Demagnetizer From a Microwave Transformer

by RobertM463

My hobby is collecting and repairing mechanical watches. From time to time, it is necessary to demagnetize a watch to correct its running. I sometimes also need to demagnetize tools that I use to repair a watch. The best quality horological demagnetizers, such as the Bergeon Magnomatic, use electronic circuitry to create a decreasing magnetic field at the touch of a button. You just place the watch on a plate and press a button; within an instant the watch has been demagnetized and can be removed. The decaying magnetic field generated by these horological demagnetizers results in a more reliable demagnetization operation.

I wanted such a horological demagnetizer but the commercial units are very expensive. So, I built my own on the cheap from salvaged parts.

The heart of this demagnetizer is a microwave oven transformer, a capacitor and some miscellaneous switches and electronic components. The circuit is not hard to build and the design can be run on mains supply of 120V or 220/240V.

WARNING*: You will be working with mains AC electricity when building and using this demagnetizer. If handled improperly, this can severely hurt or kill you.* I cannot be held responsible for any damage that you could do to yourself or to things / people around you should you decide to build this demagnetizer. I caution that you use quality components and build the device with safety top-most in mind. That includes making secure connections, avoiding sub-standard components and selecting a suitable enclosure that will safely contain the components and prevent inadvertent contact with the high voltage.

How does this Demagnetizer Work?: This demagnetizer has a coil and a capacitor in parallel forming what is known as a LRC tank circuit. This is a tuned circuit that will oscillate at a frequency determined by the values of the components. The capacitor gets initially charged by the mains when the switch is pressed. The capacitor charges up to the peak value of the mains. When the switch is released, a large current flows through the coil, saturating the core of the transformer and causing the initial demagnetization. As the current gets converted into heat, its intensity decreases and the demagnetizing effect reduces. When the capacitor is finally discharged and the current is zero, the object is in a demagnetized state. All this action takes a mere 1/2 second or so to accomplish.

Step 1: Obtain the Components

To build this demagnetizer, you will need the following parts.

Note: The designations in the square brackets please refer to the schematic later in this instructable:

Transformer [L1]: This is best obtained from an old discarded microwave; I got mine from an ancient Quasar microwave someone had left on the side of the road. The transformer will need a pretty beefy primary coil since that must carry enough current to fully saturate the core. It will be modified in the next step.

An electrolytic capacitor, 15 - 30 uF at 440 Volt AC [C1]. A motor run capacitor is an AC capacitor and I think would be best suited to this application. The exact value is not critical (any between 15uF and 30uF will work) but the voltage is critical. The rated voltage of the capacitor needs to be 440VAC or higher. Since space in my enclosure was at a premium, I chose two all-metal oil-filled 7.5uF capacitors from a discarded air conditioning unit. Don't use the capacitor from the microwave you tore apart for its transformer; it is too small in value.

A Single Pole Double Throw (SPDT) microswitch 15A / 250VAC [S2]. Ok, that's a lot of tech speak. I'll break it down. It has to be a snap action momentary contact microswitch; not a regular toggle switch. It has to have contacts rated for switching 15A current at 250VAC maximum. It needs to have three poles - Normally closed. Normally open and Common. Conveniently, this switch may be salvageable from the same microwave from which you get your transformer. These types of switches are used on the microwave to sense when the door is open or closed. I found a really nice microswitch with a large illuminated button so I used that.

A resistor [R1]: The value is not critical but should be between 20 - 600 Ohms 5%, minimum 1/2 watt. I chose 20 Ohms, 5%, 1 Watt because I had one in my electronics box. This resistor limits the charge rate of the capacitor so a larger value resistor will slow down the rate of charge of the capacitor as well as limit the current draw during charging. The low value I selected lets the capacitor charge in just a few seconds.

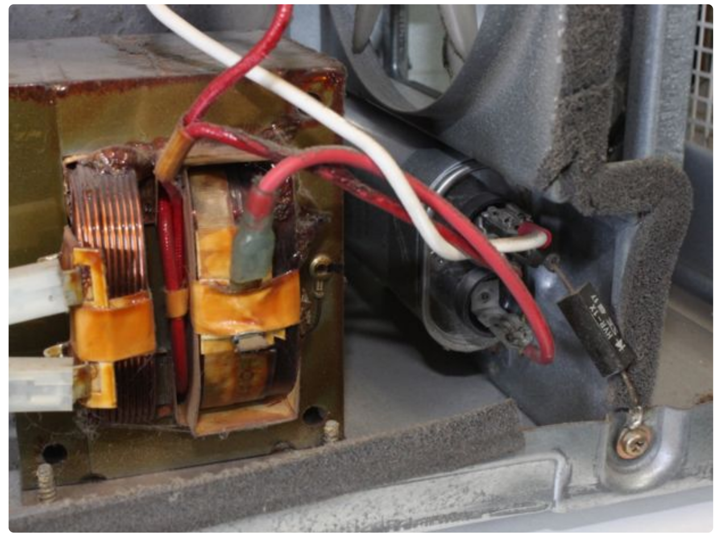
A power diode [D1]: This diode should be able to withstand the applied mains voltage as well as be able to pass about 1 ampere. A 1N4004 diode should work admirably.

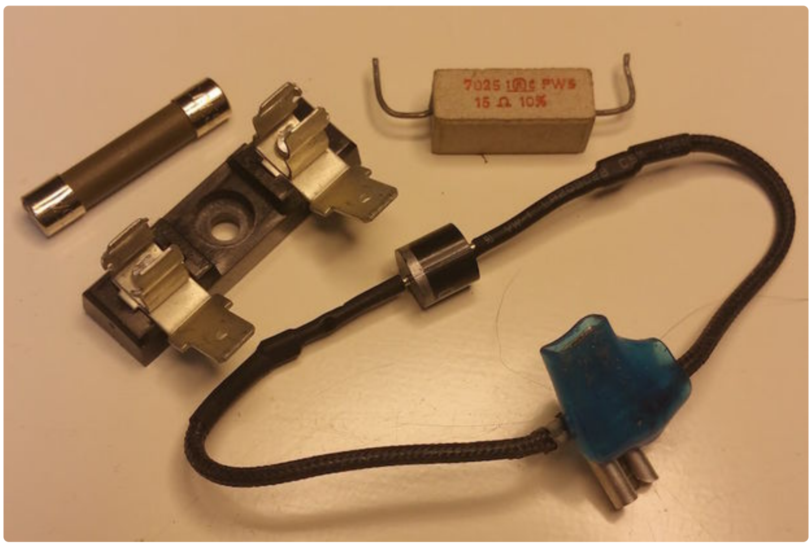
A power switch [S1]: This switch will turn on and off the power to the demagnetizer. I'd recommend a double-pole double-throw (DPDT) rocker switch. This type of switch has two separate actuators with Normally open, Normally closed and Common terminals each. This switch will break both legs of the mains when it is turned off, which is the safest method.

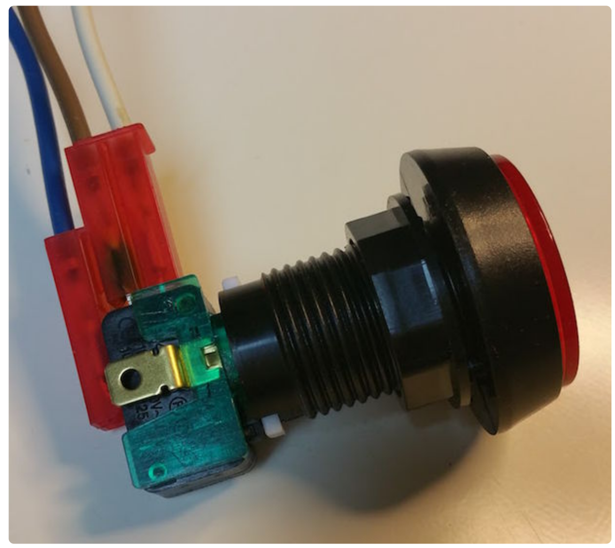
A fuse [F1]: I used the fuse and holder that I salvaged from the microwave oven. This was a 7A 125V glass cartridge fuse.

Optional - Neon indicator [B1/R2]: I had previously salvaged a pilot light from a toaster oven, consisting of a neon bulb and a series resistor. I changed the original resistor to a 220 Ohm 5% 1/4 Watt one and wired the neon light across the transformer coil (see the schematic). This light will flash each time the demagnetizer operates, feeding back to the operator that demagnetization is complete.


Quasar




15 Ω 10%




83-32
DIELEKTRO
NO PCB
CAPACITO
MADE IN US.
97F5534
440VAC 60HZ
76-24
CAPACITOR
MADE IN U.S.A.
45F275
60 HZ
7.5 uf
366-410 VAC MAX.
370 VAC NOM.

Step 2: Modifying the Transformer

The first step to building the demagnetizer is to modify the transformer for the purpose. This means removing the secondary windings, splitting the core to expose it, and repositioning the primary windings.

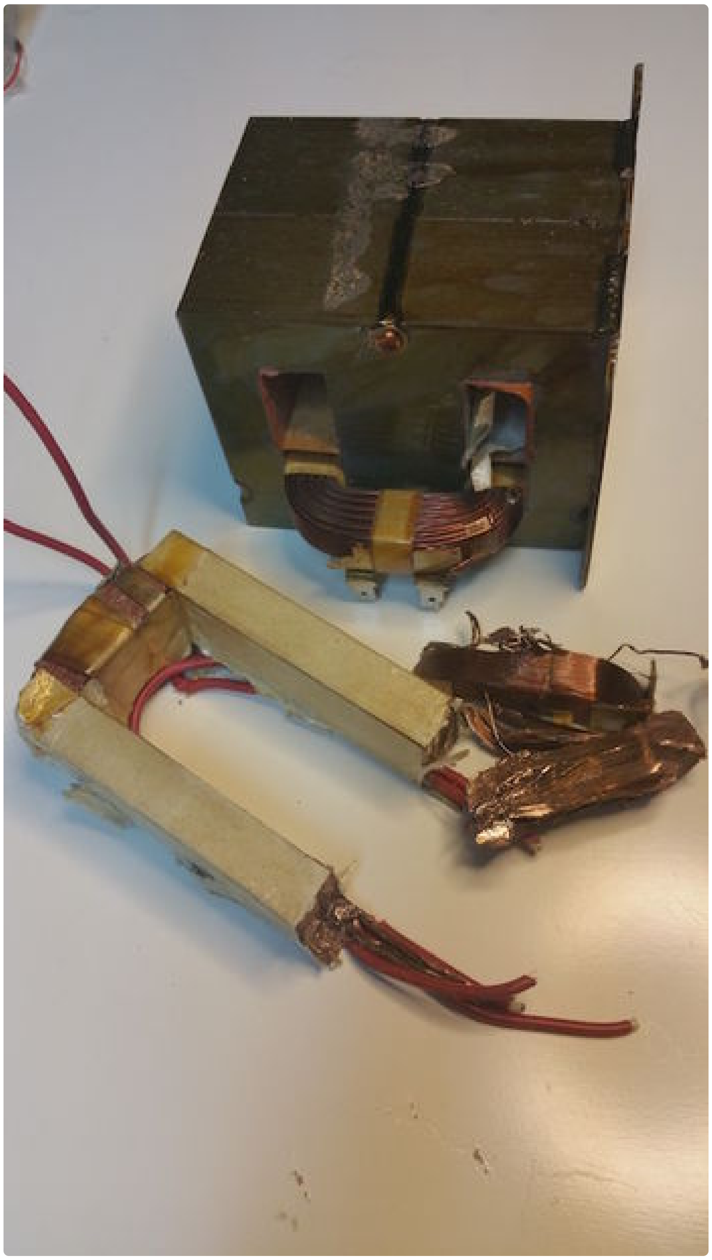
Identify the secondary winding on the transformer. This would be the winding made up of hundreds of turns of very fine copper wire. Also the secondary winding only has one connector; the other end of the secondary winding is normally attached to the transformer core itself.

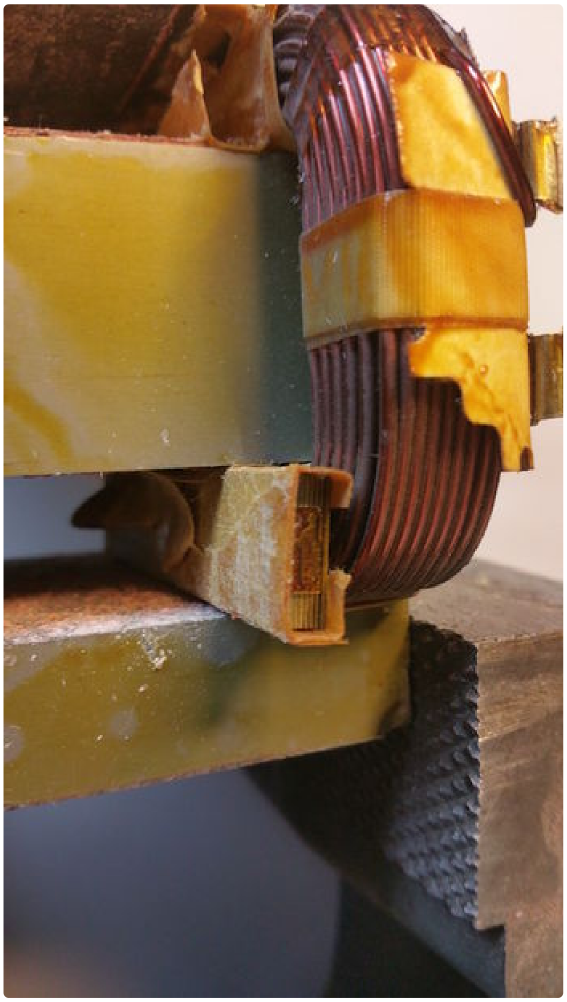
The other coil is the primary winding. The primary is usually a few turns of very heavy gauge wire. As a check, use a multimeter on resistance scale to measure the resistance of the primary core. It should be around 0.6 - 0.7 Ohms. This is your baseline to check during progress whether any damage occurs during the modification.

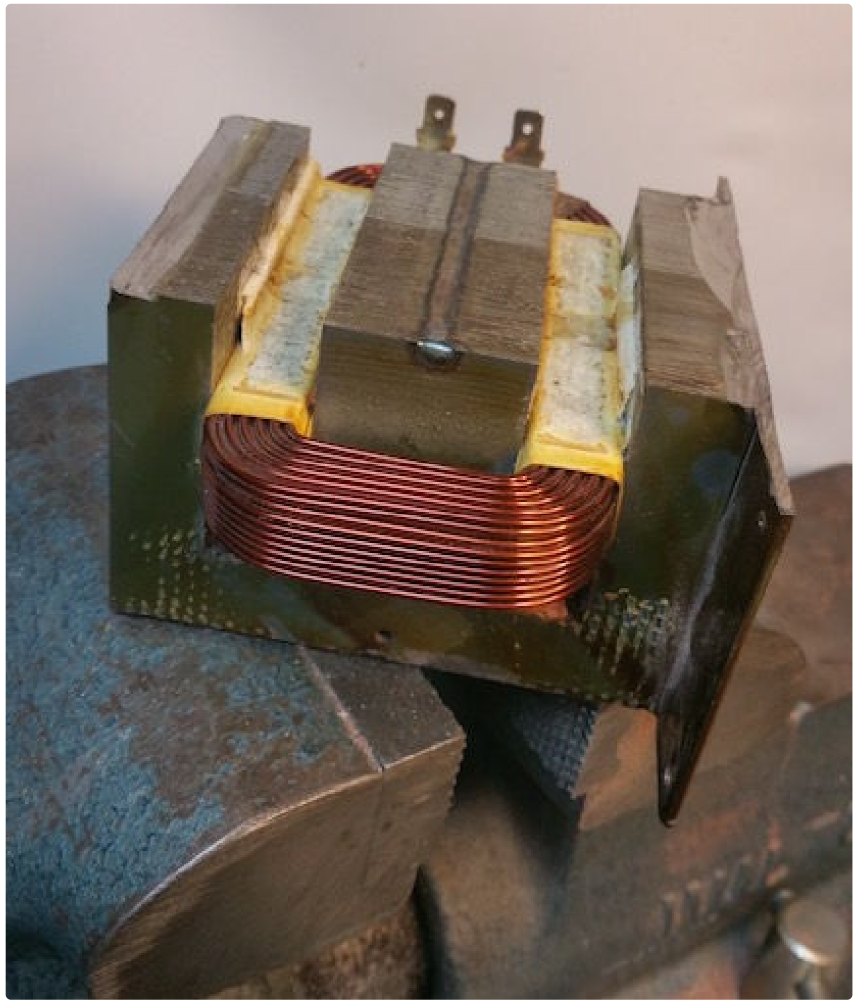
Once you've identified the secondary, use a hacksaw or cutoff wheel on a Dremel (preferred) to slice through the secondary windings on one side as close to the core as possible. Be extremely careful not to nick or cut the primary, otherwise the transformer is useless and will need to be scrapped. Once cut completely through, use a drift and hammer to knock the remaining part of the secondary through the backside. Check the primary resistance against the baseline to make sure the primary is still intact. If it reads open circuit, it means you accidently nicked a wire and the transformer must be scrapped.

Next, cut through the weld but leave some of the weld intact. The core consists of "I"-shaped and "E"-shaped metal sections which are welded together. Identify the "I" section of the core. Using a cutoff wheel or hacksaw, slice through the welds on either side until the cut is just past the weld. Make sure you cut in the middle of the weld so that some is left over after the operation. Using a cold chisel, lever off the "I" section, leaving the "E" section and primary windings behind. Discard the "I" section.

Carefully remove the heavy fibreglass insulation from the empty space where the secondary was and knock out the metal shunts with a hammer and drift. Using a 1/2" thick piece of plywood to protect the windings, carefully hammer on the primary coil, forcing it downwards towards the bottom of the "E", so that the primary winding is about 1/3 of the way down. Be careful and work slowly. You don't want to damage the primary wires at all. If you chip or scratch the enamel on the primary during this operation, you may end up shorting the coil and rendering the transformer useless. Check for continuity between any of the coil terminals and the transformer core. It should read open circuit (infinity Ohms). If there is a low reading, the primary is shorted and the transformer must be scrapped.





Step 3: Assemble the Components

Now it's time to build the electronics. The schematic diagram is shown above in the photo.

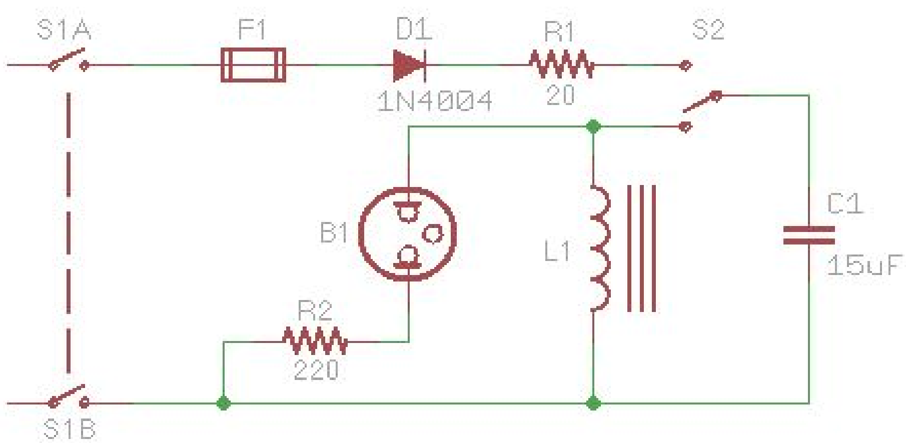
The enclosure you choose to house the components is really up to you but it should not be metal. Plastic or wood is good. For my enclosure, I chose an Ikea dry food storage container, called "Tillsluta". I chose the 2.5 litre model which was 23cm X 15cm X 12cm (9"X6"X5"). It was just large enough to compactly fit all the components. It's constructed from polyester plastic for the container and clear PET/synthetic rubber for the lid. The lid is removable but snaps on securely. The beauty of this enclosure was that it is all plastic which wouldn't interfere with the function of the demagnetizer. The container is solidly constructed which makes for a robust tool and the transparent lid shows exactly where to place the object to be demagnetized. It didn't hurt that it was as "cheap as chips" to boot.

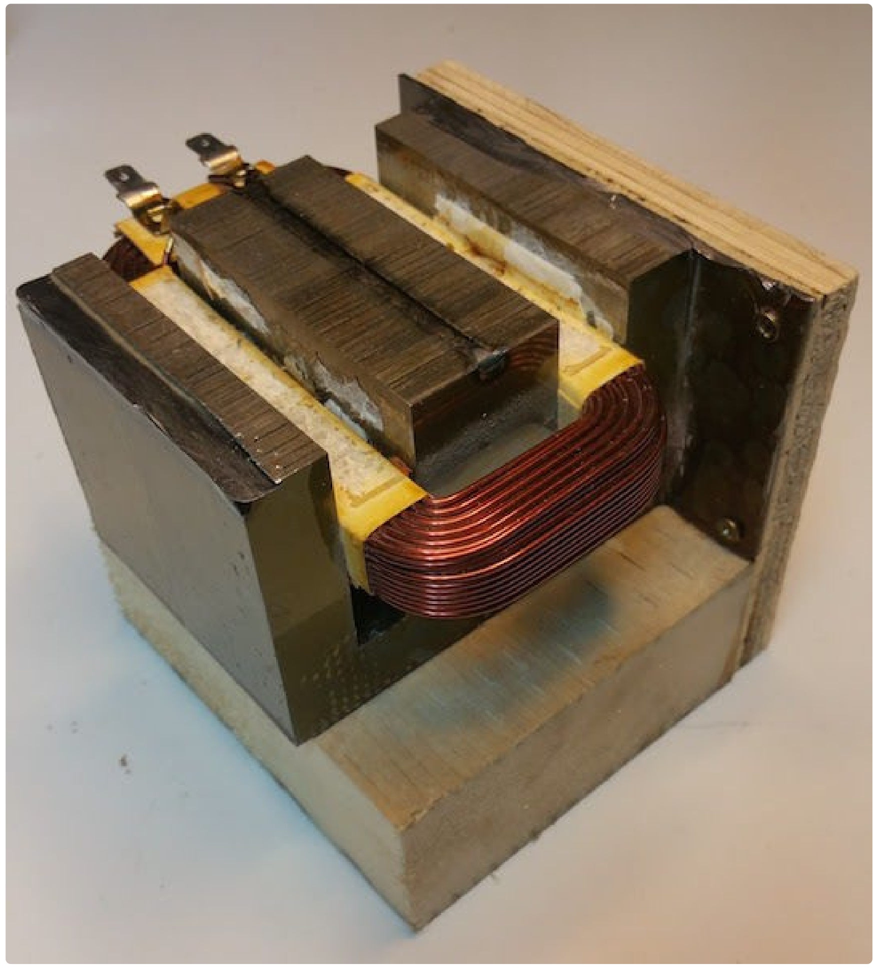
The container is deeper than I needed so I mounted the transformer on a wooden base to raise it flush with the lid. I cut the base from a scrap piece of 2"x12" spruce that I had to hand, into a piece 10.5cm x 11cm. I glued and screwed on a back piece made from 1/2" ply 10.5cm x 11cm in size (see the photo). I made sure that the transformer was securely screwed to the plywood and the base securely screwed to the container.

I mounted the pushbutton micro switch on the lid. I made sure the wires to the microswitch were long enough to remove the lid but not too long.

The main power switch was mounted on the side of the container, close to where the power cord entered. The fuse was mounted to the wooden transformer support and the line cord was strain relieved where it entered the container. I finished the wiring using 16 AWG stranded wire. I used crimped 1/4" spade connectors where required, otherwise I soldered the connection. I used heat shrink tubing to insulate exposed connections.

Wire the diode so that the anode (the end opposite the band) is attached to the fuse holder and the cathode (the end nearest the band) is attached to the microswitch, with the resistor in series. I set the capacitor beside the transformer and the capacitor was fastened to a mounting tab with a tie wrap.





Step 4: Test the Circuit

Now that the circuit is complete, it's time to check it for proper operation. For this you'll need a multimeter and optionally an oscilloscope.

***Note**: Double check your wiring against the schematic. Make sure you haven't made a wiring error. Correct any error prior to applying mains to your circuit. Always use a mains circuit protected with a circuit breaker.*

Set the meter to read AC Volts, and set the range to 200V (for North America and other countries having 120V mains) or 400V (for Europe and other parts having 240V mains).

Remove the fuse, turn on the power and test the voltage between the fuse contact and neutral to see that all is well. You should see mains voltage. Turn off the power, replace the fuse and reposition the test leads to measure across the terminals on the capacitor (the negative lead should be attached to neutral). Set the multimeter to DC Volts and keep the same range. Turn on the power and **press and hold** the microswitch. In a second, the voltage across the capacitor should rise to about 167V for North America, 340V for Europe. Be very careful around this area of the demagnetizer while the power is applied. There is a fair amount of energy stored in the capacitor with the power applied.

Now, release the microswitch. The voltage shown on the voltmeter should drop instantly to zero. Observe the neon indicator light if you've installed one; it will flash for an instant. At this time, we can assume that all is well and the demagnetizer is working.

The final test will be to see if a magnetized tool, watch or other object can be demagnetized.

Take a known magnetized screwdriver or use a magnet to magnetize a screwdriver. Lay the screwdriver over the transformer core and operate the microswitch (press and hold for a few seconds and release). Once should be enough but sometimes twice is required. The screwdriver should become demagnetized.

Optional: If you have an oscilloscope, you can see the decaying voltage across the transformer to confirm that the circuit is working. Hook the oscilloscope probe across the primary coil - the ground clip on terminal attached to the mains neutral, the probe to the hot side of the coil. Turn on the oscilloscope and set to 50V/div and 2mS/div. Turn on the demagnetizer power and operate the unit. A waveform similar to the photo should be displayed. It should be an exponentially decaying sine wave.

Congratulations, you have a working demagnetizer.