Homemade Spot Welder

by jds1969 on July 30, 2008

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Intro: Homemade Spot Welder

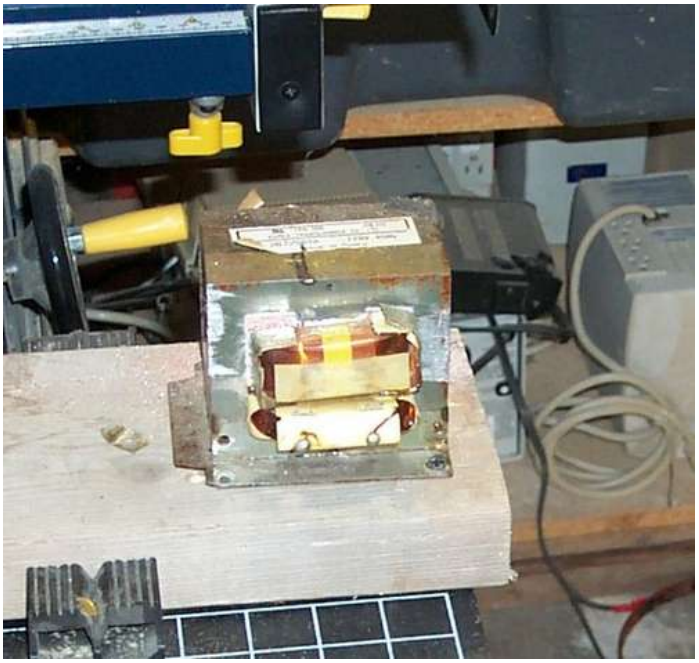
Anyone can build this simple to use light duty spot welder. I found all the parts I needed in my shop. I looked at some other plans on the Internet but they all seemed to require something I didn't already have.

step 1: The transformer (core)

I had three MOTs (Microwave Oven Transformers) collecting dust in a box with a bunch of adapters and transformers. The one was exceptional for the fact that the primary and secondary were separated by a shunt. Placed on it's base the secondary was on top and the primary on the bottom (pictured).

I used a pipe cutting blade (hacksaw blade) on a reciprocating saw to cut the secondary off the transformer core. Near the end of the cut I had to use extreme caution as I did not want to damage the primary coil. The primary and secondary can be identified by the number of turns and the gauge of wire. The secondary has many thousands of turns and uses hair thin wire. The primary is more like 18 gauge.

Once the secondary coil was cut away I used a short metal bar and a hammer to pound the trapped portion from the core. It was wedged in there pretty good. I cleaned out everything except the shunt and the primary.

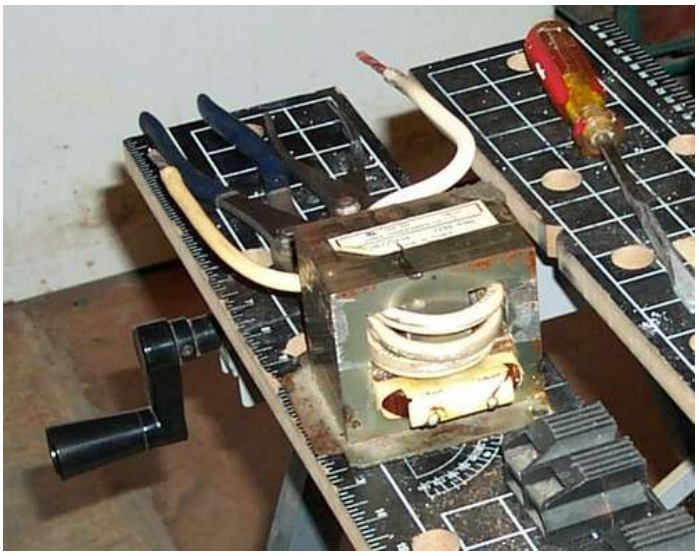


step 2: The transformer (new secondary)

I lucked out and found a 4 foot piece of grounding wire. It looks like a dozen 10 gauge wires bundled in one insulated coating. The only markings were three triangles. I understand from other sources that 4 gauge is recommended. I can't tell if I followed this exactly or not, but based on how hard it was to wind this monster in there I would hate to think of winding something thicker. It's surprising how stiff a thick wire like this is.

I bent the wire into a long tall U shape and fed the free ends into the transformer core. I then bent and curled and gently maneuvered the free ends back through the opposite sides. I ran out of room in the core before I ran out of length. I could get one more turn out of it if need be.

Transformer theory is a little beyond my ability to write about. There are many sources on the net if you are interested in this subject. The idea here is to have 3 or 4 windings on the new secondary. This will produce somewhere between 3 to 6 volts. I measured 2.5 when I plugged it in for a quick test. The lower the volts, the higher the amps. This is the main reason that such a thick piece of wire is used.



step 3: Building the jaws

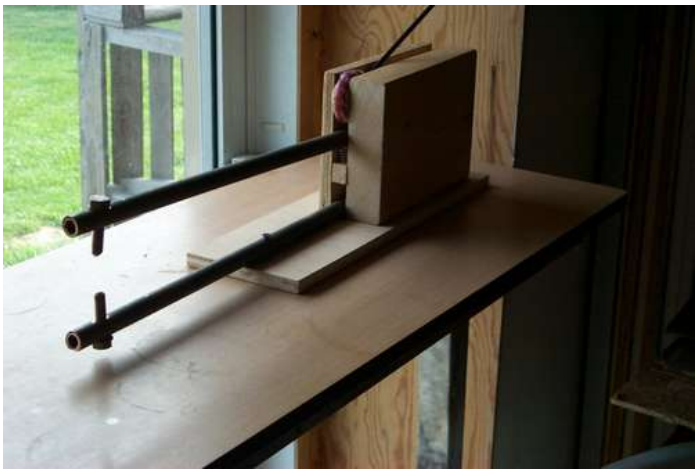
So once I realized that the new secondary was actually producing an output, I decided to proceed. Up until this point I wasn't sure it was even going to do anything at all.

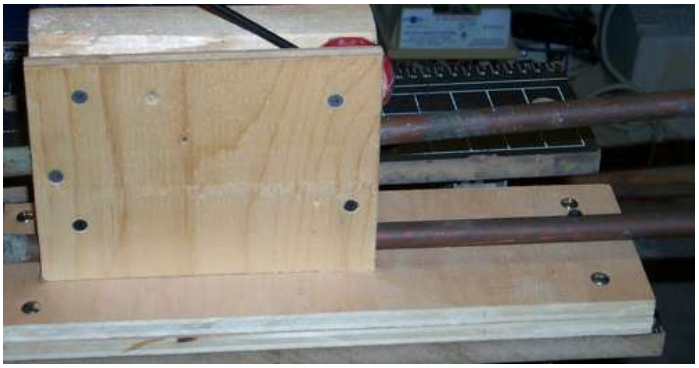
I used scraps of wood. A long narrow piece as the base. A fat piece mounted on it's side and screwed in from the bottom. A piece of thin plywood to seal in the remaining side. I had some copper pipe scraps that worked out well. In my caution over heat I doubled up, using a 1/2 inch hard copper pipe with a 3/8 inch soft copper tube shoved inside. I drilled some small holes in the pipes and then used drywall screws to assemble the entire thing.

The bottom jaw is fixed and I used a couple screws to do that, one into the base is visible in the picture. The upper jaw swings up or down and I used one screw, coming in from the side, near the back to achieve this. A small spring pushes the upper jaw up and an offset cam is used to push it down.

The bolts are made of copper. I stripped them off an old copper battery connector. I don't know how difficult it is to source copper bolts but there is a specialty fastener place in town that I would likely check first. I sharpened them on the bench grinder so that they came to a bit more of a point.

I tapped the holes, but copper is ductile enough that you can drill a hole slightly smaller than the bolt and just force it in. The bolt will cut the threads for you. I put the bolts in at the very start. I did everything else making sure that the bolts continued to meet when the jaws close. It is essential to keep the jaws electrically isolated from each other everywhere except the tips of the bolts.



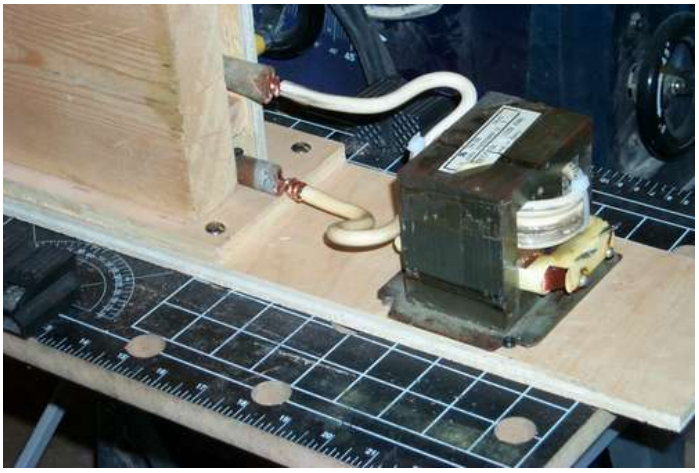


step 4: Assembly

A second piece of narrow plywood was required to extend the base for the electrical components. Being the first time I have attempted to make a spot welder I had to improvise on a few things. I would have chosen a longer piece if I had been able to see that far ahead.

I added an 8 gauge copper wire from a clean source as the copper on the pipes was quite tarnished at least on the outside. I forced the secondary wire into each of the tubes and wrapped the 8 gauge wire around the remaining exposed copper on the secondary wire. A pair of vice grips and channel locks crimped the tubes closed as tight as my hands would allow. Note: the 8 gauge wire runs up to the bolts at the front.

I had read a fair amount about spot welders prior to starting but I could never quite figure out the timer and custom power supplies. I had also heard talk of MOTs having power factor issues as well. I decided to just forge ahead and put a light switch on it. The switch is rated for 15A so I figured I couldn't go wrong. I put a red and black dot on the switch for quick reference. The box also provides a good (safe) place to connect the plug and all the wires.

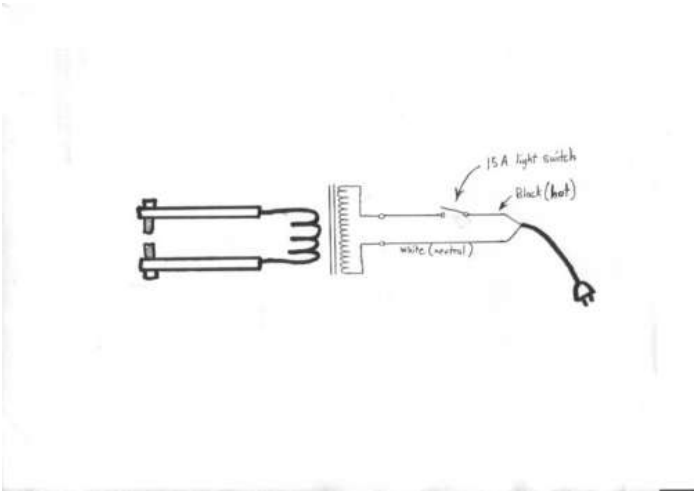


step 5: Schematic

This schematic is about as simple as it gets. It's akin to the schematic for a lamp. I include it for completeness.

PLEASE USE CAUTION: This project uses 110V AC. There are sections of the device that can deliver a deadly shock to the operator. One should take all the necassary precautions both when building or operating. If possible wires carrying 110V should never be exposed as casual contact can lead to a shock.
Mar connectors, soldering, junction boxes and electrical tape used properly can save your life.

If you don't know what you are doing or if you have never attempted projects involving 110V please don't learn the hard way. Go to Home Depot and take a wiring work shop or something.



step 6: Operation and conclusion

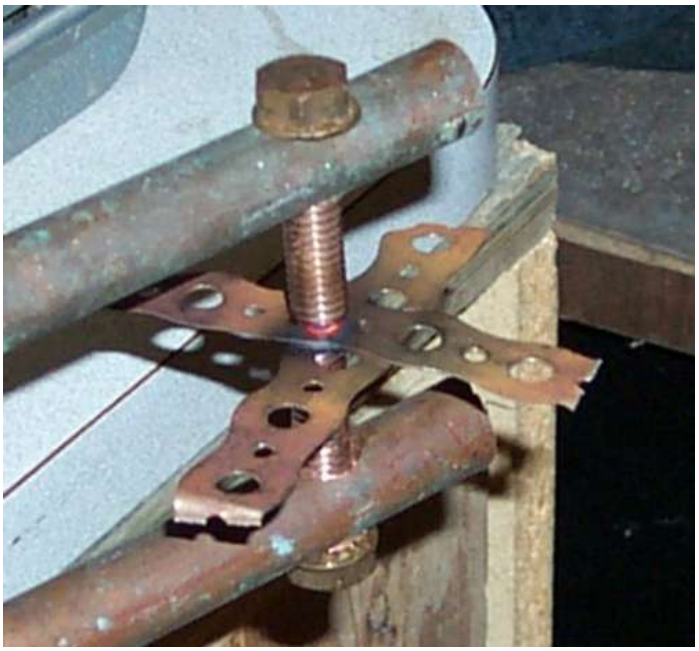
I built this spot welder for two reasons:
1) I always wanted to have a spot welder.
2) I broke the handle off a stainless steel cup measure and I wanted it back on.

I built the jaws so that there was enough room to get it in there without necessarily creating an alternate path for the electricity. It took a little fiddling to get it in there properly but once the cam locks down, the piece stays right where you want it.

I plugged it in and crossed my fingers. Threw the switch and I could hear the transformer hum. Then a small spark and an ever growing red glow between the bolts. The glow starts off red but gets orange the longer you leave it. I count to 10 and turn it off. This seems to create a fairly good bond.

The thickness of the piece changes the time you would require. I tried to join two eighth inch pieces and got nowhere. This is a light duty welder for thin metal. Sheet metal work is about the most you can expect. Heat is not as big of an issue as I thought. Maybe because I used a lot of copper. The bolts and the ends of the jaws are warm after use but not as hot as I would have expected.

For more power I could remove the shunt in between the primary and secondary. I could also add an AC capacitor (~30uF) across the primary connection to adjust the power factor. I'm just not sure why. It works fine for small pieces and I'm satisfied with low power that doesn't shoot sparks everywhere anyways.



step 7: Safety Measures

I have received some negative press regarding safety (and rightly so). I decided that I should add a box around the transformer. It will provide protection for the operator and avoid any exposed 110V contact completely. Going with the idea that it can built without purchasing anything I started scrounging around for a box. They were throwing out a broken PC power supply at work.

SAFETY NOTICE: PC power supplies contain large capacitors that can store energy for a considerable amount of time (days). I checked with the person that removed the power supply and he told me that it had not been plugged in for quite some time (months). The shock isn't likely to kill you but it will make you wish that you had waited a little longer to open the box. Please use common sense.

I removed the internal parts from the box and put them in the pile of e-junk that is scheduled to go off to the recycle depot. I left the switch and plug to avoid open holes but you can cover it with gaffer tape or electrical tape instead. Don't use the switch in these boxes as they are not rated for 15A. I also left the ground wire that is attached to the box. I carried a third wire to the box and grounded it. This effectively grounds the core of the transformer which is now attached to the bottom of the box.

The box can be modified with tin snips if you take your time. I use pliers to bend back any parts that are twisted after cutting. Electrical tape to cover any sharp edges or protect insulated wires. I tested everything after I was done. It increases the audible hum that the transformer makes when it is on. I had considered adding a light that would indicate it was on, but I don't think that's necessary. I know exactly when it is on.

I also talked to a friend of mine who works with a spot welder at an HVAC factory in town. He said that the boxes they were welding would occasionally short across the tubes instead of the tips. It doesn't harm anything but it prevents the welding. They solved the problem by wrapping the tubes in electrical tape.

I hope that this gives you a fairly good idea of how to make this device even safer to operate than it was originally. Please use caution as this device is not a toy. Serious burns and/or electrical shocks are possible if safety is not your primary concern.

Related Instructables

Make a carbon arc torch for your 220 volt stick welder by Phil B

How to Weld - MIG Welding by noahw

Small 110 volt arc welder (NYDG) by Kdemon

Power Tool Repair Made Easy by TimAnderson

Welding (guide) by noahw

Ghetto carbon arc welding by LinuxH4x0r

Cheap Welding for Punks by TimAnderson

Spool Gun Handheld Wirefeed Welder Powered by Car Batteries by TimAnderson

Comments

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BobbDobbs says: Jan 20, 2009. 5:11 PM **REPLY**

For additional safety I would take the ground wire from the cord (using a three prong plug) and tie it to the transformer case (drill and tap a machine screw into the core) and also tie the ground wire to one of the tongs, probably the stationary one.

The purpose of this is that if there are any unintentional shorts, it should trip the circuit breaker rather than floating at a high voltage waiting for you to touch it.

student.mckinney says: Nov 4, 2009. 9:57 AM **REPLY**

Yeah, that is a fate that nobody should have to meet. I recently shorted out a damaged PS with my hand and that is not a fun experience..

student.mckinney says: Nov 4, 2009. 9:49 AM **REPLY**

Yeah, and the primary can have anywhre from 200 to 3000 turns, depending on your transformer. That means that if you have 4 turns on the secondary, and the transformer primary has 2200 turns, you've got yourself a 110v 60Hz to .2v 33kA transformer. So that's 550 times greater amperage on the secondary than the primary. Wear some rubber gloves.

student.mckinney says: Nov 4, 2009. 9:38 AM **REPLY**

But just think of all that fine guage wire that was wasted..... I have like 50 spools of wire from transformers, I just cannot let go of those little guys....

jeffteclenburg says: Sep 12, 2009. 7:51 AM **REPLY**

will this work on car fenders?Or what range of material gauges have you tried

jeffteclenburg says: Sep 12, 2009. 7:40 AM **REPLY**

I think I will do this the welder worked so good.

xBrainstormerx says: Jun 17, 2009. 4:52 PM **REPLY**

Uhm i got a transformer and I took out the secondary wires already but what if I only got a 12 awg that is 2ft and 6" is that okay or is that too little?

jds1969 says: Jun 18, 2009. 5:56 AM **REPLY**

Not even close. You will likely melt a wire that thin. It is always advisable to follow the recipe, especially when electricity is involved. Look for something thicker.

mickcaulton says: Mar 26, 2009. 6:56 PM **REPLY**

HI there great instuctable. I live in England so our mains supply is 240v a/c. Now i have a fair amount of dealing with household circuits lighting,sockets ect even upto fitting consumer units (Fuse boards). I also have a good understanding of d.c circuits no problem untill you bring in the transformer into the equasion. i know how they can drop or increace the voltage and ampage and i understand how they turn highVa.c to lowVd.c using a rectifyer. What i want to know is does the trx isolate the two circuits the primary and the secondary. As if you basicaly shorted out the two tips on an unransformed circuit you would cause a short and blow the nearest fuse. Why does that not happen in your welder ?? I can only see that it is as the two circuits are not physicaly joined. the primary will not blow from a secondary short is that correct... I would be thankfull of any advice anyone can give as this would help me alot in understanding the prinsiples of electric welding. Thanks to author and all commenters. very informative !!!!! *****

jds1969 says: Mar 31, 2009. 12:13 PM **REPLY**

To be clear the output and input are both AC. The transformer limits the total input current based on the size of the core used. Hence when the circuit is "shorted" the maximum current does not exceed the limit of the fuse. I hope that answers your question.

mickcaulton says: Apr 1, 2009. 2:45 PM **REPLY**

Thankyou for your reply. I did understand that your circuit is a.c on both sides of the transformer, i was just getting a little off track when i was asking the question. You say the input current is regulated by the size of the transformers core, so if you were using say a 15amp fuse you would make sure the trx's core restricts the input current to < 15 amp's. (Am i right so far). If that is the case when i look at a old transformers is there a way of testing or measuring the impedance of that core. I know that if put a known value of voltage or ampage into a trx and measure the output i can workout the ratio the trx is working at. (the number of windings on one side to the other setting the ratio.) 1000 winds on one side, 500 on the other a ratio of 2:1 so 240v in would give 110v out. (Am i correct in my thinking here ? ?) but on this 2:1 trx if the 240v imput was 5amp, would that also mean the output would be 110v @ 2.5amps or would the ampage work in reverse so the output would be 110v @ 10amps. I know there are many questions here but if you or any of the community are able to answer either some or all of my questions i would be very grateful. Again good "..able" and thanks for reply to my question.

alexhalford says: Jun 9, 2009. 1:56 PM **REPLY**

Theoretically you are. Transformers can be very efficient, but not 100%, so you're actual current will be a little lower than the calculated current.

eric m says: May 23, 2009. 1:58 AM **REPLY**

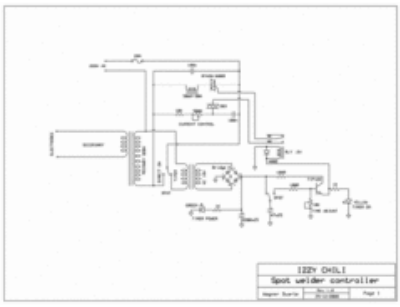
Why not just one loop of wire? Wouldn't that be better than 2 or 3 loops?

jds1969 says: May 27, 2009. 1:02 PM **REPLY**

Eric answered his own question on my orange board by stating that the voltage might be insufficient for good welding despite there being more amps available. In an earlier comment someone suggested that a commercial unit schematic showed one loop. I think it might be an interesting experiment in either event but I know that 3 to 4 winds works well.

IZZYCHILI says: Dec 29, 2008. 9:14 AM **REPLY**

This is my last version, where I place a TRIAC current control.
It works fine.
Izzy Chili

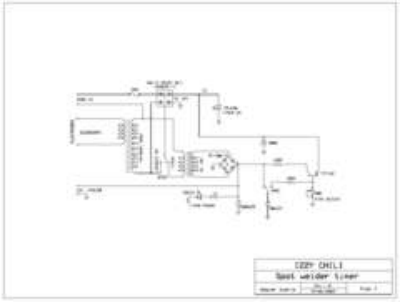


badman11 says: May 23, 2009. 2:09 PM **REPLY**

to IZZYCHILI is is possible to replace the relay in your design with a solid state relay? I want to see how small I can make this thing.

IZZYCHILI says: May 25, 2009. 4:49 AM **REPLY**

I can't place here a good image. I was tried .gif and .bmp formats. Now I using the 240D25-17, 25A solid state relay. If you want a small type, the BTA41-800 Triac is a good choice.



badman11 says: May 26, 2009. 3:54 PM **REPLY**

you sent a third schematic for a RESISTIVE WELDER CONTROLLER. What kind of transformers are you using for the Welder output. Are they microwave oven transformers and if not what are they and where can I get them?

IZZYCHILI says: May 27, 2009. 6:42 AM **REPLY**

I built my own transformers. I winding in a 60x100mm iron core 147x2 turns of 13AWG magnet wire as a primary coil - 220V, and 2 turns of 1.5"x0.25" copper rectangular bar to electrodes. For 110V, the primary coil has 74x4 turns -13AWG.
Now I using only a timer control with 2 solid state relay -25A each- in parallel.

badman11 says: May 25, 2009. 2:39 PM **REPLY**

where can I get a better image of this schematic? please email to me here http://howjo2001@yahoo.com

badman11 says: May 30, 2009. 1:20 PM **REPLY**

what I want to do is power this circuit from a 120 wall outlet and put it into a very small case. Will I have to substitute this solid state relay with another 220 volt solid state relay like for instance the Crydom #HD4890-10 or in my case a 120 volt solid state like the Magnecraft & Struthers-Dunn# 70S2-04-B-03-V? can I even substitute a solid state relay without seriously altering the design?

McCreary says: Jan 5, 2009. 4:31 PM **REPLY**

Is it possible to get a clearer copy of your design? I need to fabricate a small spot welder and want to have some measure of control over the output current so your design appears to be just what I need. The trouble is, I can't make a copy of the schematic and read some of the component values! Thanks.

Derin says: Feb 21, 2009. 10:04 PM **REPLY**

This link could help you read the values.

CameronSS says: May 12, 2009. 9:11 PM **REPLY**

Do you have recommendations for where to find 4 AWG wire? All we have lying around hereis either 10 gauge of smaller or welding cable (1/0 or 2/0, I think).

jds1969 says: May 14, 2009. 4:50 AM **REPLY**

You can buy ~4AWG most anywhere home supplies are available, usually by the foot. I'm a bit of a scrounger myself and like to find what I can where I can for free. The dump is a good source. Metal recycling places might let you have a 4 foot piece if you ask nice. All that being said I recommend using the largest wire you can wrap around twice or thrice in the core. If you think the welding wire will fit there is no harm in going larger. The 10 gauge wire will not be sufficient and you would need to wind many coils in PARALLEL (not series) which will work but will require more work. I toyed with the idea myself.

The key in all of this is to maximize the amount of copper on the secondary side due to the high amperage and accompanying heat produced.

espin66 says: Mar 9, 2009. 5:00 PM **REPLY**

excellent experiment
felicity

uberdum05 says: Feb 28, 2009. 6:41 AM **REPLY**

It's the opposite in terms of a LED, the higher the temperature, the more current, so it gets hotter and hotter and hotter, until finall it dies.Its called a 'thermal runaway'.

Derin says: Feb 21, 2009. 9:59 PM **REPLY**

Input current:8A
Output current:333A with three winds

eric m says: Feb 17, 2009. 3:09 PM **REPLY**

Am i right in saying that you should just try to fit as many winds as you can and not worry about how many.

More winds = more power?

jds1969 says: Feb 18, 2009. 4:39 AM **REPLY**

In this case: more winds = more volts and less amps. It's the amps that are doing all the heating through resistance in the piece to be welded. I would suggest one, two or three winds on the secondary and no more.

eric m says: Feb 19, 2009. 12:13 PM **REPLY**
ok

RCS says: Feb 13, 2009. 10:45 AM **REPLY**
Dear all :
You can improve the welder efficiency by change the bolts contact for ones smaller than 1/4 inch

jds1969 says: Feb 17, 2009. 9:19 AM **REPLY**
The same efficiency can be gained by narrowing the tips as much as possible. I sharpened mine by hand on the grinding wheel but I know that industrial spot-welding tips are usually quite sharp (aka. pointy). They are made with alloys of copper (beryllium) that can take the heat without melting. The copper ones need to be sharpened often as they round off after only a few welds.

BobbDobbs says: Jan 20, 2009. 5:20 PM **REPLY**
I also want to say that once you have a core ready to go, you can wrap some temporary small guage wire, like 10 turns, just to check what voltage it produces. Adjust the turns (add or remove some) to get around 2 volts. Now you know how many turns you need for the BIG gauge wire (which is a lot harder to wrap, so you want to do it only once.)

BobbDobbs says: Jan 20, 2009. 5:18 PM **REPLY**
One important "transformer theory" fact is that the power capacity of a transformer is limited by the core cross-sectional area. The bigger the core, the more power you can get to the secondary.

This means you want a big enough core, but not too big. If it is too big, a short on the secondary (which we get a lot in spot welding) will allow a huge current on the primary and pop your circuit breaker.

Aside from cost, transformer cores are never bigger than they need to be in order to prevent excessive primary draw in the case of a secondary circuit short.

dm_metalsmith says: Jan 3, 2009. 12:15 AM **REPLY**
hello,

i bought a cheap-o "speedway" brand spot welder on ebay. it worked, so so, for about a year or two, then it stopped working. somewhat.

it still comes on and there's the hum and the flicker of the lights, but no weld.

what's wrong? do you think there's a fried wire on the primary side possibly?

also, you mention, at the end of this instructable, adding a capacitor across the primary side for added power. i have two 17.5 uF capacitors. . . would i get the same result by stacking/daisy chaining these on one side of the weld point?

thanks!!

-doug

jds1969 says: Jan 3, 2009. 6:20 AM **REPLY**
Quite the opposite. The primary is where the hum comes from usually. Unplug it and check the resistance across the primary then check across the secondary. It should be low <5 ohms on both. If it's infinite on either, that's the problem.

The capacitors I was speaking of are marked for AC. AC capacitors allow for power factor correction and are attached across the primary connection. Google "MOT power factor correction" and I'm sure you'll get some info.

Good luck.

dm_metalsmith says: Jan 4, 2009. 12:29 AM **REPLY**
thanks for the helpful info! i'll try to get the thing apart and look at its guts. . .

BobbDobbs says: Jan 20, 2009. 4:49 PM **REPLY**
I just got a Speedway Spot welder. If it hums the primary is good. There is a woven copper link hooked to the upper tong to allow it to flex. That link can get red hot. It probably gets hot a lot in regular use. Plus it flexes when you open and close the upper tong. So I bet it has broken.

It is just bolted in, so it is replaceable.

rightbraincreative says: Jan 10, 2009. 12:10 AM **REPLY**
Is there any advantage to using solid copper wire in Step 2 vs. the stranded wire used in this instructable?
Any feedback on this topic will be appreciated. Thanks in advance.

laci37 says: Dec 26, 2008. 1:38 PM **REPLY**
Can you measure the resistance of your tranformers primary coil for me? It wolud help me a lot, I have tons of transformators but I don't know which should I use.

jds1969 says: Dec 28, 2008. 12:26 PM **REPLY**
I took several reads with my cheap multi-meter in both directions. Consistently, I get an initial reading of 1.3 which slowly drops to 1.0 and never changes. This would be ohms in case you weren't sure. Hope that helps.

laci37 says: Dec 28, 2008. 1:09 PM **REPLY**
Thanks, it can help a lot, but mine with 6 Ohms heats up very quickly and i'm afraid the electical tape catches fire if I leave it on mine just for minutes.

jds1969 says: Dec 29, 2008. 7:45 AM **REPLY**
That doesn't sound right at all. You may have a slightly damaged unit or you removed the wrong coil. I suggest looking for another MOT. Try to get one that is rated for 1000W. Good luck.

laci37 says: Dec 29, 2008. 8:13 AM **REPLY**
I have at least a hundred transformers lying around so I'll find a good one it's just the question of time :)

IZZYCHILI says: Dec 15, 2008. 10:09 AM
(removed by author or community request)

jds1969 says: Dec 28, 2008. 12:35 PM **REPLY**
Thanks for the suggested improvements. It's a nice reference for anyone who wants to go to the next level. I don't think I have all these parts in my garage, but who knows.

cjawahir says: Dec 27, 2008. 3:31 PM **REPLY**
great idea , the transformer output is isolated from the input side , so no danger of shock , but if the two copper rod touch together and you are holding it you can get a nasty burn.

some thing you should do to improve :

1>> use heat sheild to cover the copper .
2>> use a 10 amps fuse on the input side
3>> use a clamp on amp probe on the output side to monitor amps , this will help you to keep the transformer temp low , as not to over do it .
4>> use leather glove and eye protection .

please be carefull.

jds1969 says: Dec 28, 2008. 12:32 PM **REPLY**
Thanks for the suggestions.

mecka says: Dec 24, 2008. 11:32 AM **REPLY**
I was wandering, will this schematic work the same on 220 V MOTs!!!
Thank you

view all 99 comments