A Do-it-yourself Demagnetizer

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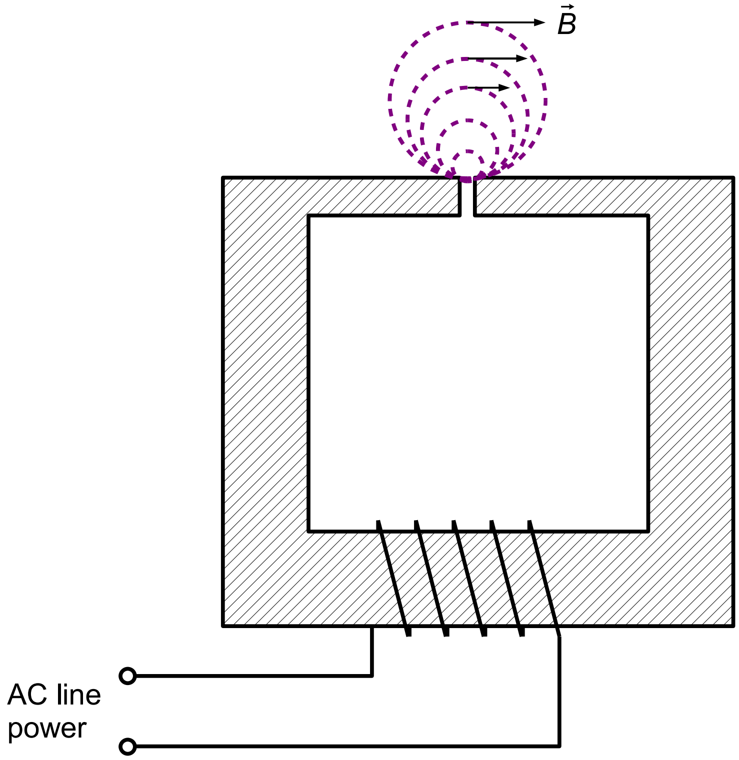
Here's a simple-to-make demagnetizer that can be made from scrap materials. It will serve you well in the shop or around the home. A few decades ago I saw this idea somewhere and immediately built one. It sits on my shop bench for demagnetizing tools.

How it works

The idea is to use the coil and laminations from a scrapped appliance motor (mine came from a can opener purchased at a second-hand store). The typical motor used with these devices is called a shaded pole motor.

You disassemble the motor and remove the rotor. You're left with the laminations and coil. You cut a gap in the steel laminations to provide a flux leakage path which is then used for demagnetizing objects (it basically becomes a big magnetic recording head). Here's a diagram:



The varying magnetic field from the gap is then used to reverse the magnetization of the object you're trying to demagnetize and reducing it in little steps by traversing around the hysteresis curve of the material. The two main requirements for this to work are:

- The field provided by the motor gap to the material must be greater than the coercivity of the material being demagnetized.
- The alternating field must be reduced in amplitude at a slow enough rate.

The first requirement is met because typical carbon and tool steels are magnetically "soft" and have coercivities in the 50-500 A/m range[1] (0.5 to 5 Oe). I don't have a tool to measure the field in the

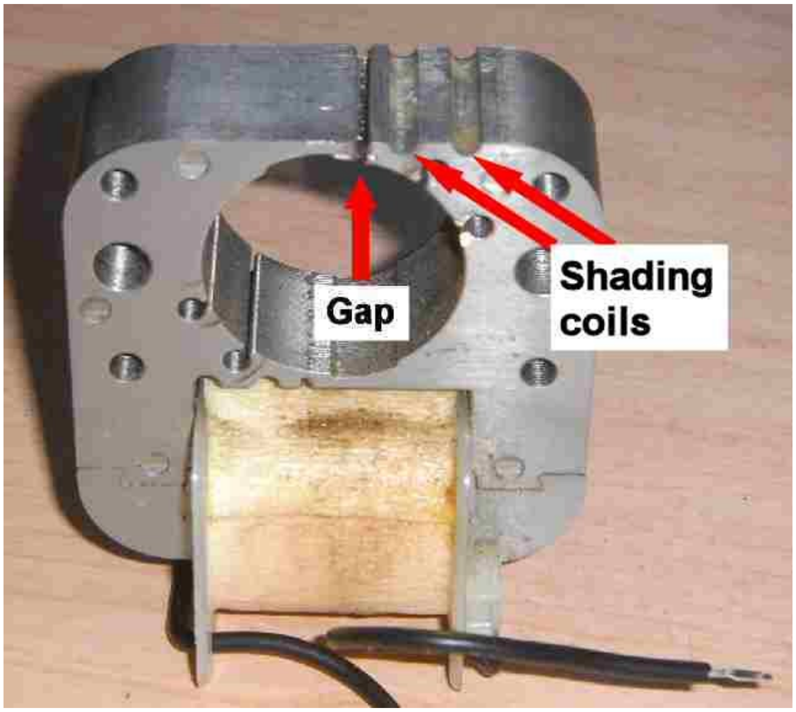
1 Contrast this to "hard" magnetic materials like permanent magnets and magnetic recording disk materials, which can have coercivities on the order of 80-800 kA/m (1-10 kOe).

gap, but it's definitely strong enough to demagnetize the tools I use in my shop.

The second requirement is met by you pulling the magnetized object away from the gap slowly enough.

Building one

Here's a picture showing such an assembly:



If you can clamp the laminations on both sides of the cut, you can use a hacksaw to cut the gap, otherwise the thin laminations will bend out of shape. Standard metal machinist's clamps work well for this or clamp one side in a vise and use a C-clamp on the other side. If you don't have suitable clamps, it would be better to cut the gap with a thin abrasive wheel. After it's cut, deburr the cut and remove any remaining metal filings in the gap. Note in the above picture that metal filings have contaminated the gap in my demagnetizer (this is just from use on the bench for a long time). They're easily removed with e.g. a credit card -- otherwise, they can somewhat short out the gap, reducing the external field for demagnetizing.

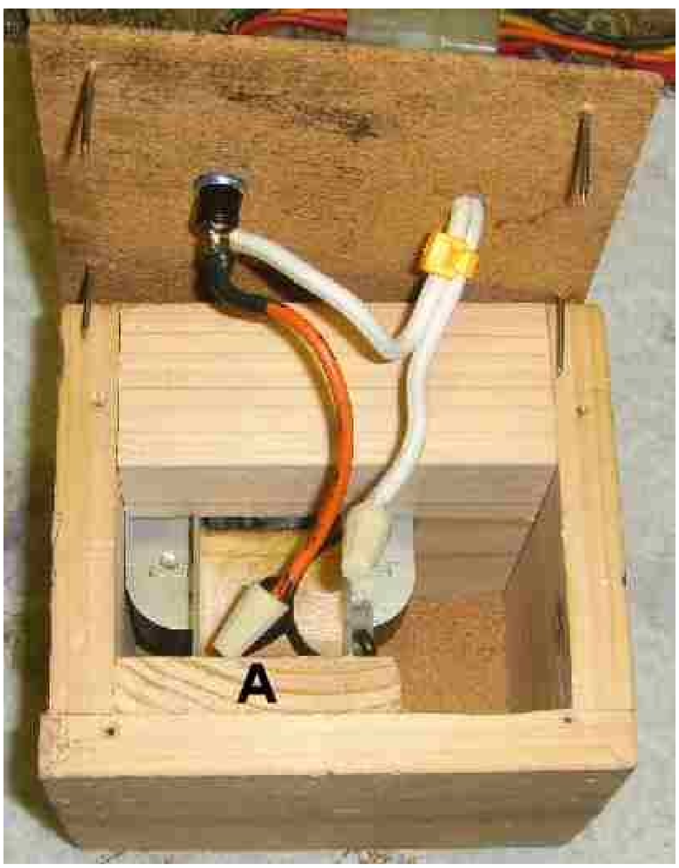
I disassembled my unit because it had stopped working. One of the solder joints under the winding tape had broken after a couple of decades of use -- the joint was a bad one to begin with and it was obvious on visual inspection why it had failed. Fortunately, it was easy to fix and my unit is back in service after taking the pictures.

You can see where I cut out the copper wire comprising the shading coils. I removed them because I wanted a flat surface on the top of the laminations.

You'll want to mount this demagnetizing assembly in a box that protects the coil and wires and exposes just the top surface. I made a small box from some scrap materials I had in the shop:

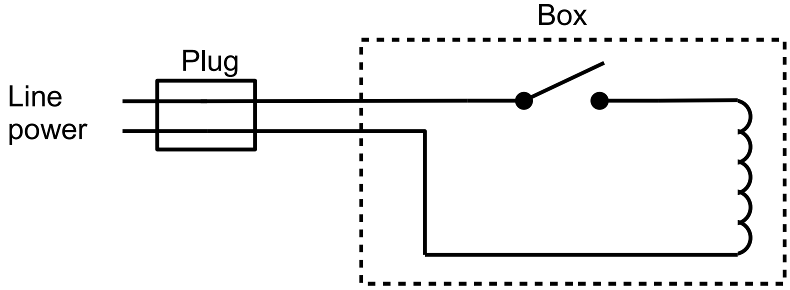
The wooden frame is made from some scrap 2x4 material I cut to size on the table saw and held together with some small finishing nails. The sides are made from 1/8" thick Masonite. The gap in the 2x4 is a close fit to the width of the laminations.

I used a scrapped 18 gauge zip cord with a plug molded on the end for a power cord. A tie wrap serves as a stop on the cord so it can't be pulled out of the box. Here's a picture just before assembly and after I had soldered the wires to the push-button switch:



Wooden piece A was sized to just press against the plastic coil form and hold the coil/laminations in place when the lid was nailed shut.

Here's a wiring diagram:



You can eliminate the switch if you're willing to plug and unplug the demagnetizer from the wall when you want to use it (I would advise against this unless you know you can leave it plugged in indefinitely; see the remarks in the next paragraph). I used a momentary pushbutton switch; this lets me leave it plugged into the wall. If you want to be extra safe, include a fuse in the circuit.

One thing you'll want to do is to test your coil/lamination assembly with power to see how long you can run it before it gets too hot. A larger shaded pole winding/lamination that I tested dissipated 137 W and the coil was quite warm to the touch after I finished writing down my measurements (it was energized for less than a minute). The measurements were essentially the same after the gap was cut. For this particular coil, my engineering judgment would say not to run it more than 30 s at any time and use a duty cycle of around 10%. Fortunately, a demagnetizer is typically only used a few seconds to demagnetize a tool. If you have a bunch of tools to demagnetize, spread the work out over time to ensure the coil doesn't get too hot.

I measured the impedance of the coil at 120 Hz so I would have the information available in the future (I used an LCR meter). It was 138.05 Ω @ 83.1° and the DC resistance of the coil was 11.19 Ω, measured with my bench multimeter. When running, the coil drew 1.79 A, dissipated a real power of 47 W, and had an apparent power of 207 VA for a power factor of 23%.

Use

Using the demagnetizer is simple. Here's a picture of a screwdriver tip about to be demagnetized:

The tip is placed across the gap and the pushbutton is pressed to energize the coil. The tip is then slowly withdrawn from the coil to demagnetize the tip (it only takes 2 to 4 seconds). Here's a picture of ferromagnetic filings from floor dirt that the tip attracted before demagnetizing:

After demagnetizing, it wouldn't pick anything up.

When working on things, you'll find you occasionally want your steel tools to be magnetized. An example is when you want a screwdriver to hold onto a steel screw. Draw the screwdriver tip a few times across a strong permanent magnet (e.g., neodymium or samarium-cobalt) to magnetize the tip. When you're finished working, use the demagnetizer to demagnetize the tip.

There are commercial tools you can purchase to do similar things:

My wife found this for 25 cents at a garage sale. I don't mind having it, but the AC demagnetizer is a more versatile tool because it can demagnetize things that won't fit in the holes of the Wiha tool. It is also a more effective demagnetizer than this permanent magnet design. Still, it's only around $5, so if you just want it for magnetizing e.g. screwdriver tips, it could be all you need.

By the way, here's an old mechanic's trick that some folks may not know:

You can hold a ferromagnetic steel screw on the end of a screwdriver by putting a small, strong magnet on the screwdriver's shaft. That magnet is a samarium-cobalt magnet from an impact printer's core bar that a friend gave me about 30 years ago. I just used this method the other day to get a screw back into my old Amana microwave oven that was in such a cramped place that I couldn't get my hand or a regular screwdriver in to place the screw. This trick worked like a charm after I found my old Phillips screw-starter tool wouldn't grip the screw I needed to install.