A Dual MOT spotwelder

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Here is my version of a microwave oven transformer (MOT) spotwelder. MOTs are commonly used for DIY spotwelders as they are readily available and have decent power (1.5 kva +-). Mine follows the usual path of removing the original secondary winding and replacing it with a few turns of very heavy conductor. Mine offers a feature that I am not aware of in other MOTSWs - the use of aluminum plate for the winding conductor.

This posting is mostly show-and-tell and not a how-to for building a MOTSW. You could build one by following what I've done, but understand that it's based upon using the materials that I had rather than an optimized design.

Some design criteria
- be able to weld 16 ga mild steel. One test welded 2 pieces of 1/8" mild steel (about 11 ga). The input power is 17A @ 240v = 4 kva. I had intended to use a single MOT, but it just wasn't enough power. It could weld 16 ga, kinda (not reliably).

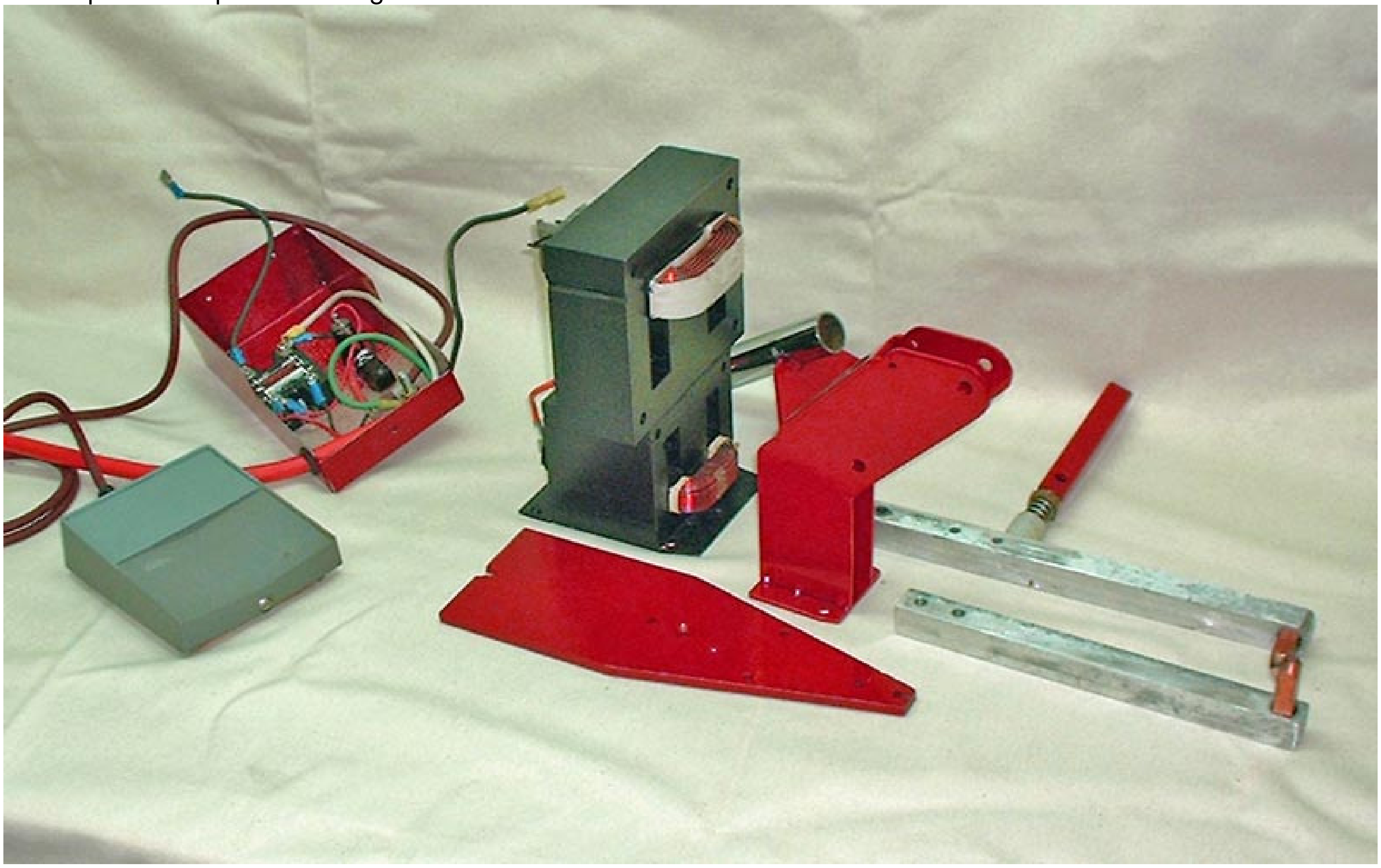
- be able reach to the middle of the longest seam that my press brake can make (22"). The reach is 9", which is within 2" of the center. Close enough.

- small and portable. My shop space is taken. The spot welder will sit on the bench in use and on a shelf when not. It is 18" long, 5" wide and 10" high. It weighs 28 lbs.

- minimize buying of parts and stock. I bought a piece of welding cable for $9 and a piece of copper bar for $4. Everything else came from the dump or my junk box.

Fabrication
I am a true believer in KISS. KISS means easier fab and greater likelihood that the designed object will work. MOTSWs are really simple to start with, so KISSing was pretty easy.

All the parts except the windings:

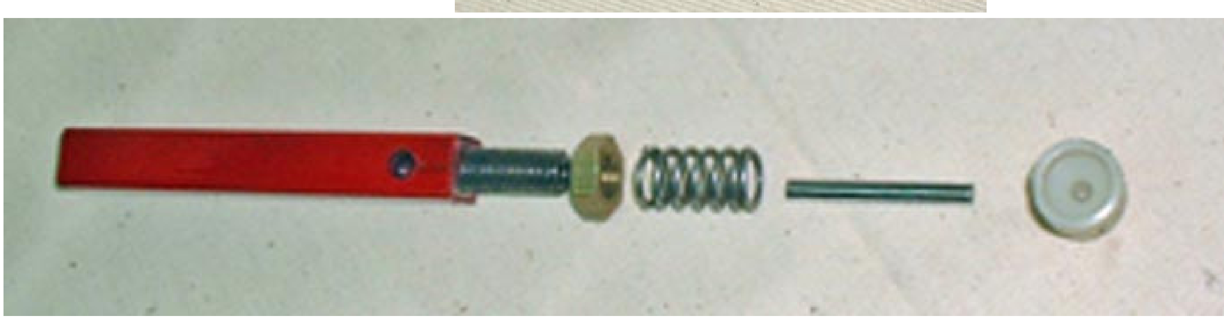


The MOTs were tack welded together. The magnetic shunts were removed along with the secondaries.

The arms are aluminum, 'cause that's what I had. They are .75 x .7", which is equivalent in resistance to a copper rod .67" in diameter.

The ends of the arms were drilled and tapped for 1/2 - 13 threads, for some bolts that I had that I thought were copper. They weren't copper (brass, I suppose) and in the first welding trials their tips got red hot, but not the material. So I bought a 3/8 x 1/2 copper bar for $5.25 / lb (!!) and made tips that press fit in the drilled-out holes. The copper works very well. I never considered using aluminum for the tips - it might work. Or not - the oxide coating might be too much resistance.

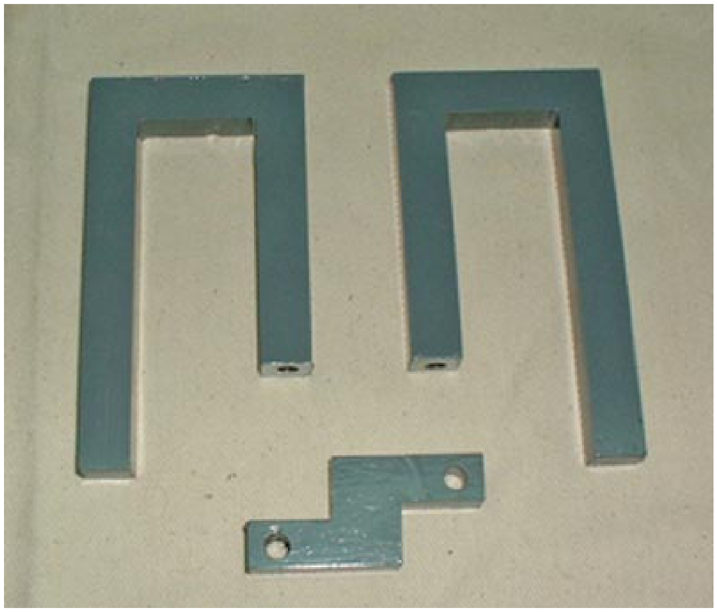
The contacts open by pivoting the upper arm, of course, to allow positioning the work and then are tightened by the pressure lever. The pressure is maintained by an adjustable spring.

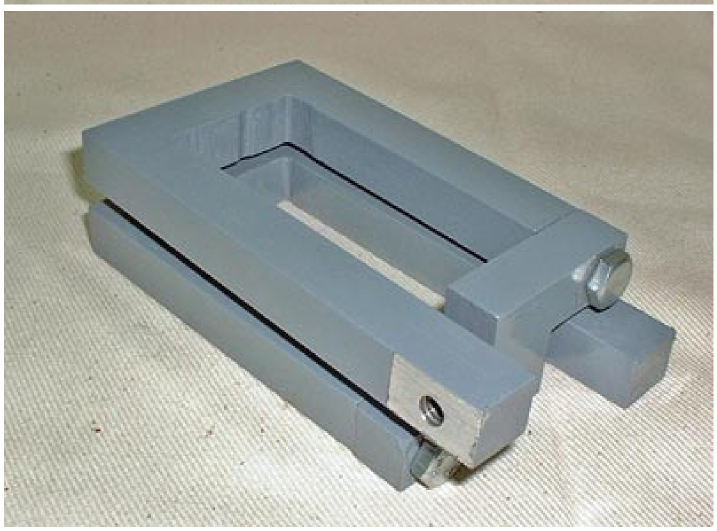


The upper arm and its return spring are insulated from their support tower by nylon bushings and from the lever by its nylon cup. It would have been a lot easier to insulate the lower arm!

The mounting bolts for the lower arm pass through over size holes, to allow minor adjustment for aligning the tips.

Commonly, the replacement secondary winding is made from copper welding cable, e.g., #2, which I didn't have. My original intent to not buy material led me to use aluminum. Not aluminum wire, which I didn't have either, but 1/2" aluminum plate.





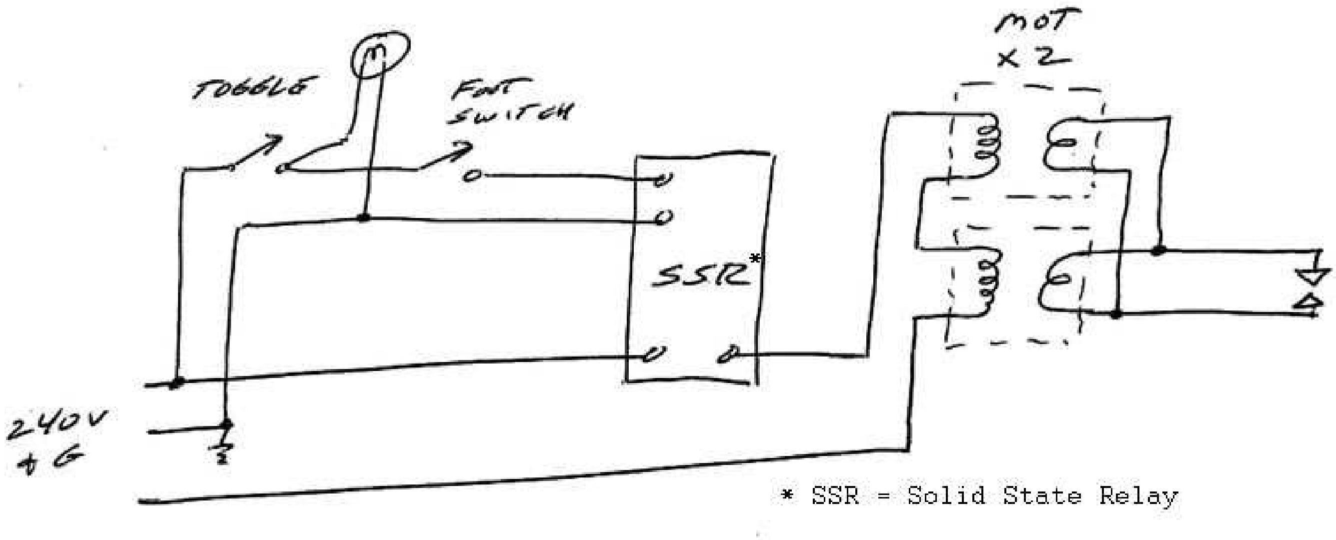
At the 2 volts in the secondary winding, insulation can be minimal, so I used paint. A catalyzing enamel that I happened to have, which I hope will be strong enough to avoid wear-through. I used duct tape first but really hated doing it.

The conductor is 1/2" x 9/16", which is equivalent to copper .46" in diameter (0000 ga). In addition to being very low resistance, the winding totally fills the space in the transformer core. I've heard that this is good, but I don't know why.

To keep the total secondary circuit resistance as low as possible it was really important to make good connections to the aluminum. This meant scrubbing off the oxide and coating with an anti-oxidant wherever there was a connection. Including the copper tips in the arms. And the connections were tightened very securely.

When I found that I needed a second MOT, I was tired of machining aluminum plate for windings and I broke down and bought #2 welding cable. Not nearly as good, but sooo much easier!

The wiring diagram:



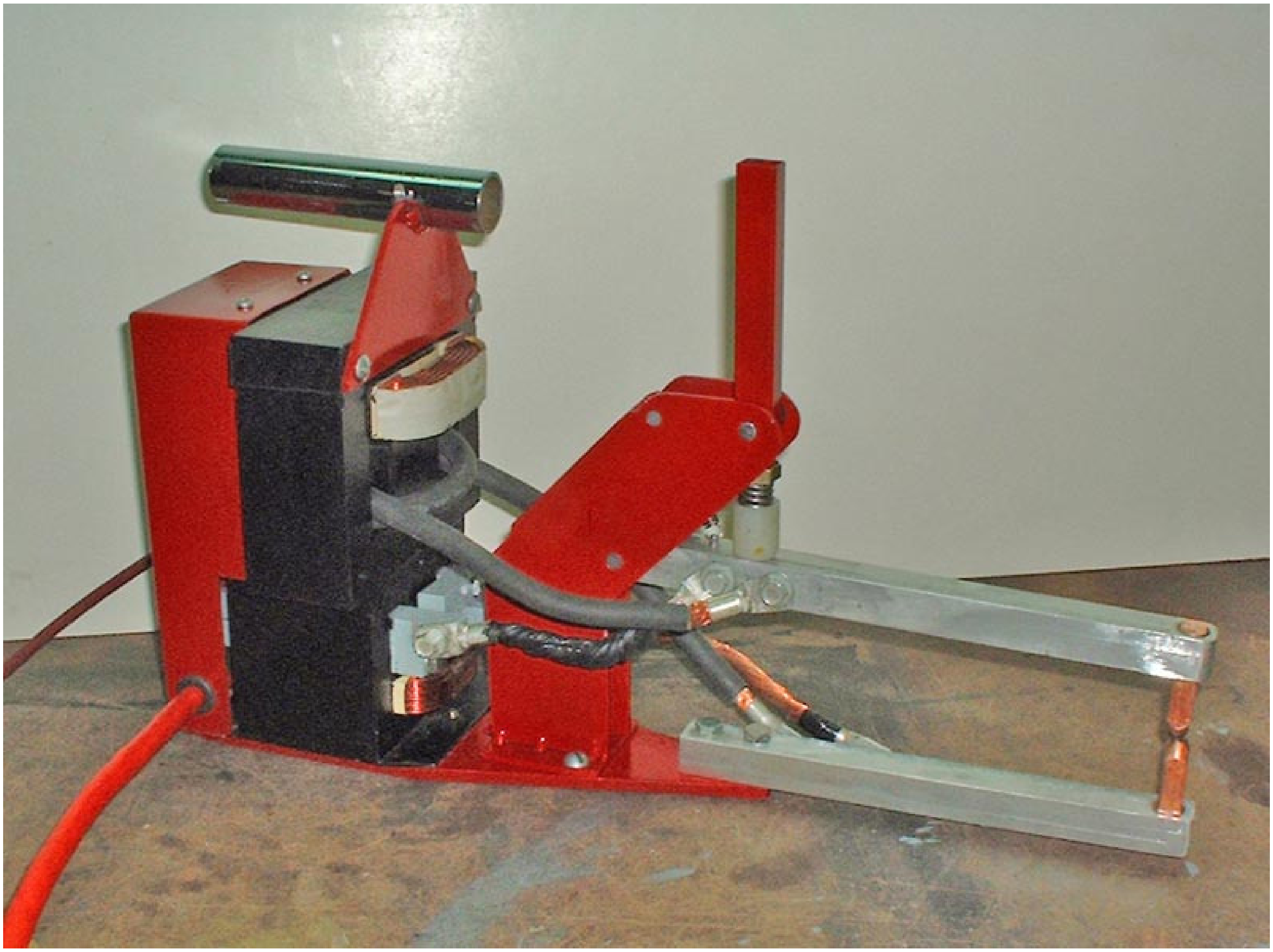
The MOT primaries are connected in series, with 240v input. Had they been connected in parallel (for 120v input), it would have required a 35A circuit!

Note that the MOT secondaries are connected in **parallel**. There is a big advantage in this as the wire in each secondary only carries 1/2 the total current and has 1/2 the i-r drop. To make sure that they were in phase, I disconnected one lead and measured to voltage between it and its partner. In phase, the voltage will be near zero. Out of phase it will be 4 volts. I had to correct an out-of-phase by reversing the primary connections on one of the MOTs.

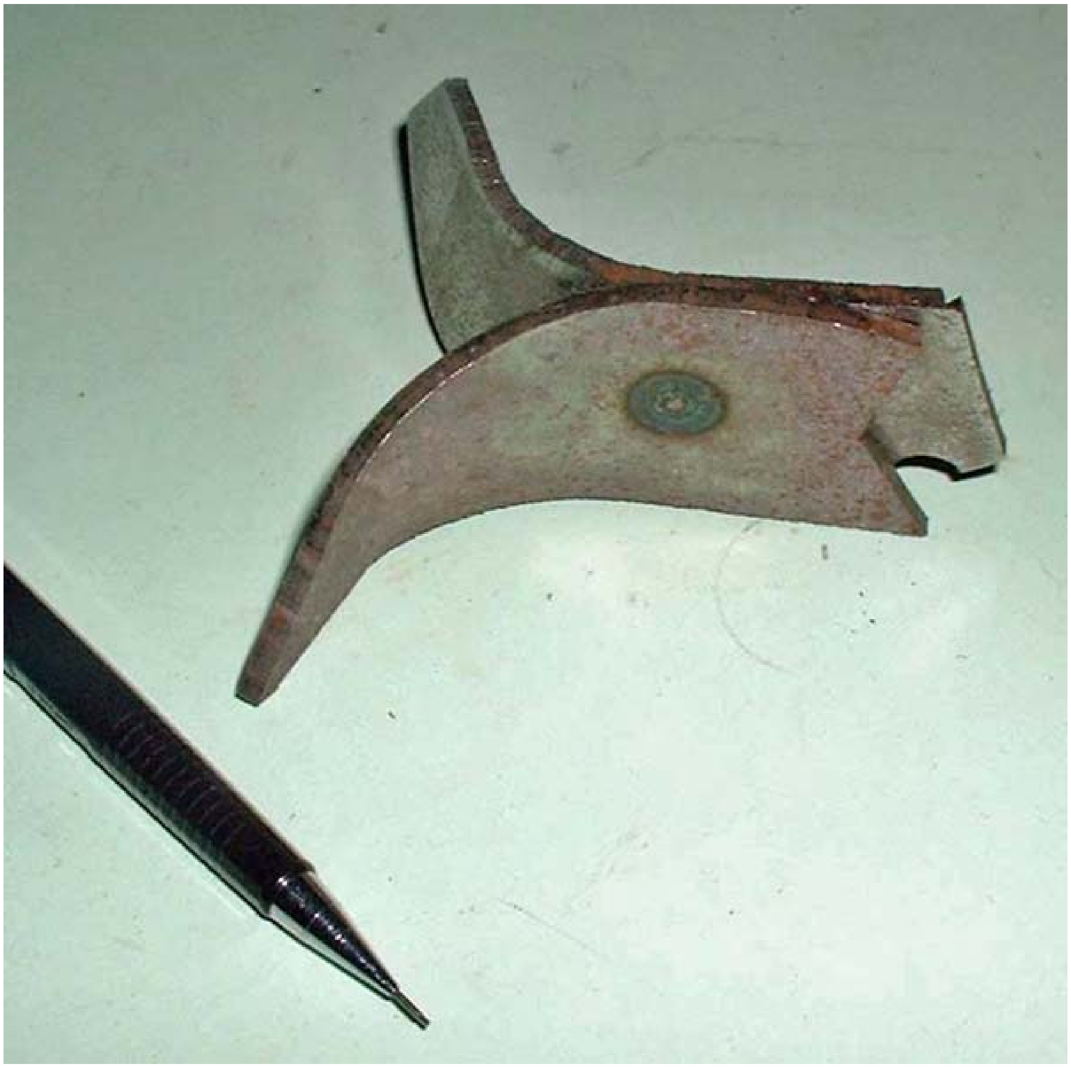
In use, the welder is controlled by a foot switch. This keeps both hands free to hold the work. This is important as sheet metal jobs are often large and awkward to control. I would even like a foot-switch controlled pressure lever so I didn't have to hold the work with one hand while I close the contacts with the other.

The toggle switch is to disable the foot switch until I'm ready to weld. I've accidentally stepped on my drill press foot switch enough to think that the welder would need an override. There is an indicator light to show when it's enabled, but I stupidly mounted it on the back of the welder, where I can't se it!

DIY MOTSWs sometimes have a timer to control the burn length. I.e., the foot switch turns on the timer which turns on the SSR for a fixed, but adjustable, length of time. I didn't know if I would need this, so I left it out until I know. So far it's worked fine without it. Just hold the switch until the weld looks OK. Most of the welds that I've made so far have been on 20 ga stock. The weld time has been about 1 sec. The allowable range is large enough that manual control has worked, most of the time (a few not-enoughs and a few burn-throughs). Also, the length is long enough for my reaction time. I.e., it's not so short that I don't have time to react. There is an advantage to manual control in that variations in the material cleanliness and fit will affect the timing, so it's probably better to be able to react to that.



The 1/8" steel test weld:



This is after the "peel" test. As welded, the 2 pieces were flat against each other. To test the weld, one piece is held in a vise and the other piece is peeled back (with a wrench in this case!).