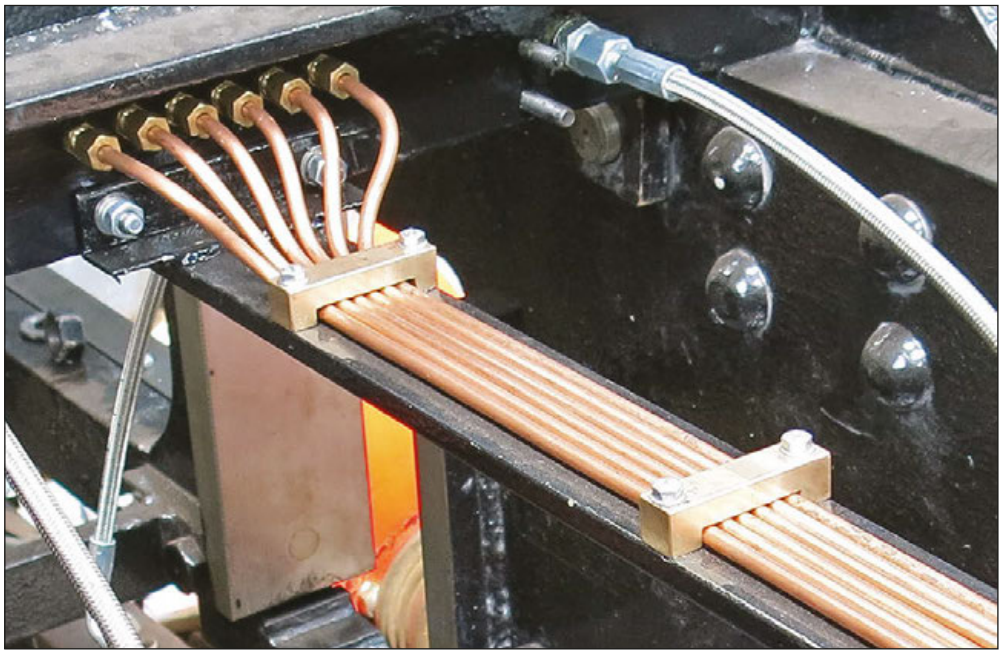
Bending copper pipe

Rich shares his thoughts and experiments on overcoming a common model engineering technique that is easy to get rather wrong...

BY **RICH WIGHTMAN**



HEADING: Well-curved pipes make all the difference whatever the size of loco – here on the Welshpool & Llanfair Light Railway. *Photo: Andrew Charman*

PHOTO 1: Set of spring-type pipe benders.

PHOTO 2: A 3/16-inch pipe being bent in

As the heading to this article suggests I'd like to show you my thoughts and the trials involved in successfully bending copper pipe. If you are a builder of steam or internal combustion engines (amongst other things) at some point you will have to bend copper pipe. Over the years I have tried many methods, some successful and some not so good, and relegated many unsuccessful attempts to the bin.

The pipe sizes I bend typically range from 1/16-inch to 3/8-inch in various gauges so I will concentrate on those sizes. Some of the smaller sizes, 1/16-inch to 1/8-inch can with care be bent by hand but the result is not always a neat finish and perhaps not the professional result one is looking for.

Way back when I first started model engineering the first pipe-bending kit I purchased was the spring type (**Photo 1**). These do work but do have their limitations. Creating a single bend is okay but once you get to three or more tight bends it is difficult to get the spring off.

A second issue is that you can't solder nipples onto the pipe prior to bending and you should definitely not solder the nipples on with the spring still on the pipe! (don't ask me how I know..). You are of course still bending the pipe by hand, the spring (in theory) only prevents the pipe from collapsing.

Photo 2 shows a section of 3/16-inch pipe being bent with the spring method. **Photo 3** shows the result. It was not too bad but this was about as tight a radius as I could get.

The second tool I bought was one of these mini pipe benders (**Photo 4**). Once again they do work but only on pipes of 1/8-inch, 3/16-inch and 1/4-inch diameter . Really tight bends are not possible, the tightest bend has a radius of about 5/8-inch. **Photo 5** shows a bend in 3/16-inch pipe.

Looking for options

I wasn't overly impressed with the results of either the springs or the mini pipe bender so I did a bit of research. One idea I discovered was to fill the pipe with fine sand or salt, seal the ends of the pipe to prevent it running out and then proceed to make the bends. One then unseals the pipe and pours the sand or salt out.

This may work on larger-bore pipes but trying to get sand down a ⅛-inch diameter pipe isn't easy, trust me.

I understand there is a very low melting point metal that can be used to fill the pipe then melted out again afterwards, but this is not something I have tried. There are no photos of various methods that I tried basically because I had no success at all and at the end of the day I was still bending the pipe by hand.

A further method I tried was to fill the pipe with water, firstly sealing one end with a bit of Blu Tack and once the pipe was filled sealing the other end in the same way. The pipe was then put in the freezer for a few hours until the water had frozen solid then the bends made. After this one could either warm the pipe or wait for the water to thaw and run out.

This process works, that's about all I can say, but again you are still making the bends by hand and it is time-consuming waiting for the water to freeze.

The wheel method

During the course of my current loco build, 'Conway' a 3½-inch gauge 0-4-0, I needed to make a considerable number of pipes. Something better than the above-mentioned methods was needed so more research was carried out. There are some absolutely beautiful pipe benders out there that people have made complete with beautifully crafted wooden boxes to keep them in. But I'm more of a practical sort of bloke who just wants a bit of kit to work and is quite happy to keep it in a plastic ice-cream tub.

Having said that some good ideas were gleaned and a pipe bender duly constructed to bend 3/16-inch pipe (**Photo 6**). This worked okay but I found it rather difficult to reposition the pipe once the first bend had been made. Note also that the pipe is slightly crushed on the inner radius (**Photo 7**).

A Mark 2 version for larger pipe of 5/16-inch diameter (**Photo 8**) also worked okay but was still awkward in use and the same crushing of the pipe occurred (**Photo 9**).

At this point my good mate Julian who is building a Martin Evans Simplex loco was also having similar problems with pipe bending and came up with the idea illustrated in **Photo 10**, which is designed for 3/16-inch pipe. The handle is drilled 3/16-inch while the wheel part, which is silver soldered to the handle, has a 3/16-inch groove machined in it. This works fine (**Photo 11-12**). ▶

PHOTO 3: The 3/16-inch pipe after being bent in the spring.

PHOTO 4: A mini pipe bender.

PHOTO 5: Bend in 3/16-inch pipe made with the bender.

PHOTO 6: Wheel bender for use with 3/16-inch pipe.

PHOTO 7: The 3/16-inch pipe bent using wheels – note slightly crushed inner radius.

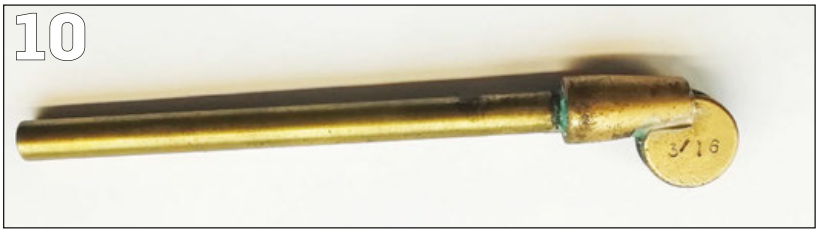
PHOTO 8: Wheel bender for 5/16-inch.

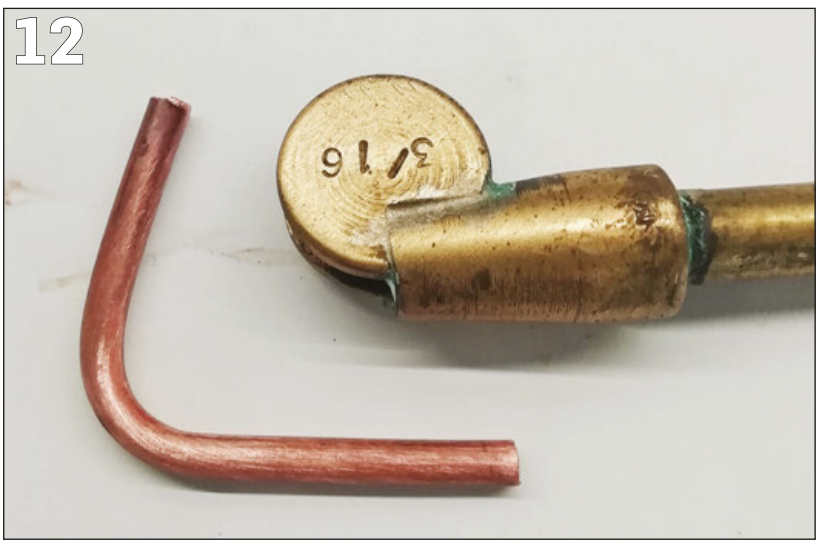
PHOTO 9: 5/16-inch pipe wheel bent, crushing on inner radius.

PHOTO 10: Fixed wheel bender for 3/16-inch pipe.

PHOTO 11: The fixed wheel bender in use.

PHOTO 12: 3/16-inch pipe bent using the fixed wheel bender.





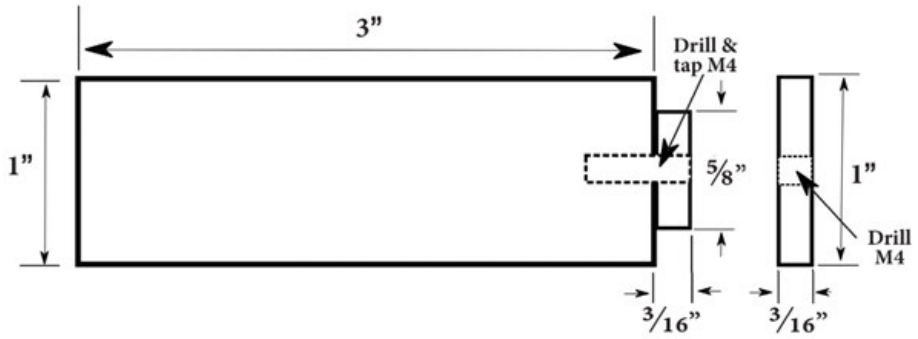
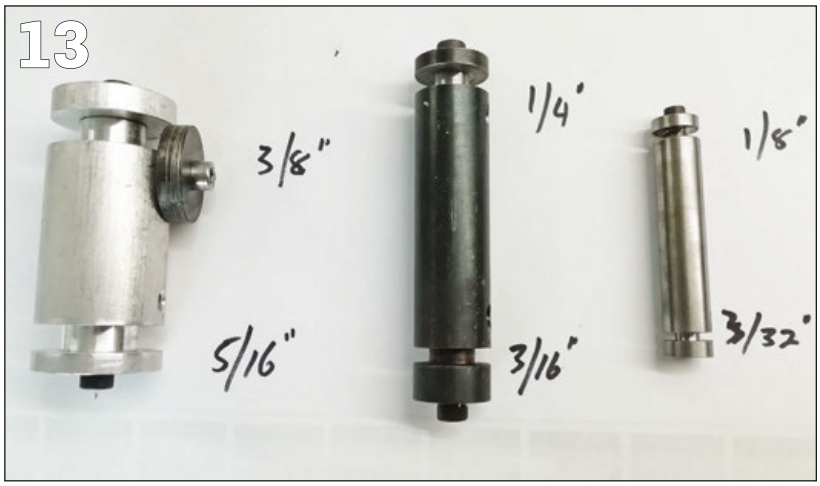
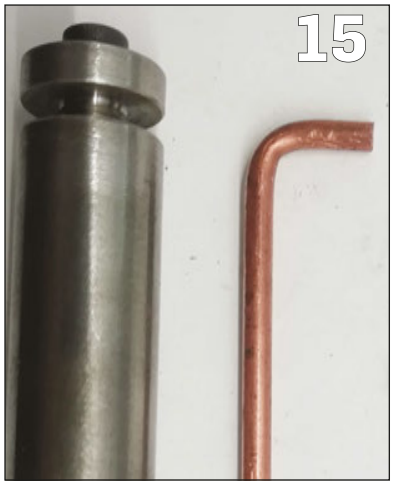


FIGURE 1

In trying all these bits of kit pipes were bent and fitted but I still wasn't 100 per cent happy with the results I was getting. I decided to give the problem one more go so I researched the subject again looking for something simple, quick to make and which above all would work.

When carrying out research on the internet one will find a link that leads to another link that leads to well, so on and so forth, until deep in the bowels of somewhere in the world I came across the following idea, about as simple as you can get and not difficult to make. **Photo 13** shows a trio of pipe benders that I have made and I have to say they work absolutely perfectly every time.





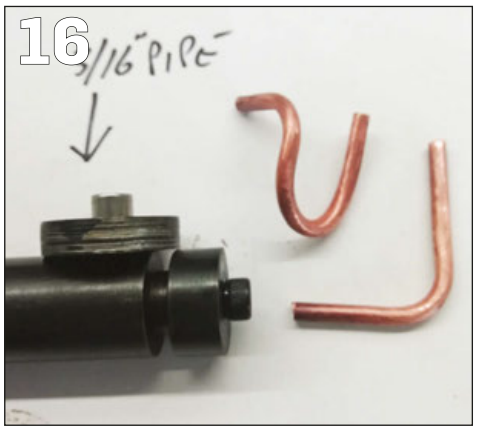


FIGURE 1: Drawing of the 3/16-inch end of a pipe bender.

PHOTO 13: A trio of home-made pipe benders.

PHOTO 14: A sample 'hairpin' bend formed in 3/32-inch pipe.

PHOTO 15: Similar process in larger 1/8-inch pipe section.

PHOTO 16: More complex bends in 3/16-inch pipe.

PHOTO 17: It works just as well in larger 1/4-inch pipe.

All photos and diagrams by author unless stated

Simple build

Construction couldn't be easier. The 3/32-inch and 1/8-inch bender is made from 9/16-inch round steel bar. The 3/32-inch end is the only end I didn't bother to use a separate washer, the small pipe being easily removed from the slot.

The 3/16-inch and 1/4-inch bender is made from 1'-inch round steel bar and the 5/16-inch and 3/8-inch bender is made from 1½-inch round aluminium bar.

I will describe the making of the 3/16-inch and 1/4-inch bender. Take a piece of round bar, something from the scrap box will do, steel, brass, aluminium, it doesn't matter which but it needs to be around an inch in diameter for pipes up to a 1/4-inch.

In the lathe centre drill and then drill tapping size for say M4. Part off a thick washer about 3/16-inch thick. Tap the body M4 and drill the washer part 4mm.

Turn a shoulder on the body part 3/16-inch wide and 3/16-inch deep. It doesn't matter if it is a little deeper but the width, 3/16-inch must be correct – **Sketch 1** will give you an idea of what to aim for.

For larger pipes it makes life easier to drill and tap the side of the body and fit a thick washer that is large enough to cover the slot, this will hold the pipe in place. The same big washer can be used on both ends of the two larger benders, see Photo 13. That's all there is to it – machine the other end in a similar fashion but sized to take 1/4-inch pipe.

The tool can be hand-held or used in a vice. In use it helps if you anneal the pipe first then re anneal for each bend. To use the bender simply pull the pipe around the groove. The walls of the groove prevent the pipe from collapsing and going out of shape. To reposition the pipe for the next bend slacken the bolt/bolts a little, move the pipe and re-tighten the bolts.

Photos 14 to **17** show some sample bends in pipes of 3/32, 1/8, 3/16 and 1/4-inch diameter. As can be seen quite tight bends are achievable. If a bend of a particular radius is required it's a quick job to knock up another tool to the required radius.

The tool is cheap, easy to make, will last a lifetime and above all does the job. I hope readers will find this tip of use. EIM