

# A \$10 Upgrade to my Harbor Freight® 90 Amp Flux Wire Welder, version 2

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My Harbor Freight 90 amp flux wire welder is surprisingly good. But as with most of their products, they always leave the owner a few things to improve.

I recently replaced the broken plastic handle with a steel one. This time around I have reworked the wiring of the welder so the tip is electrically dead until I pull the trigger. To do this I needed to buy a contactor (\$5.05), a small power supply (\$3.00), plus use a few bits from my junk pile. This

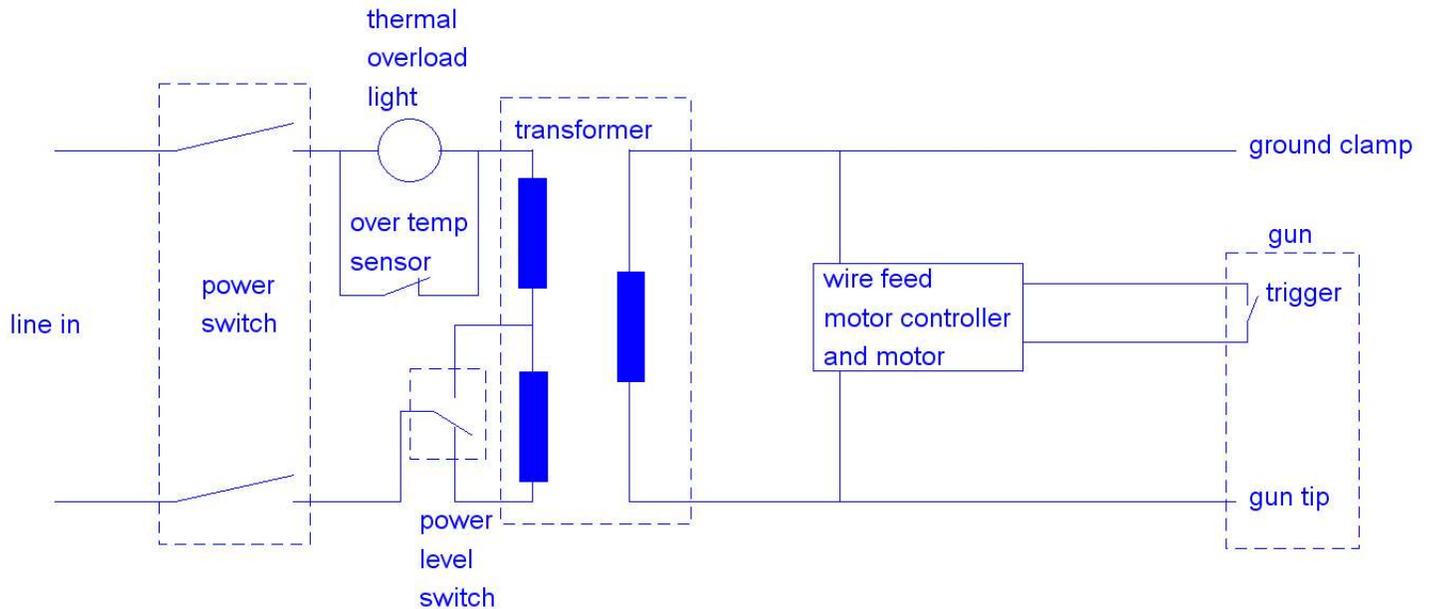
article provides some pointers on how you can do the same mod.

One word of warning, Harbor Freight often changes the design of their products without changing the product number or documents. Do not blindly follow these instructions as they may not completely apply to your welder.

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# The Original Schematic



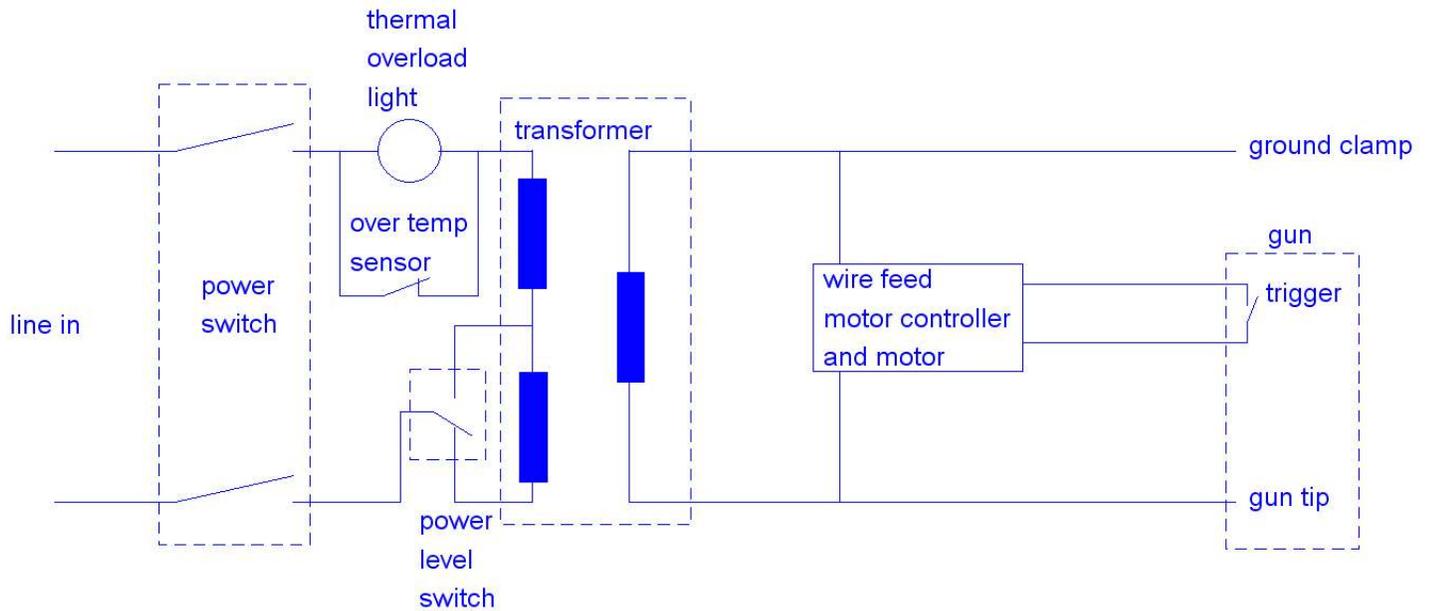
I have intentionally left off labels for wires shown on the schematic provided with the welder. They didn't match the markings found on my machine.

First let's review how the welder works and then I will explain how I modified it.

Starting on the far left, we have "line in". This is where the power cord connects. I have not shown the ground wire but it bolts directly to the steel body of the welder. The power switch is one of the two front panel toggles.

When this switch is in the on position, line voltage is applied to the power transformer via an over temperature circuit and a power level switch. If the transformer gets too hot, the over temp sensor opens up and removes power. This also causes the thermal overload light to go on. The sensor automatically restores power when things cool off.

The power level switch is the second front panel toggle. It enables you to select a minimum or maximum power level.

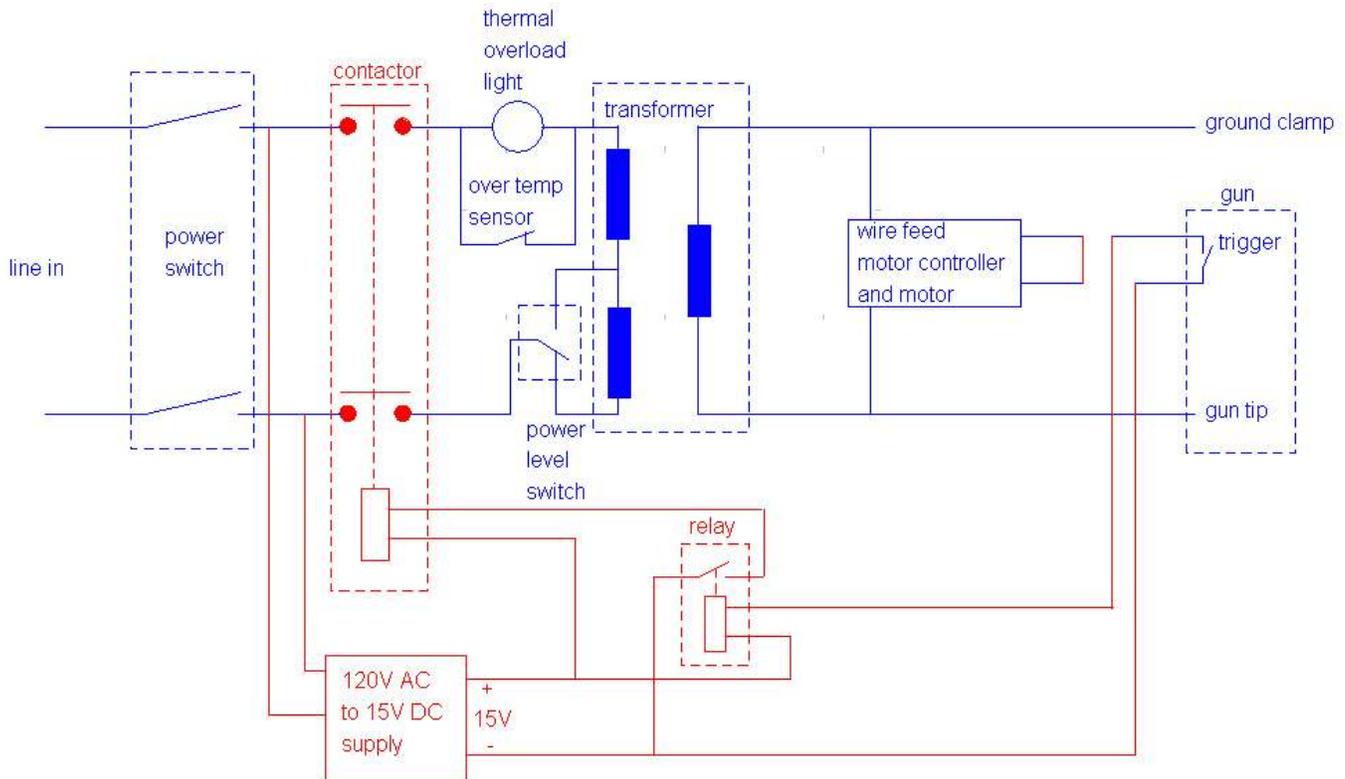


The output of the transformer connects to the ground clamp and to the gun tip. It also feeds a small circuit board that contains the wire feed motor controller. The controller connects to the motor and to a pair of wires that lead off to the trigger inside the gun.

To weld, you first turn on the power switch. Then select your power level. At this point your gun tip is electrically hot. In other words, if you touch the flux core wire to ground, you will get an arc, even though you have not pulled the gun trigger yet. Now, when you do pull the gun trigger, it starts the motor and the wire feeds.

If the over temp sensor opens, the thermal overload light will be on as long as the power switch is closed.

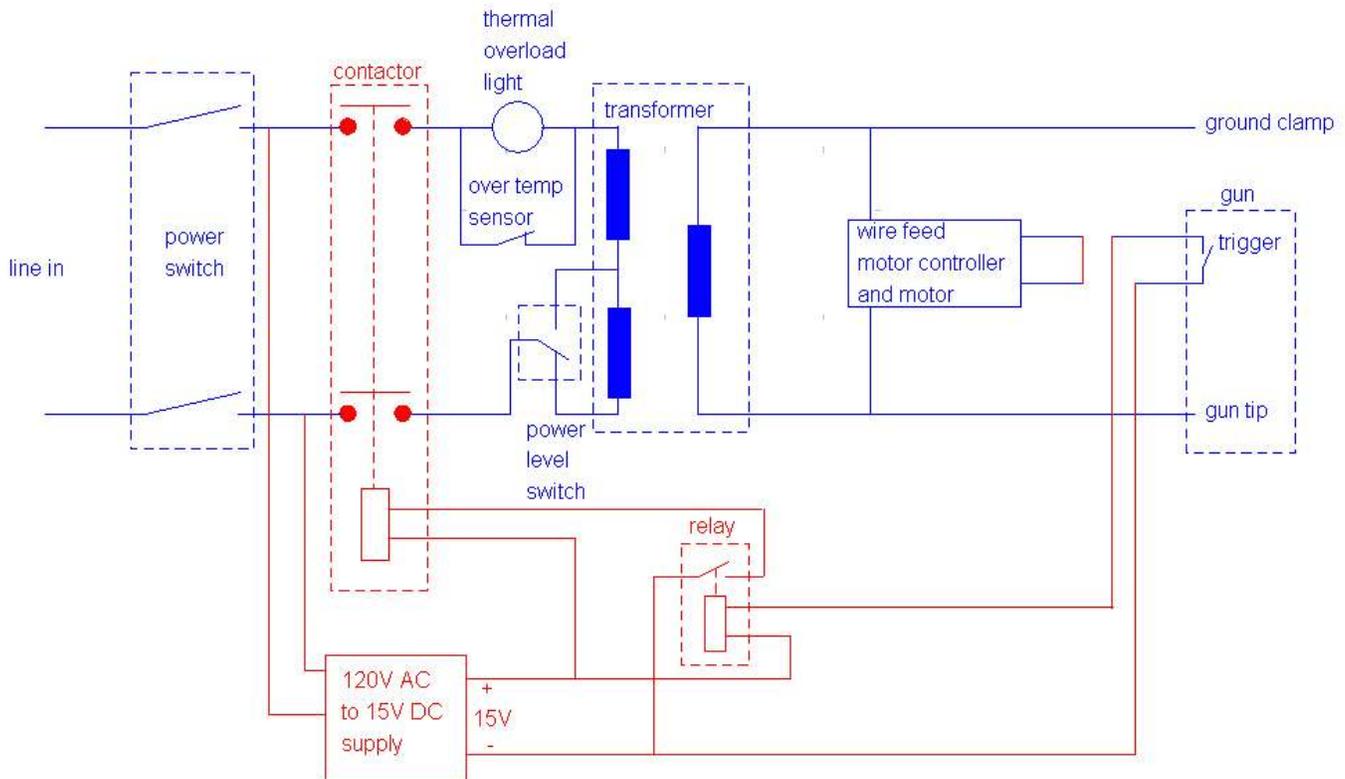
## The Modified Schematic



The purpose of this modification is to enable me to control the welder's power from the gun trigger. The complexity shown here is due to the limited current that the trigger can handle. If the trigger switch could control 120V at 24 amps, the task at hand would be a simple rewiring. From what I can tell, the trigger switch can handle more like 0.05 amps.

Again starting at the far left, we have the line in which is still controlled by the main power switch. But out of the power switch we now have a massive, electrically controlled switch called a contactor. When the contactor operates, power is sent to the over temperature circuit and the power level switch as before.

The contactor is operated by applying power to the contactor's coil. The power needed to operate the contactor is still more than what the trigger switch can handle.



I have chosen to use a small relay to control the contactor's coil power. Functionally, a relay is the same as a contactor. The difference lies in the power levels being switch. The relay can switch the contactor's coil power and can, in turn, be controlled by the trigger switch.

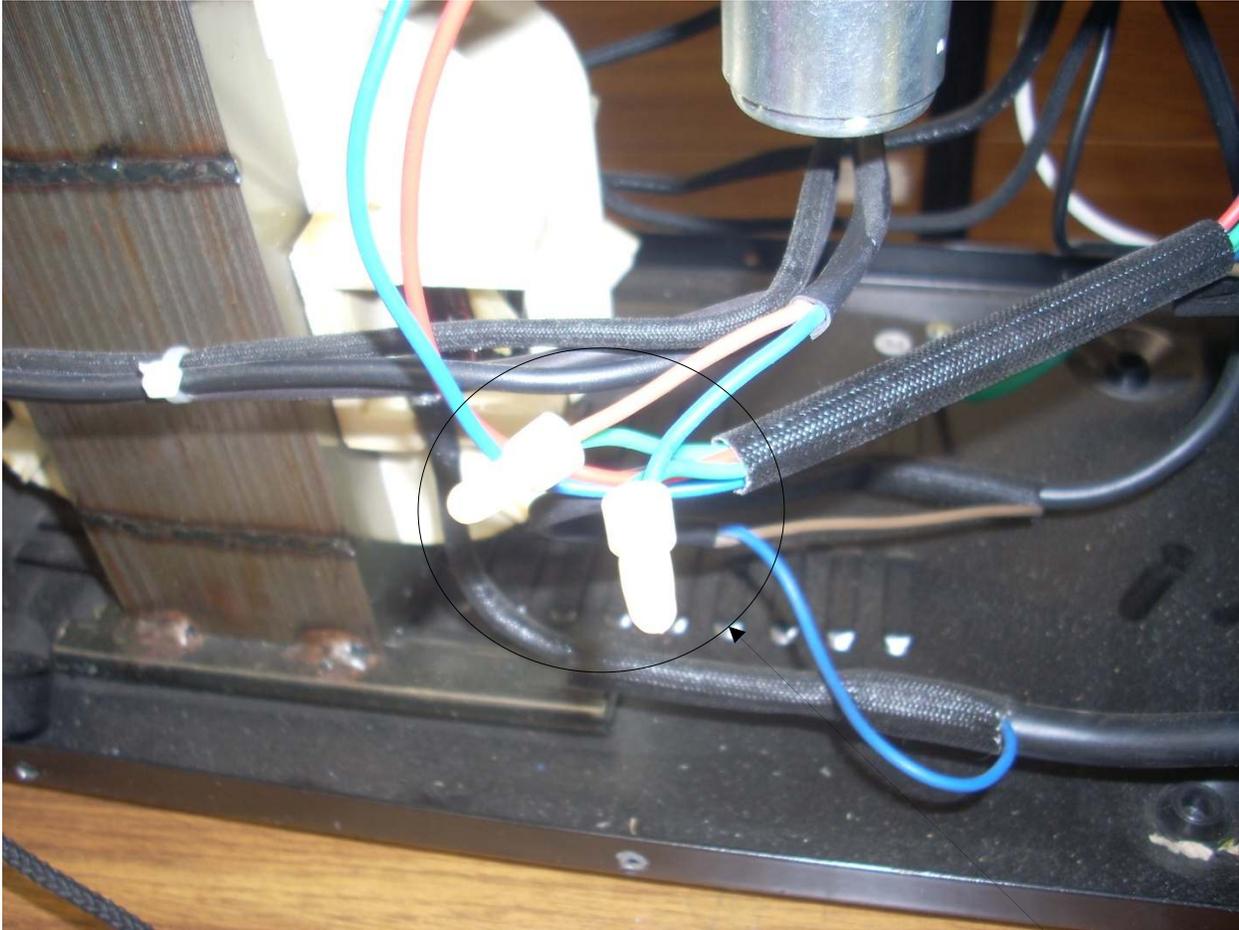
Let's walk through the steps leading up to welding. I plug in the welder, switch on the power switch, and position the gun on the grounded steel. When I pull the trigger, current flows from my AC to DC power supply's output and into my relay coil. This causes my relay contacts to close. That provides a path for current to flow from the same AC to DC power supply and into the contactor coil. With the contactor coil energized, power is conducted into the transformer via the over temperature circuit and power level switch.

Whenever power is available between the gun tip and the ground clamp, the motor runs and feeds flux core wire.

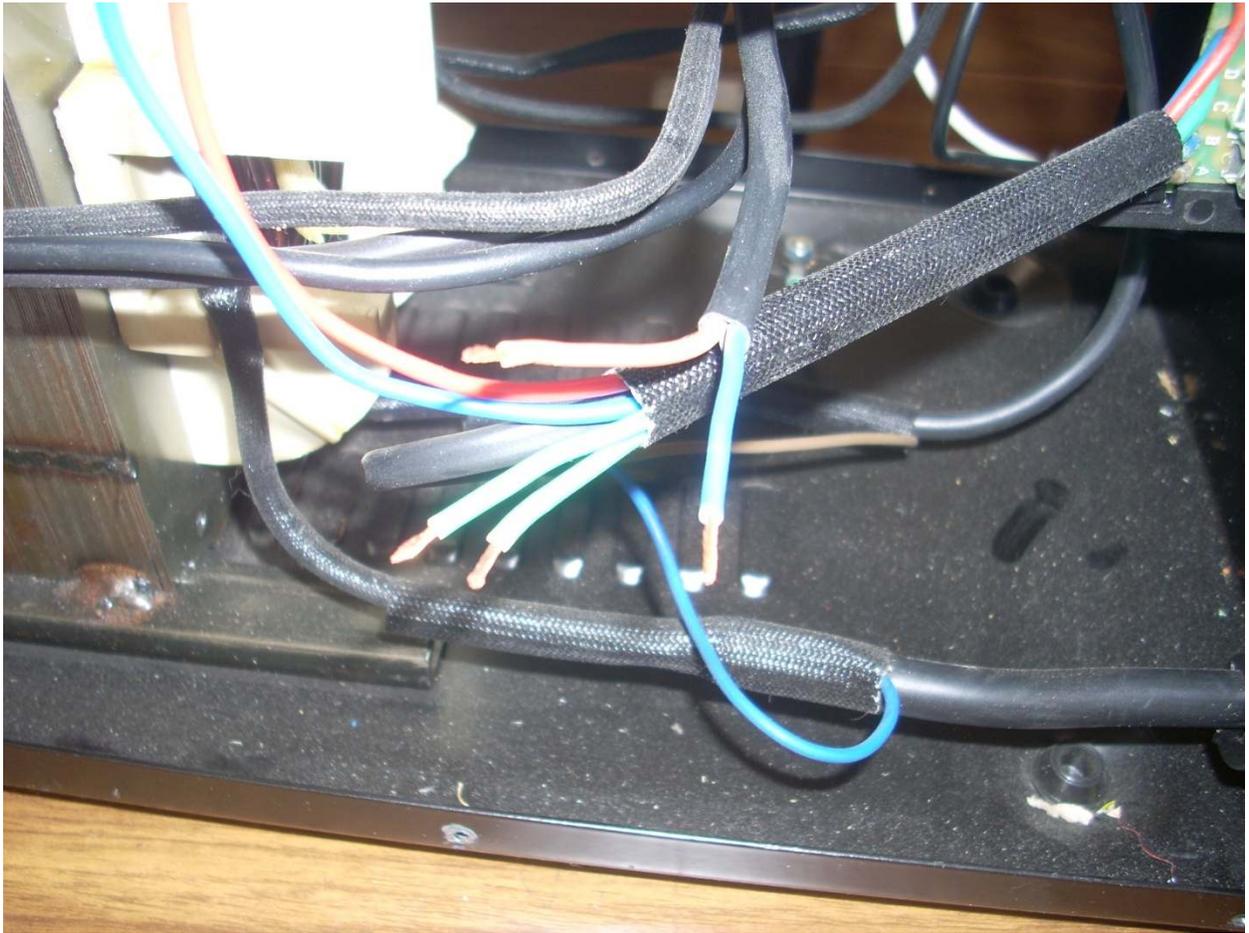
Let go of the trigger and the relay drops out. This causes the contactor to lose power and the gun tip no long has power available to it. At the same time, the motor stops running so the wire stops feeding.

CT2 of the gingery\_machines Yahoo group pointed out that if the transformer is in over temp, the sensor would be open. You will only see the thermal overload light go on when you pull the trigger. In this state you will hear the contactor operate with a loud click but no wire will advance.

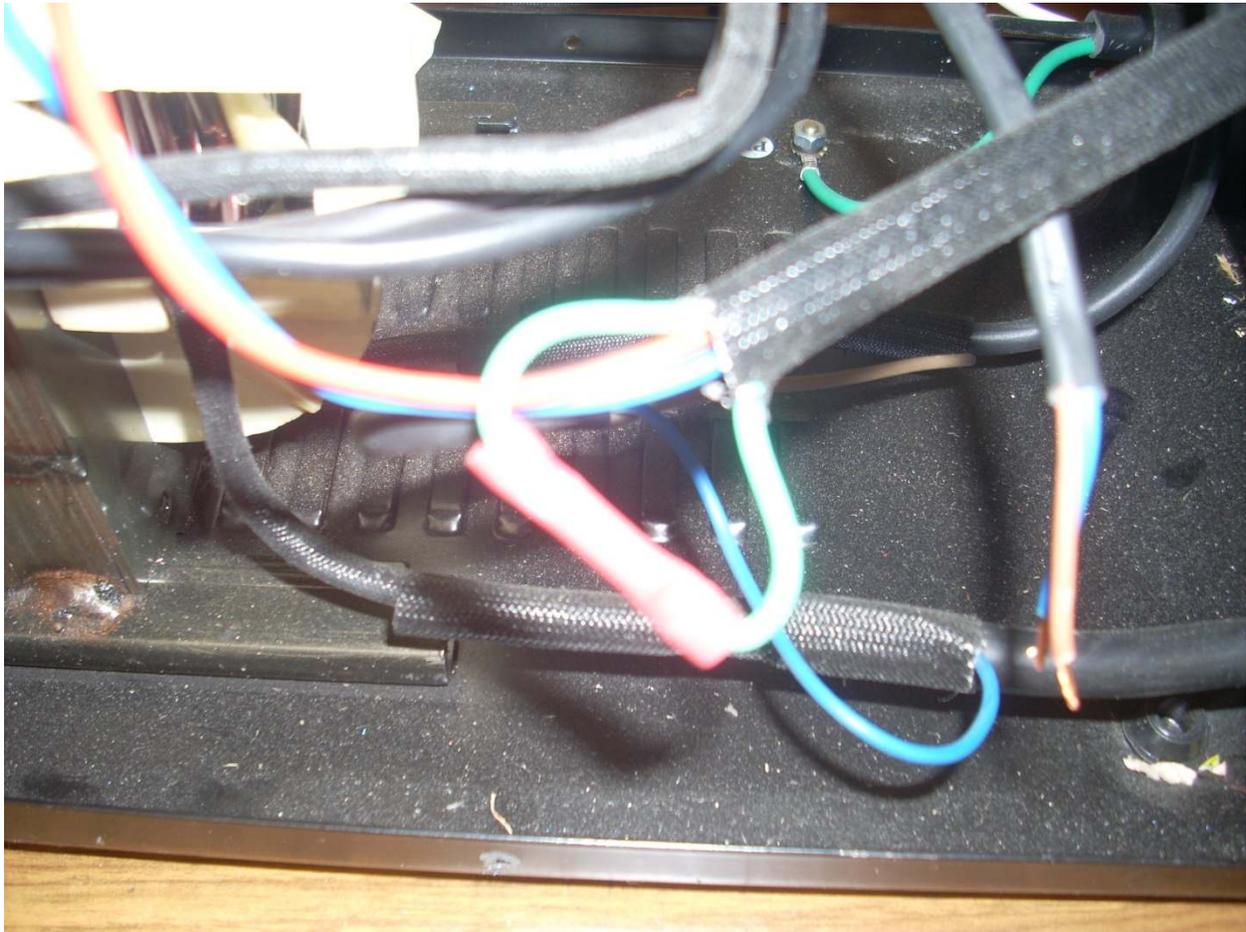
## The Welder Modification



With the side covers removed, it is easy to access all internal wiring. These two wire nuts connect the trigger switch to the motor controller.



I have cut off the wire nuts and stripped back insulation on all 4 wires.



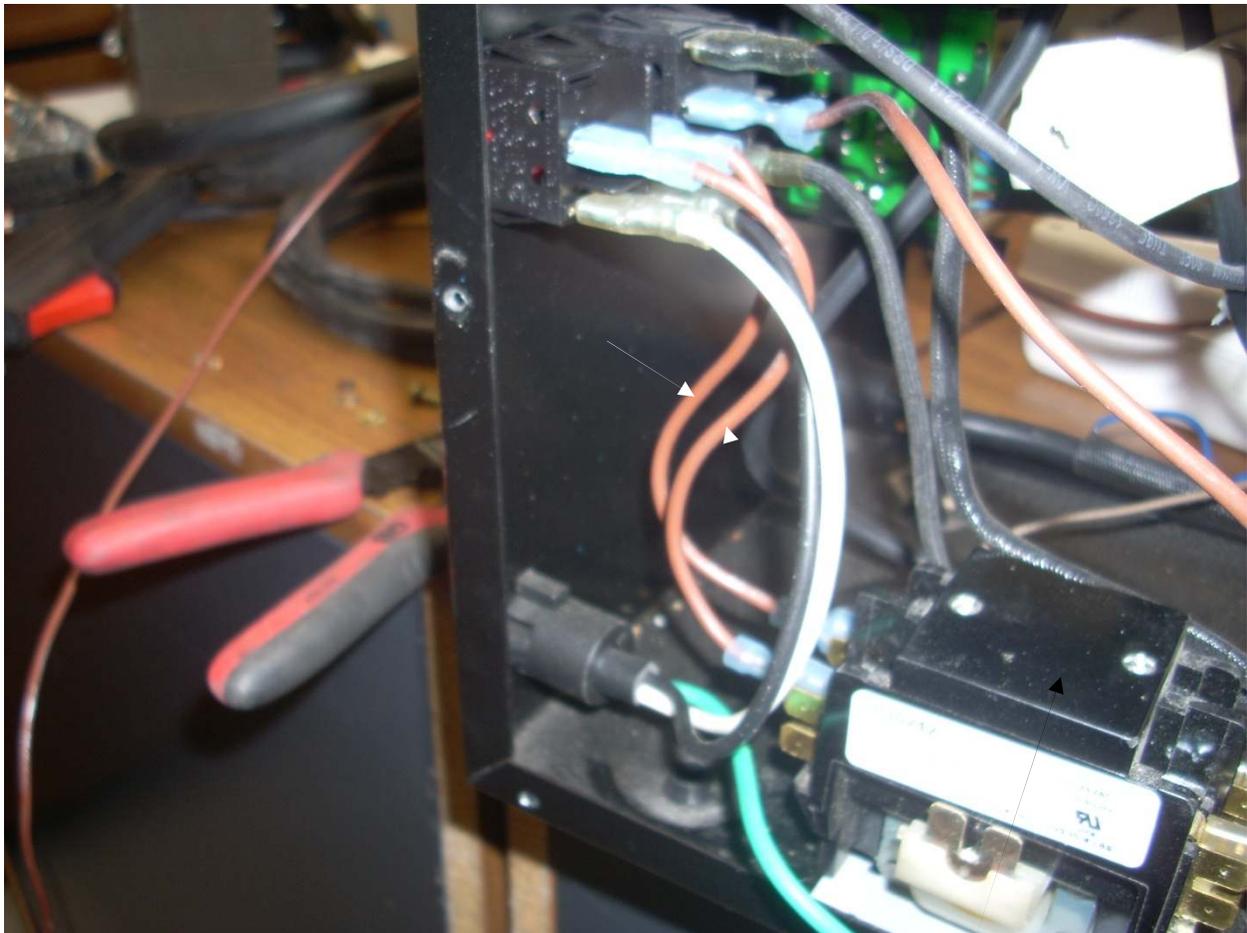
Using a crimp connector, I have connected the wires from the motor controller together. When power is applied between gun tip and ground, the motor will run.



You are looking at the back side of the front panel. On the left is the power switch. To its right is the min/max switch. Happily, it is all connectorized which makes the mod much easier to do.

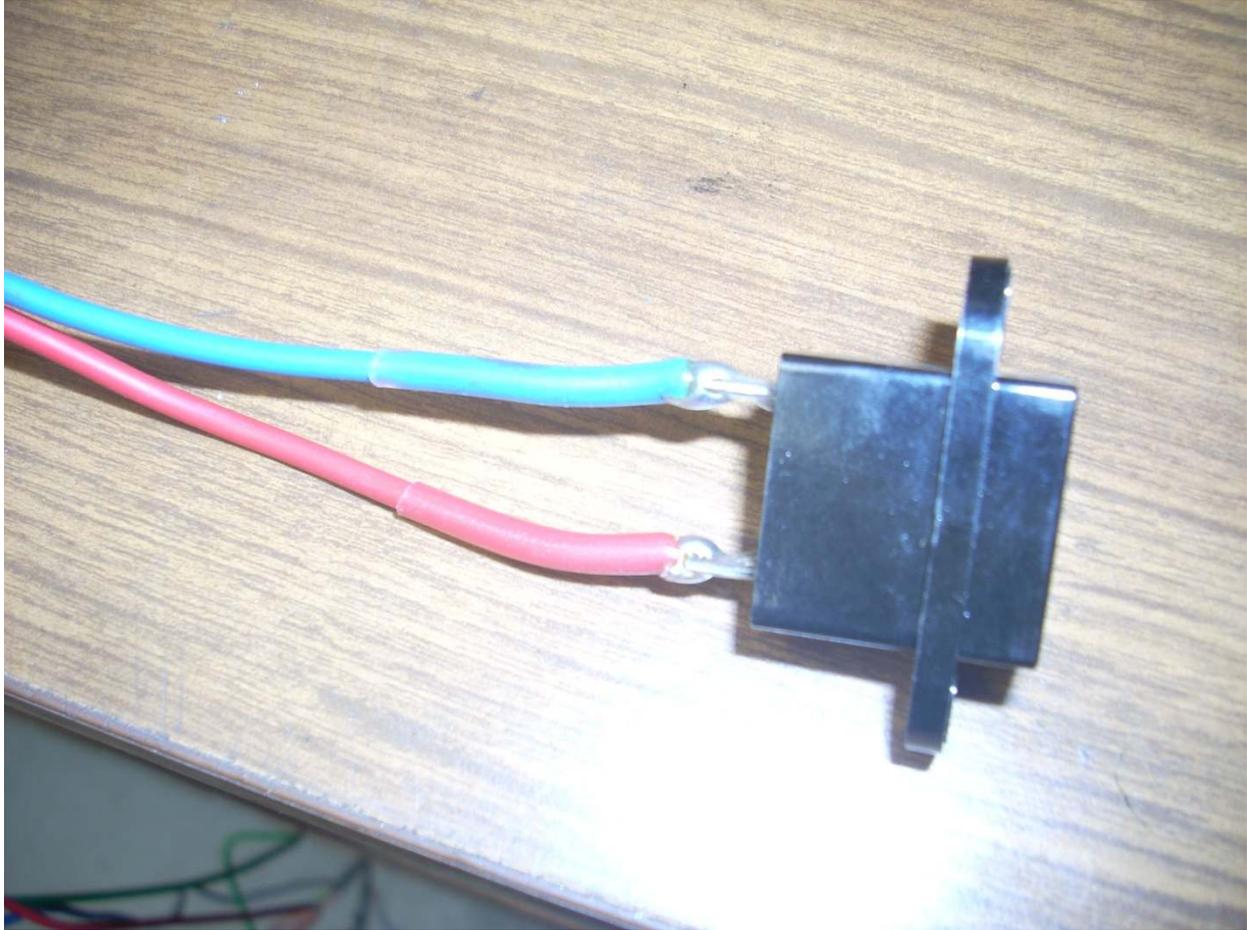


I have pulled off the wires that go to the over temp circuit and min/max switch.

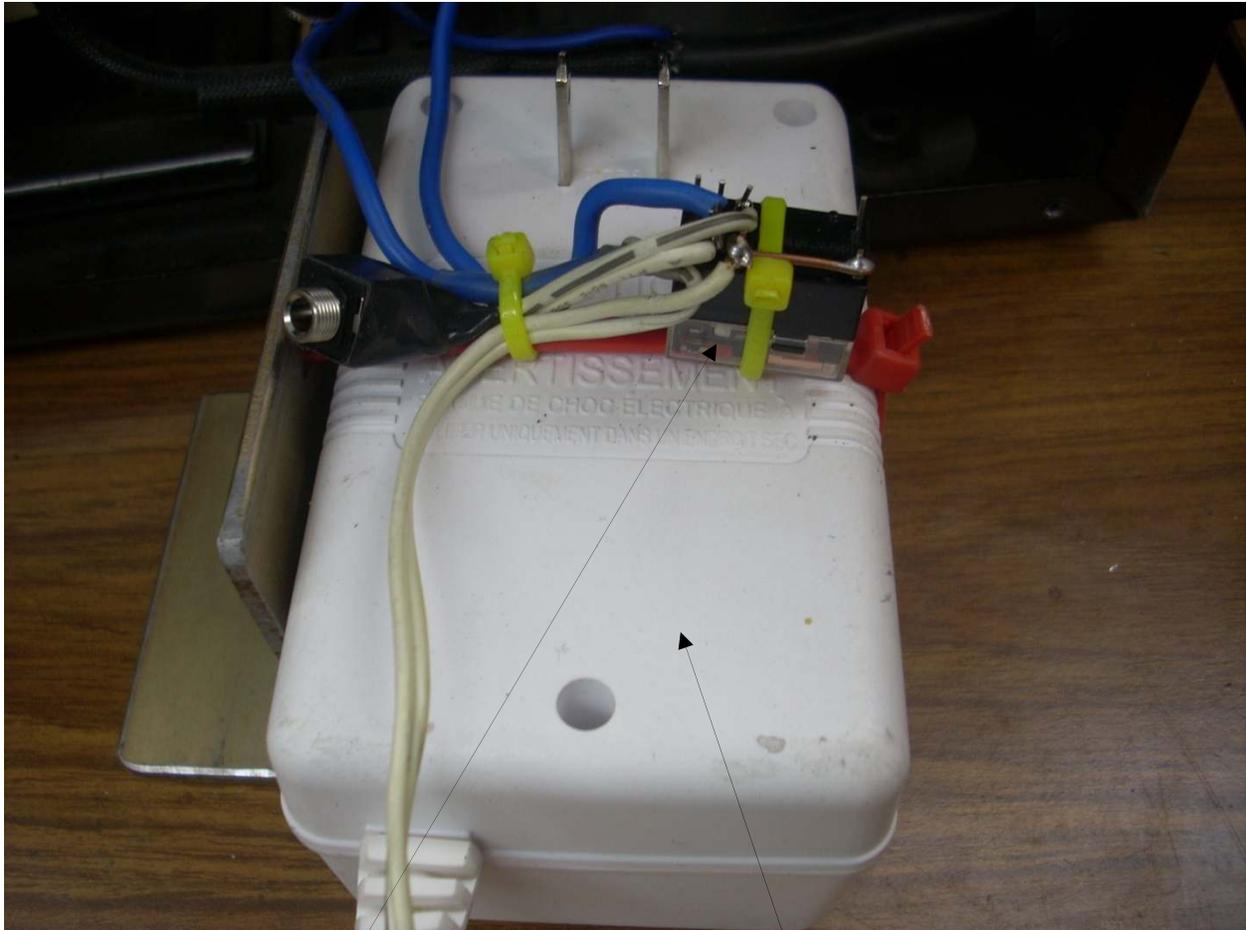


My contactor is that black box in the lower right corner of the picture. I have run red wires from the power switch to the terminals of the contactor.

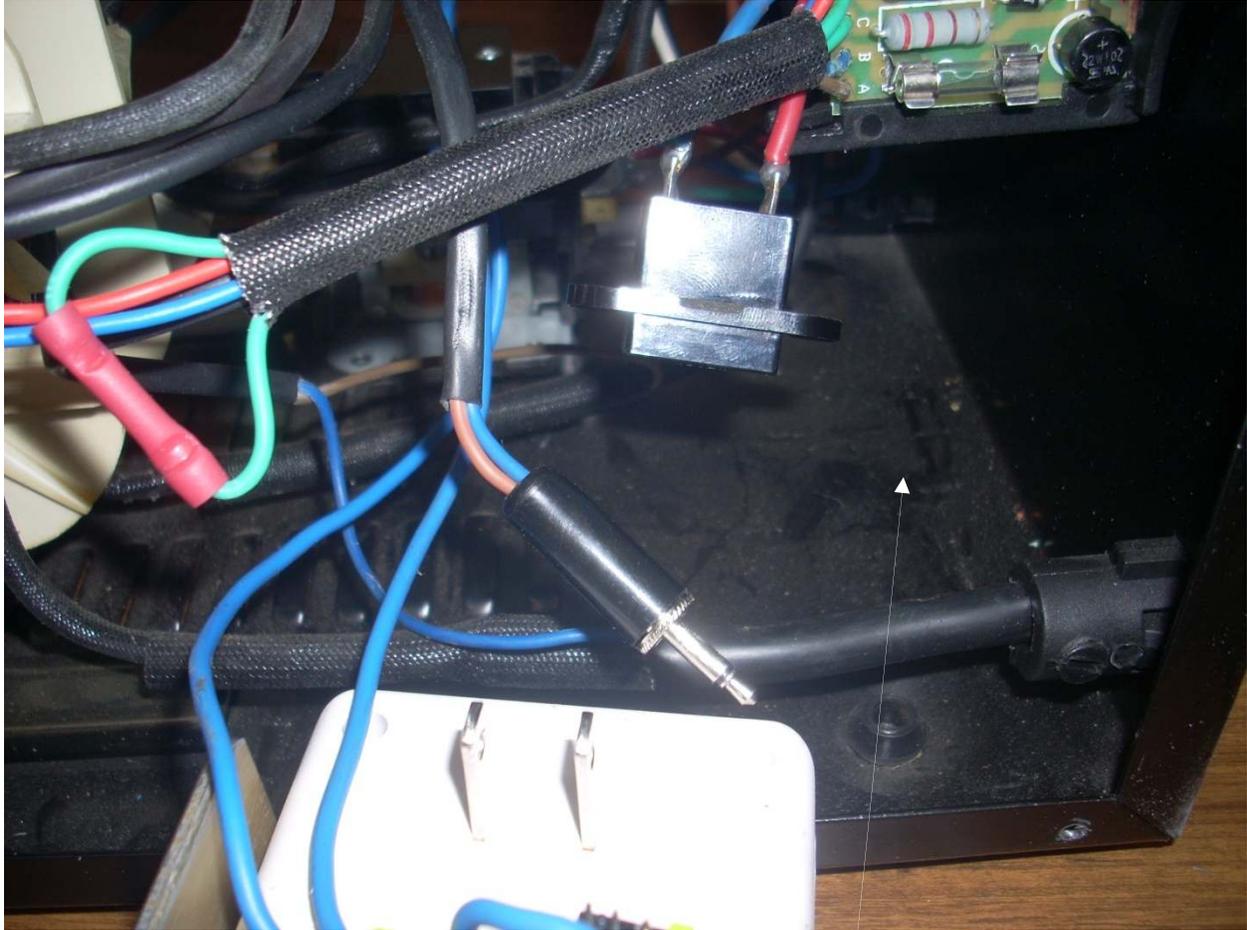




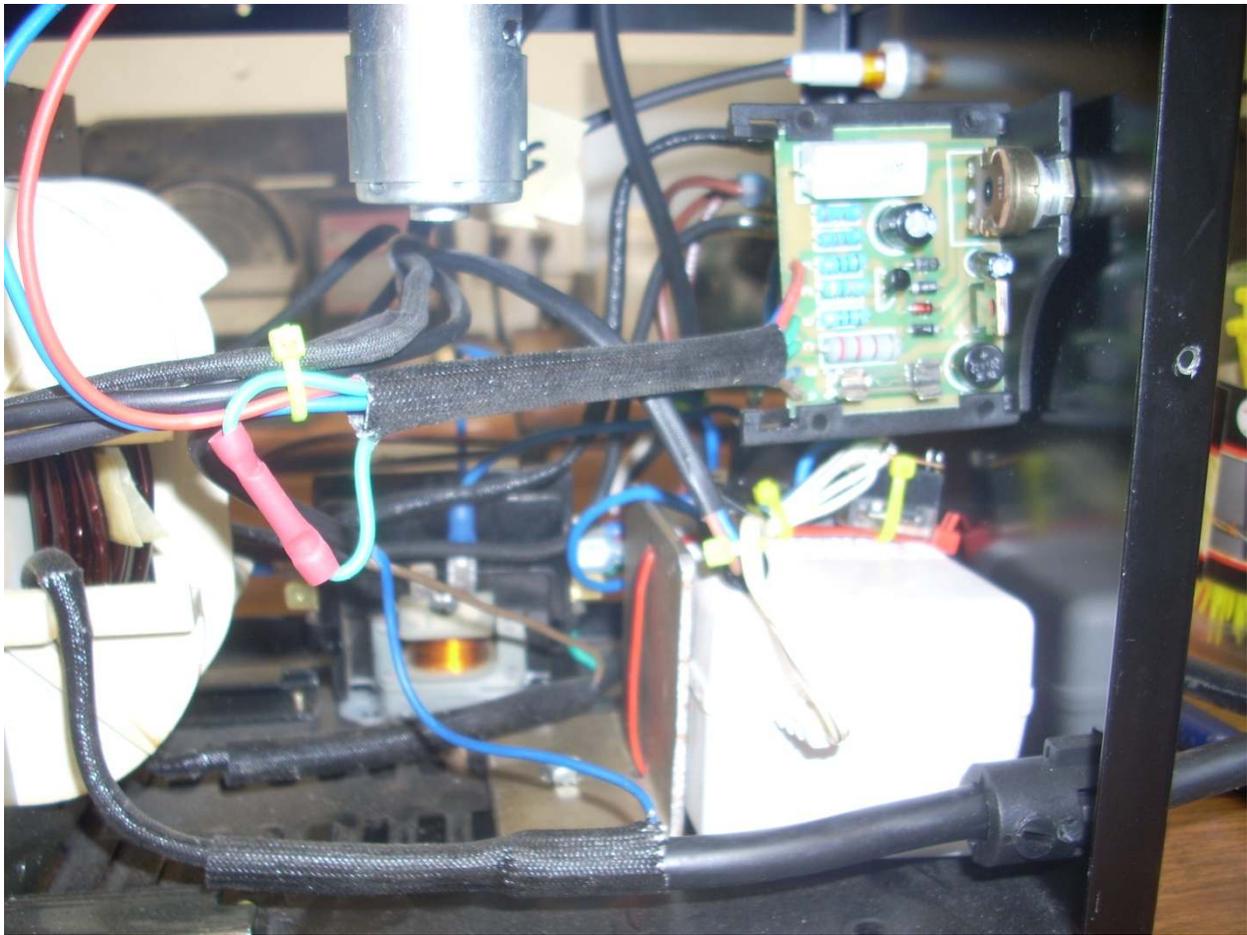
My AC to DC power supply is intended to plug directly into a wall outlet. I made up this socket to serve the same purpose. If you look closely, you will see clear plastic sleeves over each conductor.



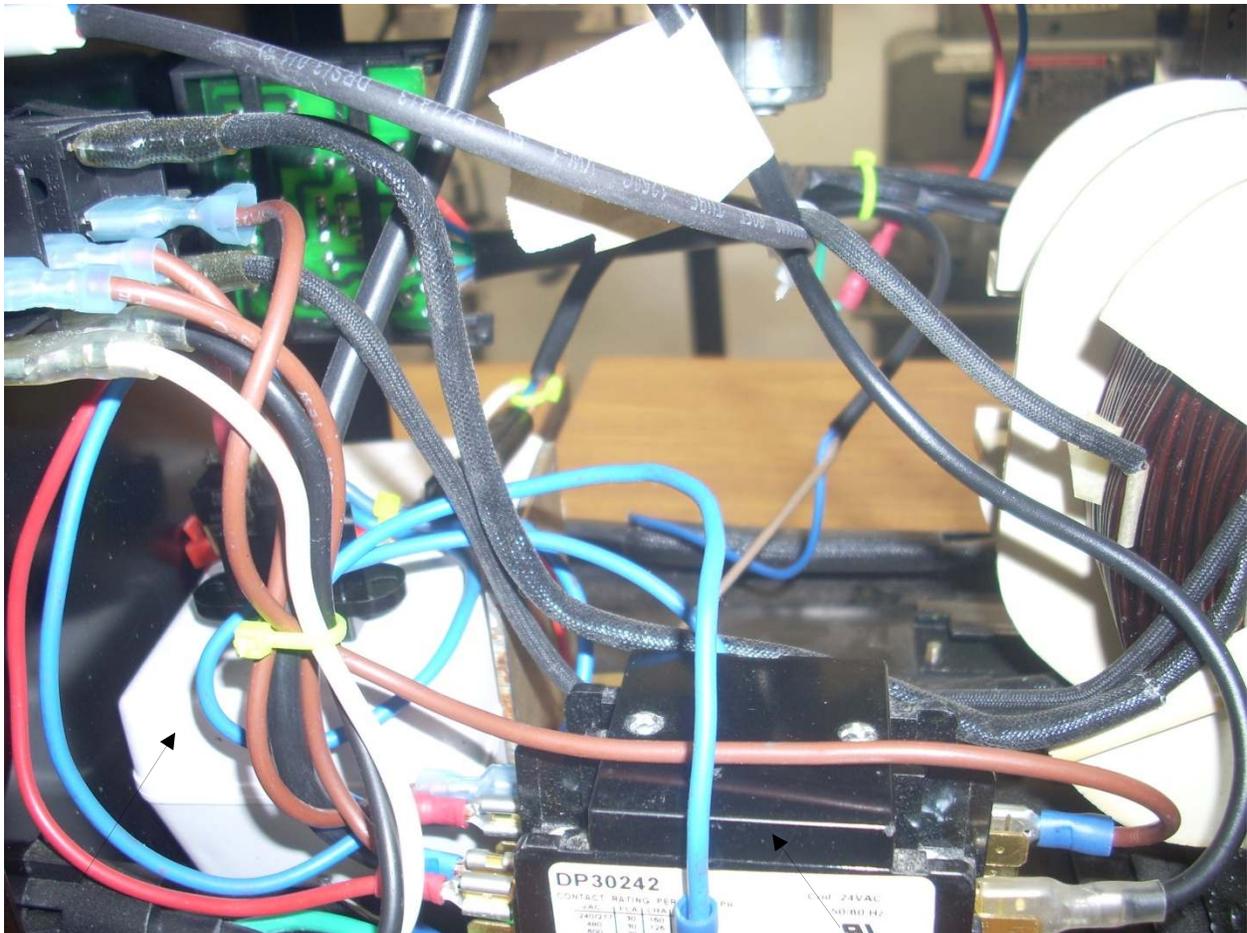
I have strapped my relay onto my AC to DC power supply. A second cable tie feeds through the angle bracket on the left. This bracket was bolted to the bottom of the welder. All of this wiring is low voltage.



Here is the space that will hold my power supply with relay. I have used an old phone jack plug on the end of wires that go to the trigger.



Now the power supply and relay has been installed.



This is the view from the other side. You can see the contactor at bottom center and the AC to DC power supply to the left.

I do have a few “dirty little secrets” in this design. The contactor coil is rated at 24 volts AC. I found that I could power it from 15V DC at 1.2 amps. Since I had this AC to DC power supply on hand, that is what I wanted to use. Works fine. The relay is able to switch 30V DC at 2 amps so is able to handle the contactor’s coil power. I may find that the relay contacts erode over time because the contactor’s coil is a rather large inductive load. It will cause arcing when the relay contacts open. If that becomes a problem, I will add a “snubber network” across the relay contacts to reduce the arcing.

I ran some test welds with the modified welder and did not notice any difference compared to the un-modified welder. It sure is nice to have a cold tip. I don't have to worry about placing it back into its insulating holder anymore.

## **Future Modification**

Since the welder now has a source of low voltage DC, it would be easy to add one or more 6" muffin fans. Most likely, I would bolt them on the back end of the welder and have them pull air from around the transformer.

## **Acknowledgement**

Thanks to CT2 for pointing out that the thermal overload light will not come on unless the trigger has been pulled.

I welcome your comments and questions.

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