PROJECT ABSTRACT

Spot Welding Machine using MOT Transformer

Demonstration resistance spot welder built from a rewound microwave-oven transformer with Arduino weld timer.

01. Title

Spot Welding Machine using MOT Transformer

02. Introduction / Background

Resistance spot welding joins thin sheet metal by squeezing the sheets between copper electrodes and passing a brief, intense current pulse through the contact — resistance heating fuses a nugget between the sheets. Commercial spot welders are too expensive for occasional student-lab or small-workshop use. The microwave oven transformer (MOT) offers a classic low-cost route: its core handles high power, and replacing the high-voltage secondary with two or three turns of heavy cable yields a low-voltage, very-high-current source — exactly what resistance welding needs. This project builds a working demo spot welder around a rewound MOT with timer-controlled pulses, copper electrodes and a foot-pedal trigger.

03. Problem Statement

Manufacturing-process students usually study resistance welding only from textbooks, because commercial spot welders are costly and industrial units are unsafe for student handling. There is a need for an affordable demonstration welder that shows the real process variables — current, weld time and electrode pressure — with repeatable timer-controlled pulses, while treating mains safety, duty cycle and material limits with complete honesty. The build must also give students a way to verify weld quality themselves.

04. Objectives

- Rewind a microwave oven transformer secondary with 2–3 turns of heavy copper cable for high-current output.
- Build pivoted copper electrode arms with pointed tips and adjustable spring-clamp pressure.
- Implement an Arduino weld timer giving repeatable 0.2–2 s weld pulses via a foot pedal.
- Provide fused, earthed mains input with a thermal cutout and a documented duty cycle.
- Supply a peel-test procedure so weld strength on sample coupons can be verified by the buyer.

05. Proposed Methodology

The methodology has three stages. (1) Transformer: the MOT's high-voltage secondary is removed and replaced with 2–3 turns of heavy copper cable, keeping the magnetic shunts removed and the core properly mounted; the primary stays on fused, earthed 230 V mains. (2) Mechanical and control: pivoted copper electrode arms with spring clamping are built on a frame; an Arduino timer drives the weld contactor for the set duration when the foot pedal is pressed. (3) Weld trials: the guide gives a coupon procedure — weld, then peel-test — so the buyer verifies nugget formation and the practical thickness limit instead of taking it on claim.

06. System Architecture / Working

The operator sets the weld time and positions the sheet stack between the copper tips. Pressing the foot pedal makes the Arduino close the switching device for exactly the set duration. Mains feeds the MOT primary while the rewound secondary delivers a few volts at very high current to the electrodes; current through the sheet-to-sheet contact resistance produces I^2R heating that forms and solidifies the weld nugget. The thermal cutout and duty-cycle discipline protect the transformer between welds.

07. Hardware / Software Requirements

- Microwave oven transformer (core with rewound 2–3 turn heavy-cable secondary)
- Heavy copper cable for the secondary winding
- Copper electrodes with pointed tips, pivoted arms, spring clamp
- Arduino Nano weld timer with foot-pedal switch

- Weld contactor/SSR, mains fuse, thermal cutout, earthed enclosure
- Plywood/steel frame; thin mild-steel sheet coupons for trials
- Arduino IDE for the timer firmware

08. Expected Outcomes

The expected outcome is a working demo welder that produces fused nuggets on thin mild-steel sheet, with weld time repeatable to the timer setting and quality verifiable by the buyer's peel tests. The design target is sheet up to about 0.8 mm; the report presents this as a target confirmed by testing, not as a guaranteed rating. Weld current is likewise a design target (hundreds of amps), not a measured figure. Safety outcomes — fused earthed input, enclosed transformer, duty-cycle discipline — are documented as part of the deliverable.

09. Applications

- Demonstration of resistance spot welding for manufacturing-process coursework
- Student experiments on weld time, current and electrode pressure
- Low-cost joining of thin sheet for workshop and hobby fabrication
- Viva and exhibition piece for mechanical engineering projects

10. Future Scope

- Pneumatic electrode actuation for consistent clamping force
- Current sensing with closed-loop weld-time adaptation
- Water-cooled electrode holders for longer duty cycles
- Capacitor-discharge variant for finer thin-foil welding

11. References

- American Welding Society — Recommended Practices for Resistance Welding. AWS.
- Kalpakjian, S. and Schmid, S. R. — Manufacturing Engineering and Technology. Pearson (joining processes chapter).