-down transformer which takes a normal input i.e 230V, and 10 amps and deliver the output as 1.5 – 2 V and 500 – 800 amps . This type of step-down transformer is impossible to find in the general markets .

Generally, in the transformer, the output voltage is decided on the basis of the number of turns in the secondary winding . If the number of turns in the secondary winding is greater than the primary winding then it gives the high voltage and low current it is a step-up transformer . if the number of turns in the secondary winding is less than the primary winding then it gives low voltage and high current it is a step-down transformer .

One turn in the secondary winding represents one voltage and its respective current. we need a two voltage output step-down transformer so in our transformer, we have to place only two turns of secondary winding so that we can convert a step-up transformer into a step-down transformer .

IV. MODIFICATION OF TRANSFORMER

Present work, we need a portable ½ kva transformer . Generally, this type of transformer is not manufactured separately so as an alternative we found that in some electronic home appliances approximately this type of transformer is used that home appliance is the microwave oven .

In the microwave oven, we can get the rated portable ½ kva transformer but it is a step-up transformer because in the microwave oven high voltage and low current are needed so we have to modify that step-up transformer and convert into the step-down transformer .

We purchased the transformer of microwave oven separately from the LG customer care and services and we know that the main block of that is just laminated sheets but they are thickly joined . If we deeply observe that block of transformer there are only two sections they are E-section for the housing of the primary and secondary windings and an I-section for closing that E-section these two sections are joined by the shallow welding.

Our aim for this transformer is the to remove the secondary winding and place the another winding as our requirement . For that first we have to separate the two sections . So, we cut the shallow welding by using the hacksaw blade, chisel and hammer with some effort only those two blocks are divided .

Now the two blocks are separated then we can see that a very thick copper wire is made of turns and a thin copper wire is also made as turns . The thick copper wire turns are the primary winding and thin copper wire turns are the secondary winding . the very important is the primary winding so we have to remove it very carefully if anything happens to the primary winding it would be so critical so while removing better to use the cloth so that the winding will not be damaged .

After safe removal of the primary winding, we have to remove the secondary winding . Actually, we don't want that secondary winding

so don't bother too much you can remove that winding in any way but be careful about the E-block now we completely disabled the transformer and we have transformer block and the primary winding .

Already we know that transformer has to work with both primary and secondary windings but we removed the secondary winding of the transformer now we have only the primary winding so we have to prepare the secondary winding as of our requirement . After removing the primary winding there are the separators between both the windings remove those separators and also after removing the both windings clean the block .

We know that our output voltage may be small but it produces a large amount of current for that purpose we are placing only two turns of secondary winding so our secondary winding has to withstand that large current .

For the above purpose, we selected a wire which is generally used in the arc welding to supply the power from unit to the electrode holder . The wire is the welding wire number 72 of 1 ½ meter we were taken . Later we have taken two copper straight lugs and attached to the both ends of the secondary winding by using the lug press by this preparation of the secondary winding is completed .

Now we have the transformer block, a primary winding, customized secondary winding . now we have to assemble all parts . First, take the E-block and carefully insert the primary winding . Later take the welding wire and turn two times on the slots of E-block . Make sure that two lug ends have to come one side only and also the same distance from the E-block because those two are connected the electrode holders .

After arranging the both primary and secondary windings once check the secondary winding carefully . Majorly we have to check the continuity of the both primary winding and secondary winding because now we are going to seal the transformer so checking continuity is very important if continuity is not there re-check the windings .

If continuity is there it is good so we can seal the E-block with I-block . Initially, we removed the shallow welding again also we can do that but it is very difficult to find and also costly the cheapest way is using the metal glue

(Ex:Araldite clear) after applying it leave it for 2 hours it is sufficient to bond firmly . By this, the modification of transformer is completed .

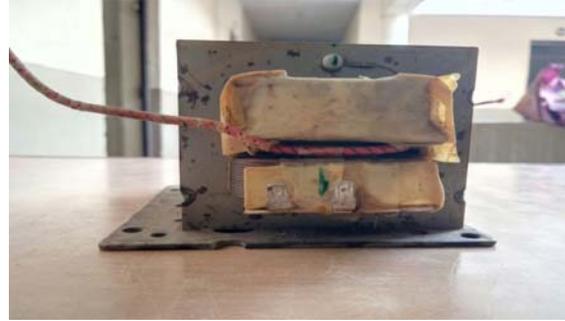


Fig.2. Step-Up Transformer



Fig.3. Core without Winding



Fig.4. Step-Down Transformer

V. METAL MELTER

Metal melter is the word which is given to our transformer after modification because now our transformer produces the high current which is sufficient to melt the metal so we call our modified transformer as a metal melter .

Now we have to check the metal melter output for that we need a multimeter . Before checking the output once again check the continuity because now we are going to supply the power to our metal melter . After checking the continuity if it is good then connect the two terminals of the primary winding to the power supply terminals and also make sure that power is switched off . After the terminals are connected just switch on the power supply if the power is supplied to transformer then buzzing will come it indicates

that the transformer is working . Now we have to take the multimeter connect the terminals and set as voltmeter and also range . Now take the two terminals from the multimeter and made a contact with the lugs which we arranged to the secondary winding then it shows the reading and note it .

Our metal melter shows the value as 1.6V . By this, we achieved the desired output voltage and also we come to know that a high current of 650amps is produced .it is enough to melt the metal . Now we have to make this metal melter into a spot welding machine .



Fig.5. Metal Melter lugs

VI. MAKING OF CABIN AND BASE

The cabin is the main housing for the transformer and electrical circuit which we are going to do in 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 .

There are so many materials which we can use for making our cabin some materials are carbon fiber, aluminum, copper, wood, plastics, steel, cast iron etc we can use any of the above materials

Cast iron is the metal which we can use as a material for making the cabin it is very good for holding the transformer because it has high strength and we can join the cast iron by using welding very cheapest method to use but here the problem is cast iron weight is somewhat high so, By using the cast iron we have to compromise with the mobility feature .

Steel is the metal which we can use for making the cabin it is very cheap and reliable . it can be joined by using the rivet which is a very cheap method but the strength is high . By using steel there is a problem if it is a stationary it is fine but our product is movable so it is not reliable . if we want reliable we have to increase the thickness of the sheet by this the cost is high .

Aluminum is the metal which has the high strength material and also which has the high thermal conductance . It is a very lightest material but it can hold the transformer . In our machine high heat is produced for the purpose of resistance spot welding . We already know that aluminum is a good heat conductor . So ,It absorbs the heat continuously due to this it starts melting at some point of time if we work continuously .

Plastics plastics is also a very cheapest material which we can use for making of the cabin but it has a problem same as the aluminum that is it starts melting if we use continuously and also we have to prepare a mould for making a cabin .

Copper is the best metal which we can use for making the cabin it has a high thermal resistance , shock resistance and also it can hold the transformer firmly the main defect for using this is it costs very high so it is not economical for making of cabin

Carbon Fibers is a recent material came into account for lifting the heavy weight with less body weight but here also a problem which is same as the copper it is not economical for making the cabin .

Up to this, we have seen some of the materials which we can use for the purpose of making the cabin and we have given some reasons why we did not select those materials for our purpose last we have selected one material for making of cabin and base .

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 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 .

We take mango wood for cabin and apple wood for electrodes holders . First, we take 30x1½ inches for long and heavy base later we allotted 10 inches for the cabin 17 inches for the purpose of electrodes and remaining 3 inches for the purpose of safety because while welding the sparks will occur . We took the square cross-section electrodes 2x2 inches and 17 inches long . We fixed the down electrode and upper is movable for that movement we have given V-groove . we took the square cabin of height 10 inches and we attached a safety switch at back this is the construction of cabin and base .



Fig.6. Play wood for Cabin



FIG.7. Legs and Cables



Fig.8. Transformer

VII. ELECTRICAL CIRCUIT

We have already discussed the metal melter 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 .

To overcome the above problem we have to arrange a safety electrical circuit which will supply the power safely to the transformer . In our project, we have decided that we have to give the extreme safety to the operator and also very easy to weld the workpieces .

For the safety purpose, we have selected two types of switches they are one is contact switch and another one is the main switch . The main switch is used to supply the power from the source to the transformer . Now the transformer does not start because it is not safety so for this we have used a contact switch it is arranged at the upper electrode . whenever we placed the work plates and also the electrodes get contact with the plates then we press the contact switch then it allows electricity to the transformer and then welding is done .

The main switch is arranged at the back side of the cabin it is just an on and off switch with two terminals and the contact switch consists of the three terminals they are common terminal , NC terminal, and NO terminal we did not bother about the NO terminal because that is for higher work purposes so we just simply remove the NO terminal .

Now coming to the circuit it is very simple but it must be connected very carefully because if anything happens the transformer will be destroyed so after connections are given check them once again .

First, take the power cord which has the three wires(Red, White, Green) inside by removing the main insulation and insert them in a hole which is provided at the back side of the cabin. Now take the red wire among the three wires and connect to the negative terminal of the main switch .

Now take a piece of wire and connect the connector to one side now that connector is connected to the positive side of the transformer and another side of the wire is connected to the positive terminal of the main switch . Now take another piece of wire and connect the connectors at the both sides and connect one side to the NC terminal of the contact switch and another side to the negative side of the transformer .

Now connect a wire with a connector to the common terminal of the contact switch that wire is connected to the white wire of the power cord . At last, connect the green wire to the power cord

to the transformer base it acts as a ground to our project.

VIII. DESIGN OF OFFSET LUGS

For our project, there is a typical problem that how the electrodes have to be installed to our electrode holders for that we have designed an offset lugs which will hold our electrodes .

For the making of offset lugs, we have decided to use the copper buss bar of 1cm thickness . The main design in these offset lugs is the one Z-shaped design and another one is the square shaped lock is there for the purpose of locking the electrode .

First, we take one buss bar of 14cm 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 $\frac{1}{2}$ cm for the purpose of the curvature . Like this, we have made two lugs and we made an internal tapping on one side of the each lug because by this tapping only we attach these to the electrode holders .

Now we take another buss bar of 16cm 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 . Here we use a copper electrode that's why we copper buss bar for making of offset lugs .

IX. ASSEMBLING

Now the actual assembly starts initially we take the base and made the marking like there we have to place the electrodes and transformer . now place the transformer on the base where we alloted the place for it while placing just keep in mind that the welding wire has to come on electrode side if it is ok then simply fix the transformer by using nails .

After this, we have to place the electrodes holders at their place one on another make sure that the electrode holder which has the groove come on top side because it is movable and also we said that the down electrode holder is fixed so fix it with the nails . Now attach the respective offset lugs and to that lugs attach the copper electrodes .

Now coming to the electrical circuit we have already discussed how the electrical circuit will

do as follows . Keep in mind that the ground is attached to the transformer base .

Now plug the machine to the power supply and check whether the machine is working or not . If not check all the connections . If the machine is working the work is done and we have to do the analysis .



Fig.9. Assembling of parts



Fig.10. Final view of Spot welding machine

X. ANALYSIS

Now coming to the analysis of our machine we do the three tests they are Type of material , Thickness , Time of weld

Type of material:

By using machine we can weld the sheet metal , aluminum sheets , galvanized iron sheets , copper sheets . We do experiments on these materials only and we studied that it can weld another material also .

Thickness:

The maximum thickness that our can weld is the 5mm of the single plate . if the thickness exceeded more than that the time of weld is more and more and the main problem is the machine gets overheated .

Time of weld:

- If we take 1mm thickness plates it takes 1.7 sec of time
- If we take 2mm thickness plates it takes 2.6 sec of time
- If we take 3mm thickness plates it takes 4.3 sec of time
- If we take 4mm thickness plates it takes 5.6 sec of time
- If we take 5mm thickness plates it takes 7.4 sec of time

Averagely our machine takes 5 sec of time for welding and this is the analysis which we have done on our machine.

XI. CONCLUSION

By this, we conclude that the we fabricated a portable spot welding machine at a very low cost. By this machine, we can fulfill all our domestic spot welding purpose and also we can fulfill some workshop purposes 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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