# A Handy Degausser

Roger Backhouse seems to have had some fun trying to demagnetise his magnetic screwdrivers. For the most part I do not mind when small components become magnetised. For someone as clumsy as I am, it is quite helpful for things to be retrievable. I suspect that any time and motion study of my activities would reveal that I spend more time recovering things I have dropped than I do making use of them. If small items are magnetic, recovery is often simplified. However, magnetised components can have an adverse effect on the performance of instruments.

Taking a simplistic view, magnetisation results from a change in the net orientation of magnetic domains in a material. A material such as mild steel, in which the domains are randomly orientated will not exhibit a magnetic field of its own. Subjecting such a piece of steel to a magnetic field will cause the magnetic domains to align themselves with the applied field. When the field is removed, the domains will tend to relax to their original orientations. However, since removing a field is not the same as applying a randomising influence, a net bias will remain in the orientation of the domains. The steel has become magnetised. The effect is known as remanent magnetism.

Photo 1. My "Weller" soldering gun after 45 years of regular use. The tip reaches operating temperature within a few seconds.

In an attempt to randomise the domains, it is necessary to subject the magnetised item to a fluctuating magnetic field. The field is arranged to alternate from being as strong as possible in one direction to being almost as strong in the opposite direction. The maximum strength of the field is arranged to decrease progressively with each reversal in direction. Eventually the fluctuating field dies away altogether. Try the degauss facility on a CRT type computer monitor and you will see the effect.

In practice, the *intensity* of variation of the magnetic field is not usually altered. Instead, the component to be demagetised is introduced into the alternating field then slowly withdrawn until it is far away from the influence of the field. Both approaches are only approximations to a truly randomising influence, but they are satisfactory for most purposes.

Note that there is no difficulty in producing a fluctuating field which does not change in direction. However, such a field would only serve to magnetise the component. For example, the output from an ordinary battery charger will be rectified AC. Its polarity never changes, but the voltage fluctuates between zero and some maximum. Connecting a supply of this type to a coil will create a fluctuating magnetic field in which the field direction does not change.

A convenient source of alternating magnetic field is the instant heat type of "*Soldering Gun*" as shown in Photo 1. My own soldering gun dates back about 45 years, and has been utterly reliable.

It remains my weapon of choice for most electrical soldering, and for soldering some electronic components. Similar soldering guns are often available cheaply in the "*Landfill*" section of certain supermarket chains.

The soldering gun is simply a transformer in which the mains voltage is stepped down to about one thousandth of its input value. With a mains supply of about 220V, my soldering gun produces about 0.25V across the soldering tip. The power rating of the soldering gun is 120 Watts. In an AC circuit, Power = Voltage x Current x Cos(φ), where the term Cos(φ) is the power factor. For convenience, the power factor may be taken as unity in this example. On that basis, the current taken from the mains is just over 0.5 Amp. If power in is equal to power out this would suggest that the current flowing through the soldering tip might be getting on for 500 amps. Naturally, the soldering gun is not 100% efficient, and measurement indicated that the current through the soldering tip was about 120 Amps.

School or college Physics books on the subject of magnetism will generally provide a derivation of the magnetic field resulting from a current flowing in a circular loop. The simplicity of circular symmetry serves very well for educational purposes.

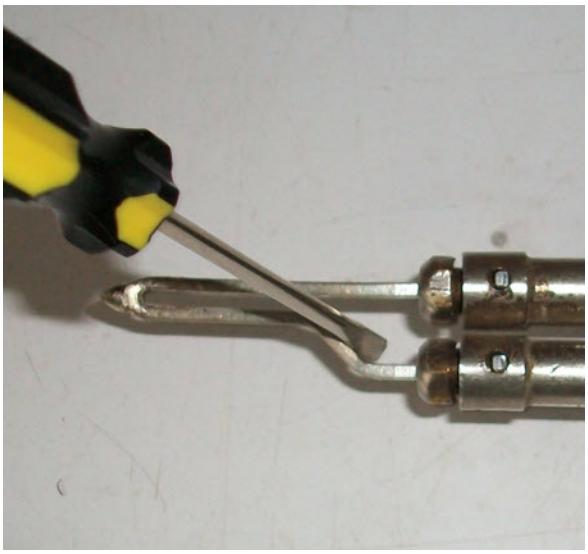

Photo 2. The screwdriver will vibrate in sympathy with the alternating magnetic field when the blade is held in close proximity to the soldering tip.

The soldering tip is far from circular, and it will be found that the field is anything but uniform. Adequate demagnetisation of an ordinary screwdriver blade can be achieved by holding the soldering gun switched on, while bringing the blade close to the tip as shown in Photo 2. The fluctuating field is easily detected as a consequence of the tendency of the screwdriver blade to vibrate in sympathy with the magnetism. Keeping the soldering gun switched on, the blade is slowly withdrawn until the effects of the magnetic field are no longer noticeable.

The magnetic field can be intensified by increasing the number of turns in the coil through which the current flows. Photo 3 shows a coil which I made by wrapping an offcut of 2.5mm$^2$ copper wire around a screwdriver blade.

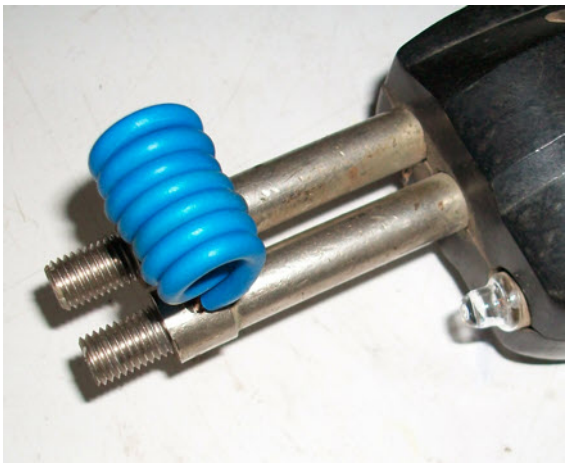

Photo 3. The degaussing effect is enhanced by making a multi-turn coil. If desired, more than one layer of turns can be employed.

The coil replaced the soldering tip and was held in place by a suitable pair of screws. The increased intensity of field was quite noticeable. The wire heats up fairly rapidly, but there is ample time for demagnetising.

As a practical test, I deliberately magnetised the blade of the screwdriver using the traditional method of stroking the blade with a magnet. I used some swarf as a means of indicating the magnetism of the screwdriver blade. This is illustrated in Photo 4.

After inserting the screwdriver blade in the coil and withdrawing it, I again tested for magnetism. On the first attempt I was surprised to find that a few pieces of swarf were still attracted to the blade tip. I then realised that the swarf itself might be magnetised. To see whether this was the case, I introduced the swarf to the degaussing coil. The effect was rather amusing as the swarf danced about under the influence of the alternating field.

The dancing swarf reminded me of a story which my Uncle Charlie told me many years ago. Uncle Charlie McCann served his time as a riveter. My grandfather Willie McCann was also a riveter and Charlie was on his squad. They were employed by John Brown's in Clydebank.

Family folklore has it that at the end of the depression, when work resumed on the partly finished 534, later named the Queen Mary, my grandfather was chosen by the other workers to drive the first rivet in a kind of "*Return to work*" ceremony.

In the years following WWII, Charlie became well known for his welding skill, as riveted fabrication was progressively displaced by the newer technology.

In those days, Manual Metal Arc (MMA), otherwise known as stick welding, was the norm. The welding equipment in the shipyards had long leads coming from the transformer. One of the tricks which Charlie used to play on the unsuspecting was to leave his welding lead neatly coiled up with some welding rods lying in the coil. He would then strike the arc, and the magnetic field due to the current through the coiled lead would make the welding rods dance, causing consternation in the minds of the uninitiated.

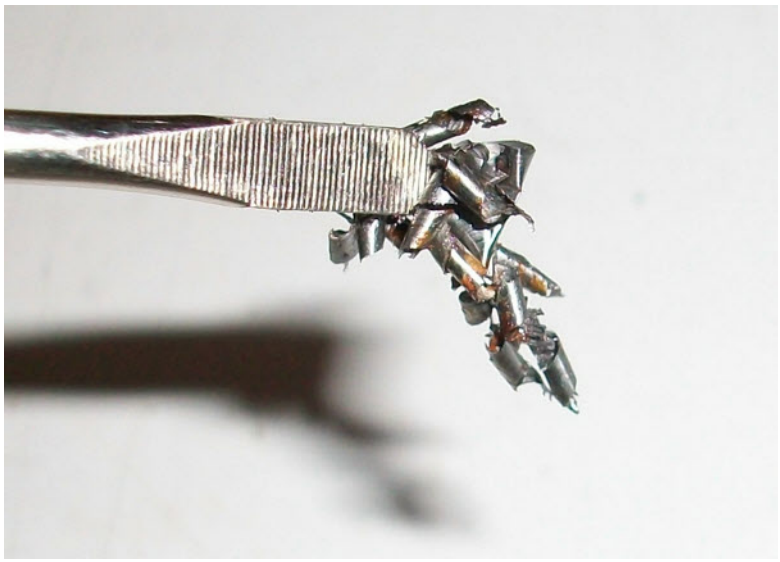

Photo 4. The magnetised screwdriver blade attracts quite a lot of swarf.

Photo 5. What this photograph cannot show is that there is no tendency for the swarf to stick together or be attracted to the screwdriver, once both have been demagnetised.

I was once told that Uncle Charlie was the man the foreman would rely on to do the difficult welds in awkward positions. However, he was a self taught welder and insisted that he had not served his time at that trade. So when Charlie was offered a welder's card he refused to accept it. He felt that to accept would be unfair to those who were formally time served welders. With the spread of the "*Closed Shop*", his decision progressively excluded him from employment opportunities.

Although Uncle Charlie tried to pass his skills on to me, I always had difficulty with anything other than downhand welding. Trying to weld in the vertical, horizontal, or over-head positions invariably defeated me. Had I been employed in the shipyards, the hulls would have needed to be turned on their sides or completely inverted to compensate for my ineptitude.

To my credit, I can just about handle a soldering iron. Once the swarf and the screwdriver blade have both been de-gaussed, there will be no tendency for them to be attracted to one another. Photo 5 purports to illustrate this fact.

Having demagnetised everything in sight, all that remains to be done is for one or more of the more fastidious members of SMEE to write into Alan and complain about the shocking condition of my screwdriver blade.