Making Wire and Tube

by Gary Wooding, 2007

Draw-plates

Draw-plates are ancient devices used for reducing the diameter of wire, and consist of a tapered hole in a hard plate; their first recorded use can be traced back to 3000BC in Egypt. **Fig 3-A** shows the shape of a typical hole. The small hole determines the cross section of the wire and the transition from the tapered to parallel hole is smoothly rounded. Wire slightly larger than the small hole is "funnelled" into it by pulling or "drawing", as shown in **Fig 3-B**. They are not restricted to round holes; holes of almost any shape are possible. The plate is usually made of hardened steel, but more durable (and more expensive) ones contain TC (tungsten-carbide), or even diamond, inserts. The most common form contains a series of numbered holes of slightly different sizes, arranged

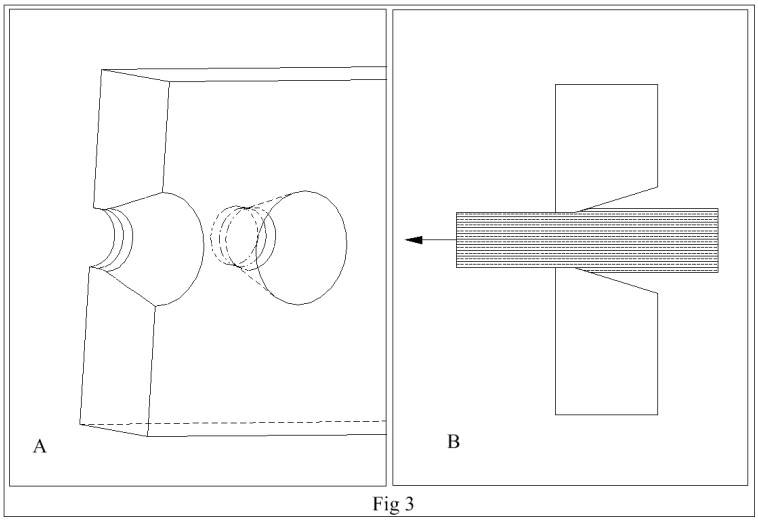

Fig 3

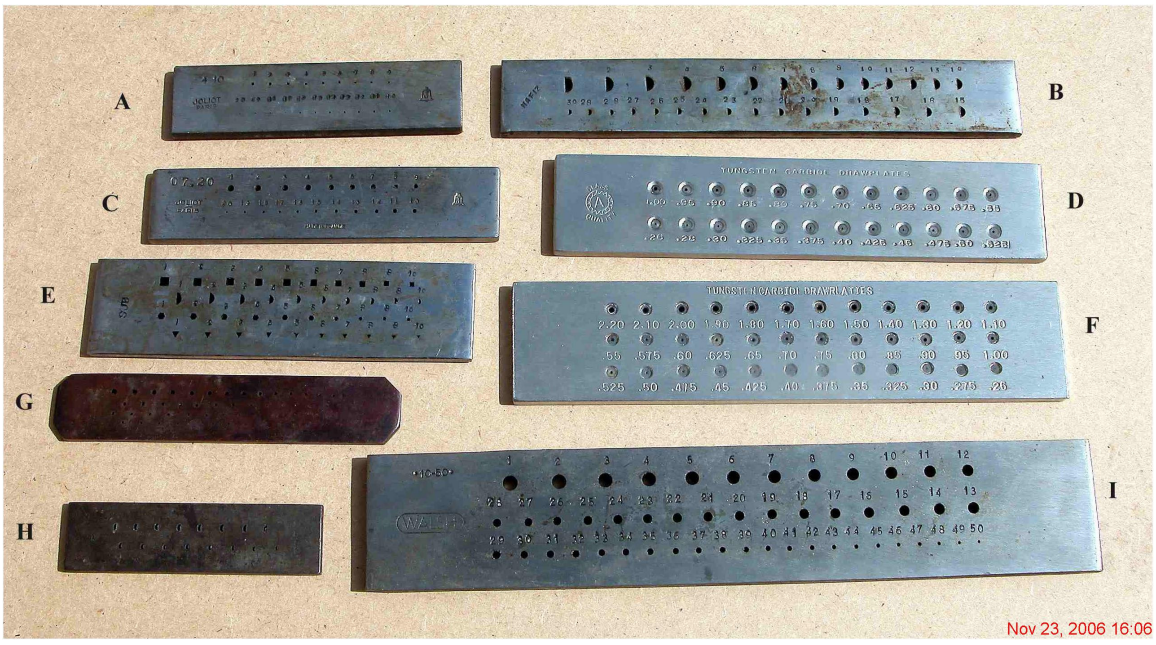

Photo 1

so that after pulling wire through one hole it is of a size suitable for feeding into the next smaller one. The numbers just identify the holes and have no connection with the actual size. Where a great deal of wire making is done it is more usual to have many

plates each containing just one hole. **Photo 1** shows a selection of draw-plates: the largest measures 270x50mm.

All are of normal hardened steel except D and F which have TC inserts, and all except B, E and H are for standard round wire. B and H are for "D" section wire, and E has an assortment of shapes: square, "D", triangular, hexagonal, and round. G is a very cheap item, made in India, and purchased for about £3. It works OK but the holes are neither marked nor properly graduated and instead of gradually getting smaller, some are the same size as the previous one. D and F are expensive items (around £100 each), but they give a superb polished finish and, instead of being marked with an identifying number, have accurate wire diameters. I is for large diameter round wire. F can make wire from 2.20mm to 0.26mm

Making Wire

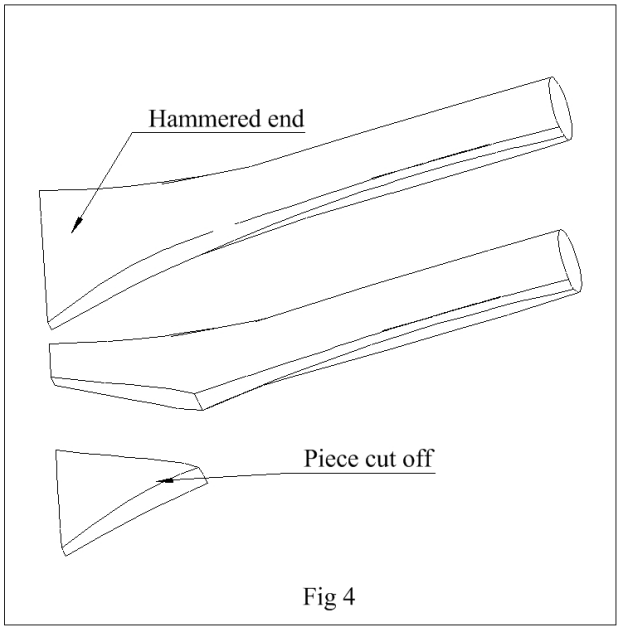

Fig 4

To use a draw-plate you must start with a piece of annealed metal that will almost enter the first hole. You taper the end by hammering it on an anvil or some other flat, hard, surface. This spreads the end, and the text books say to rotate it by 90° and hammer again. This doesn't work for me: I hammer the end, cut off one of the sides that have spread (see **Fig 4**) and then true it up by gently hammering it at 90°. You then file the corners off. The tapered end is called the ***dog***.

You must then lubricate the wire; various types of suitable lubricant are: Vaseline neat or mixed with a little paraffin, beeswax, soap. You don't need a lot, just enough to cover the surface and no more; certainly not enough to drip off.

You then need some way of holding the draw-plate, and this is most likely to be determined by the diameter of the wire you are going to draw. For wire less than about 1.5mm diameter, and if you are reasonably strong, you can probably make do with holding it in a vice. Almost everyone can use the vice for wire less than 1mm, but above 1.5mm the pulling force becomes very large: I've managed to draw 2mm 9ct gold by sitting on the floor, placing the plate under my feet, and pulling the wire between my feet, but I did it only once and would certainly not recommend it: it was *very* difficult.

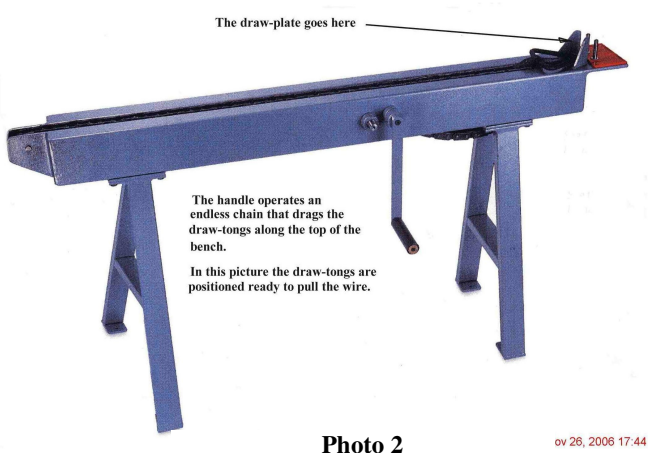

Photo 2

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When you are unable to use arm-strength you must use a ***draw-bench***. **Photo 2** shows a fairly representative commercial draw-bench. They are fairly expensive items with a typical price being somewhere around £200-£500, but it is not difficult, and far cheaper, to make your own. See below for more details.
However you choose to hold the draw-plate, you are now ready to pull some wire. You poke the dog through the rear of the plate (the funnel bit) in the first hole that the main section of wire will not enter. There should be enough of the dog protruding at the front to be gripped by some suitable pliers. If it's too short you will have to remake it.

Proper, purpose made, ***draw-tongs*** are available (see **Photo 3**), but I generally use some ordinary pliers for small diameter wire. You then just draw the wire through with a smooth steady pull. If you jerk it it is liable to break, especially where the dog leaves the pliers. If you stop the pull you stand a good chance of creating a small ridge on the wire, so it's best to complete it in one operation. You then continue with the next hole until the wire is the required diameter. Often the dog will break, or will have to be made smaller as you progress to smaller and smaller holes. Don't forget to anneal after every 3 or 4 holes.

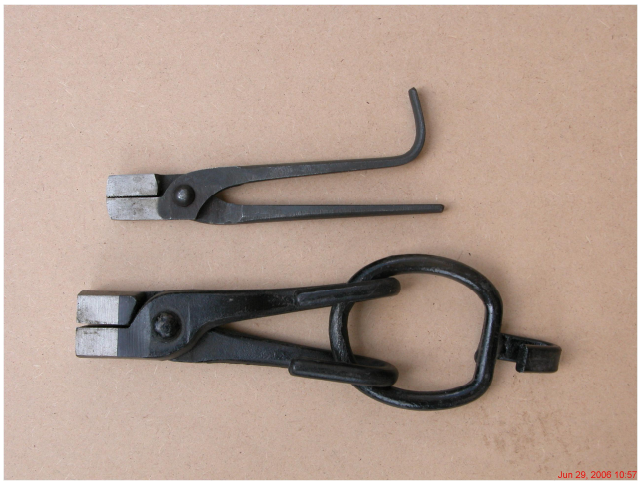

Photo 3

Photo 6 shows two types of purpose-made draw-tongs: the top ones can be used for pulling by hand and can be used on a draw-bench by the addition of a loop of rope, the bottom ones are specifically for use with a draw-bench, the shape of the ring ensures that the harder the pull, the tighter the grip on the wire.

A friend of mine had a need to make some scale nuts and bolts, but couldn't find a source of hex brass of the correct size. He borrowed a hex draw-plate and made the exact size required. The nuts and bolts were perfect.

Making tube

Making tube with a draw-plate is only one step up from making wire, but you do need an additional piece of kit: a *swage-block*. **Fig 5** shows a fairly typical swage-block, it is basically a hardened steel block containing a series of semi-circular grooves.

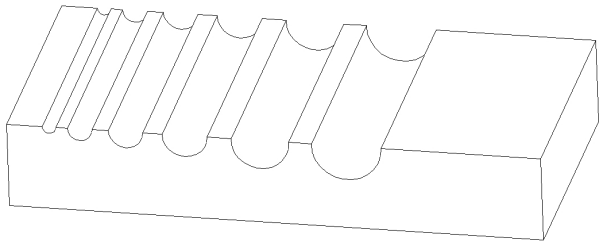

Fig 5

Jewellers have a fancy name for tube; we call it *chenier*, but it's really just tube.

You first decide the size of tube you need and then make an annealed strip of metal the same thickness as the tube wall thickness, 3.14 times as wide as the tube OD, and with one end cut into a blunt point about 1" long; this is going to form the dog. Draw-file the edges to ensure they are flat and square and it should look a bit like item **1** in **Fig 6**.
Now is the time to use the swage-block.
Choose an appropriate groove in the swage-block, and a suitable length of round rod to act as a former, and carefully hammer the rod to bend the strip into a "U" shape as in **Fig 6-2** and **6-3**. You will probably find that it's best to use a large groove to start with, and use a mallet to do the hammering. When you've reached the point shown in **6-3** you continue hammering (gently) to close the tube as far as you can, as in **6-4**. Don't worry about closing it right up or making it look nice and smooth at this stage; just make sure there are no sharp digs or angles that would result from using a steel hammer.

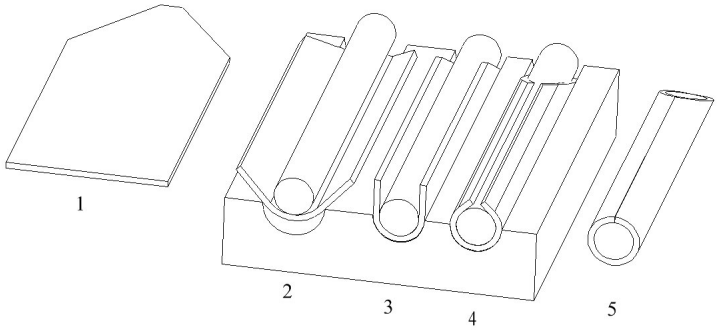

Fig 6

You now remove the rod and use a steel hammer to carefully close the dog to make a cone – it will probably be very uneven and messy looking but don't worry, it is only used as a convenient thing to be gripped by the draw-tongs and will get worse later. Lubricate the strip with soap or some other water soluble lubricant, poke the dog into an appropriate hole in the draw-plate, and draw the embryonic tube through. Continue doing this until the seam is totally closed as in **Fig 6-5**. If the OD is now too small the initial strip was too narrow; if it's too big, just draw it through smaller and smaller holes until it's the right size. Strangely, drawing tube has little effect on the wall thickness, as the OD gets smaller the ID gets smaller too.

If the ID is important it is necessary to use a filler wire of the required ID. Make sure the filler wire is long enough to protrude at both ends of the final tube, lubricate it, place it inside the tube, and continue to pull both of them through successive holes until the OD is correct. You then have the problem of removing the filler wire, but this is easier than you might think. Simply choose a draw-plate hole that will *just* accept the filler wire, feed it through from the *wrong* side, as shown in **Fig 7**, and pull the wire out of the tube.

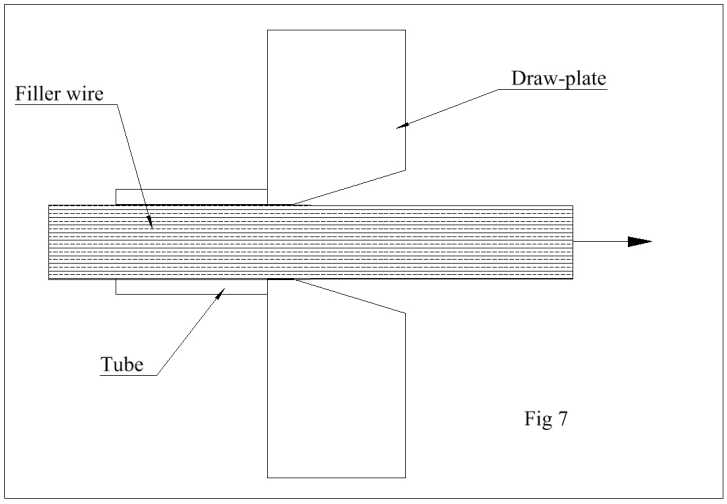

Fig 7

Whether or not you used a filler wire that has been removed, you should now have a tube of the correct size, but it's got a seam. If you don't mind that, then you've

finished, otherwise you need to solder the seam. Do this the jeweller's way. Wash off all the lubricant to ensure the tube seam is nice and clean, then flux it with your favourite flux. Flatten the end of a rod of silver-solder and cut off a series of narrow strips (jewellers call them *paillons* – but this is more correctly applied to small squares of solder). Heat the tube until the flux goes transparent, and then pick up the paillons one by one, touch them on some fresh flux and place them along the seam at appropriate intervals – see **Fig 8** – when they will immediately stick to the hot tube. Apply the flame to the tube until the solder melts and flows along the seam, remove the flame and pickle the tube to remove the oxides. You can pass it through the draw-plate again if there are lumps. That's all there is to it.

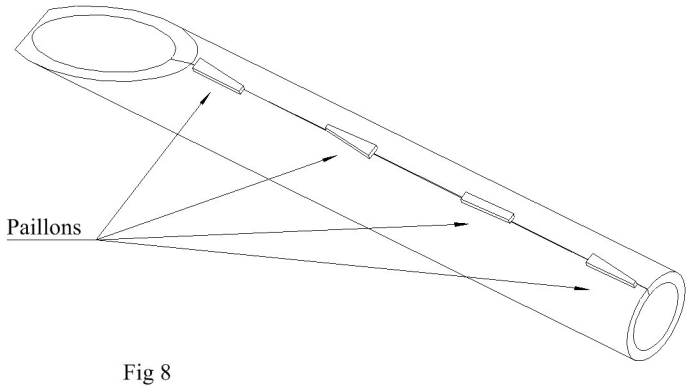

Fig 8