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Fabrication of a Portable Spot-Welding Machine for On-Site Repairs and Maintenance

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ABSTRACT: By applying heat, the process of welding allows similar metals to be joined. It is possible to weld with or without applying pressure. The edges of metal components are either melted or become plastic during welding. Filler materials can be used in welding, or they can be omitted. welding is used for making permanent joints. It is used in the manufacture of automobile bodies, aircraft frames, railways wagons, machine frames, structural work, tanks, furniture, boilers, general repair work and ship building. At most in all metal working industries welding is used. In this project we are making portable spot welding machine , which will be easy carry and will be used in many filed.

Keywords: welding machine , Portable , Easy to carry , Handling is easy etc.

1. Introduction

The spot-welding process, which produces millions of automobiles annually, was governed by current and time for decades. The nugget volume and, thus, the weld's outcome were determined by the specified welding duration and current level. The introduction of adhesives and the daily expansion of the variety of high-strength steel types produce new initial conditions for the assembly to be welded, making it more difficult to achieve effective welding outcomes. The output was now determined by more factors than just current and time, including the welding voltage. [1][2]. The process resistance, which varies independently from spot to spot, is defined by the actual voltage to be measured directly between the electrode tips and the actual welding current. There was no known method for monitoring the precise welding voltage and consequently, the transient process resistance due to the loss of measuring cables close to the touching sites between the electrode tips and the material to be welded. [2].

Fig..1Spark between two electrodes

The energy input, however, is a function of current, process resistance, and time during the entire process, and depends on the nugget's diameter, volume, and technological parameters. The physical context of this has long been widely known: Energy is produced by the integral of current in square times the impedance over time (e = i(t)2 * r(t) *dt, where e is energy, i is current, r is resistance, and t is time). Current and resistance are time-variant quantities since they change over time. A trustworthy statement on the energy input must falter if the variable resistance is not measured or employed in the weld controller[3].
One of the earliest methods of joining two or more sheets of metal without the use of filler material is spot welding, a type of resistance welding.
There is room for adjustment in the design of the traditional spot-welding system, according to studies of various spot-welding processes and automatic and semiautomatic spot-welding machines.

2. Problems Identification

1) "Conventional spot-welding machine manufacturing purpose, it is needing a step-down transformer but in markets, it is very difficult to find the step-down transformer as per requirements also cost of that machine is high"
2) For our project, we need a step-down transformer which takes a normal input i.e., 230V and 7 amps and deliver the output as 12V and 7 amps.
3) 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.
4) We are trying to make an portable, lightweight & low cost spot welding machine for workshop sheet metal working.
5) The spot welding available in market is too big in size and have huge electric power consumptions. Due to their size, it is impossible to use these portable or handy.
6) The study of various spot-welding process and various automatic and semiautomatic spot-welding machine reveal that there is scope for modification in design of conventional spot-welding system.

3. Literature Review

Shyam Sundar and Sandeep Kumar (2018) - Development of a Low-Cost Spot-Welding Machine for Metal Joining, published in the International Journal of Current Engineering and Scientific Research (IJCESR). This study outlines the modification of transformers to achieve high current output for spot welding applications. The authors highlight the challenges and solutions related to housing the transformer in materials like wood, which is cost-effective and suitable for heat resistance TRO India.

Taniguchi Koichi, Okta Yasuaki, and Ikeda Rinsei (2022) - Development of Next-Generation Resistance Spot-Welding Technologies for Automotive Applications, published in the International Journal of Advanced Research in Science, Communication, and Technology (IJARSCT). This research focuses on advanced resistance welding technologies for high-strength steel and aluminum. It discusses Pulse SpotTM and Intelligent SpotTM technologies, which optimize weld quality and adapt to different material properties. The study emphasizes the need for robust design and simulation techniques to improve weld joint strength.

Mansoor et al. (2020) - Optimization of Resistance Spot Welding Parameters for Aluminum Automotive Components, published in Materials Today: Proceedings. This paper evaluates the effect of welding pressure, current, and time on the quality of welds for aluminum sheets. It stresses the importance of FEA simulation in determining optimal welding conditions for lightweight materials used in the automotive industry.

Patel and Sharma (2019) - Portable Spot-Welding Machine: Design and Analysis, published in the Journal of Mechanical Engineering and Automation. The study provides a detailed analysis of portable welding machine design, focusing on transformer efficiency and compact housing. It also explores the impact of different electrode materials on the weld quality and portability of the machine.

Ahmad and Kumar (2021) - Development and Performance Analysis of a Compact Spot-Welding Machine, published in the International Journal of Mechanical and Production Engineering (IJMPE). This research emphasizes reducing machine size without compromising weld quality, discussing innovations in transformer design and the use of lightweight materials for portability.

Choudhary et al. (2020) - Optimization Techniques for Resistance Spot Welding in Automotive Industries, published in Materials Science Forum. This paper highlights optimization approaches for welding parameters, such as pressure, current, and weld time, for high-strength steel and aluminum components. It also discusses the application of computer simulations in welding process optimization.

Smith and Taylor (2019) - Enhancing the Efficiency of Portable Spot-Welding Machines for Small-Scale Industries, published in the Journal of Industrial Welding Research. This study investigates cost-effective methods to enhance the portability and functionality of spot-welding machines for use in industries with limited resources.

Hossain et al. (2020) - Portable Spot-Welding: Challenges and Opportunities in Emerging Markets, published in the International Welding Journal. The authors explore the challenges of adopting portable welding machines in developing regions, emphasizing the importance of durable materials, energy efficiency, and affordable production methods.

Park and Lee (2021) - Application of Pulse Current Technology in Portable Spot Welding Machines, published in Welding in the World. This study introduces pulse current technology to improve weld precision and quality, particularly in lightweight and thin materials, making the process more efficient and adaptable to portable designs.

4. Working Principle

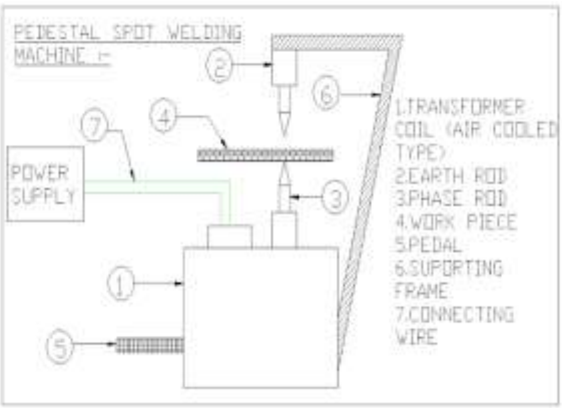

Fig..2 Constructional arrangement

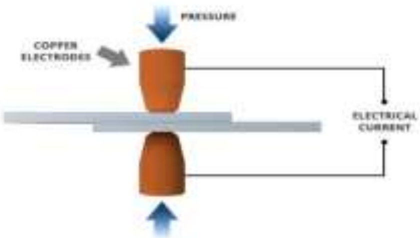

Fig..3Working Principle

Due to the pressure applied by the two electrodes, which are attached to the lower and upper arms, where the lower arm is stationary and the upper arm is mobile, two parts are welded together.
The electrode is put into the electrode holder, which is then insulated with hylam sheets and attached to the upper arm. A connecting rod connects the upper arm to the pedal. The spring is attached to the connecting rod so that it can raise and lower the upper arm. In this machine, the electronic weld controller is employed. It is equipped with the timer T1,

weld control switch, and timer T2. It uses a 3KVA transformer. The upper and lower parts are connected to the power supply..

Between the top and lower electrodes is positioned the workpiece. When the weld switch is turned on, the circuit's current starts to flow. The upper arm descends and a weld is made when the pedal is depressed. The electronic weld controller, timers T1, and T2, which have already been set to indicate functioning, beep when current flows across the circuit, signalling the process' completion. The electrode is then released after the pedal is removed, and the work piece is fused as a result. Before the process is finished, the pedal is released.

Using shaped alloy copper electrodes that conduct an electrical current through the weld pieces, the procedure entails applying pressure and heat to the weld region. When the material melts and fuses the components together, the current is cut off, the electrodes' pressure is maintained, and the liquid "nugget" solidifies to create the joint.

5. Components Utilized

Since the transformer has been entirely disabled, the primary winding and transformer block are all that remain. We don't want the secondary winding, so you can remove it in any way. We already know that a transformer must have both primary and secondary windings in order to function, but because we removed the transformer's secondary winding and are now left with only the main winding, we must prepare the secondary winding in accordance with our requirements [4].

There are separators between the two windings that need to be removed after removing the primary winding. You should also clean the block after removing the two windings. We are placing only two turns of secondary winding because we are aware that while our output voltage may be low, the quantity of current it generates is high, and our secondary winding must be able to resist that high current.

In order to supply the power from the unit to the electrode holder for the aforementioned function, we chose a wire that is typically used in arc welding. The wire is a welding wire with a length of 1 1/2 metres that we were given. Later, using a lug press, we affixed two copper straight lugs to the ends of the secondary winding, finishing the secondary winding's preparation. We currently have the transformer block, a primary winding, and a secondary winding that is unique. We now need to put everything together. First, gently place the primary winding into the E-block. [4][5].

Later, take the welding wire and rotate it twice on the E-block slots. Make sure that the two lug ends, which are used to connect the electrode holders, come from the E-block on just one side and at the same distance from it. Once the primary and secondary windings have been set up, carefully inspect the secondary winding. Since we are about to seal the transformer, it is crucial that we thoroughly examine the continuity of both the primary and secondary windings. If necessary, we should recheck the windings.

It is advantageous if there is continuity so that we can seal the E-block with the I-block. The shallow welding was initially removed; however, since doing so would be expensive and difficult to locate, the cheapest option would be to use metal glue (such as Araldite clear), which, when applied and left to dry for two hours, would accomplish the trick. This completes the transformer's modification [5][6].

6. Fabrication & Assembly

A variety of techniques had to be used when constructing and welding the spot welding equipment. First, a process planning diagram needed to be created. This serves as a direction that should be followed so that the time can be managed and the final model fulfils the criteria. The effectiveness of the project would be determined by this. Because each of these processes has certain requirements that must be met, regulation and analysis of these steps are crucial.

The major goal is to make welding practical, transportable, and economical.

The device will be easy to understand and use, and it won't need expert knowledge to complete the work. This tool can be used by individuals as a means of income.

A machine needs a lot of heat to produce the high current needed for welding. We'll get high current with a step-down transformer's assistance.

It functions by putting alloy electrodes in contact with the sheet surfaces. Whereby heat is produced by the passage of current through resistive materials like low carbon steels while pressure and electric current are applied.

7. Advantages

- Spot welding is quick and easy
- High welding rates
- Low fumes
- Cost effectiveness
- Easy automation
- No filler materials are required
- Low distortions.

8. Dis-Advantages

- High equipment cost
- Low strength of discontinuous welds
- Thickness of welded sheets is limited - up to 1/4” (6 mm).
- The metal may also become less resistant to corrosion.
- The size and shapes of the electrodes will determine the size and strength of the weld.

9. Application

• In the fabrication process, the placement of two electrodes in opposition has a significant impact in factors like electrode movement.
A good heat-generating point is achieved by attaching electrodes in opposite directions at the right speed.
• The copper electrode is positioned at the mild of the frame by taking into account the aforementioned factor. An extended angle plate positions one electrode parallel to a horizontal frame. Another electrode is positioned in the bottom frame with its point pointing upward.
• The portable automatic spot welding machine is constructed by the aforementioned procedure.

10. Conclusion

1) The user benefits greatly from the welding machine's portability because it allows for use in a variety of settings and operating conditions, such as overhead work.
2) Portable spot welding equipment typically cost between Rs. 4,500 and Rs. 9,000 on the market and weigh between 14 kg and 16 kg. As a development, the machine we made costs only Rs. 2,235 and weighs 12 kg. This makes it quite evident that the machine's original cost and weight have been greatly lowered.
3) The electrode's lifespan is jeopardised by the lack of a cooling system.

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