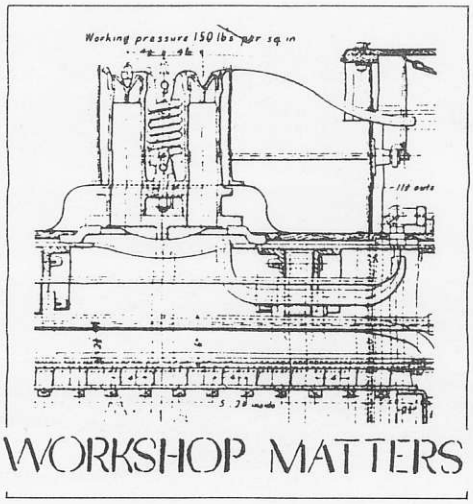
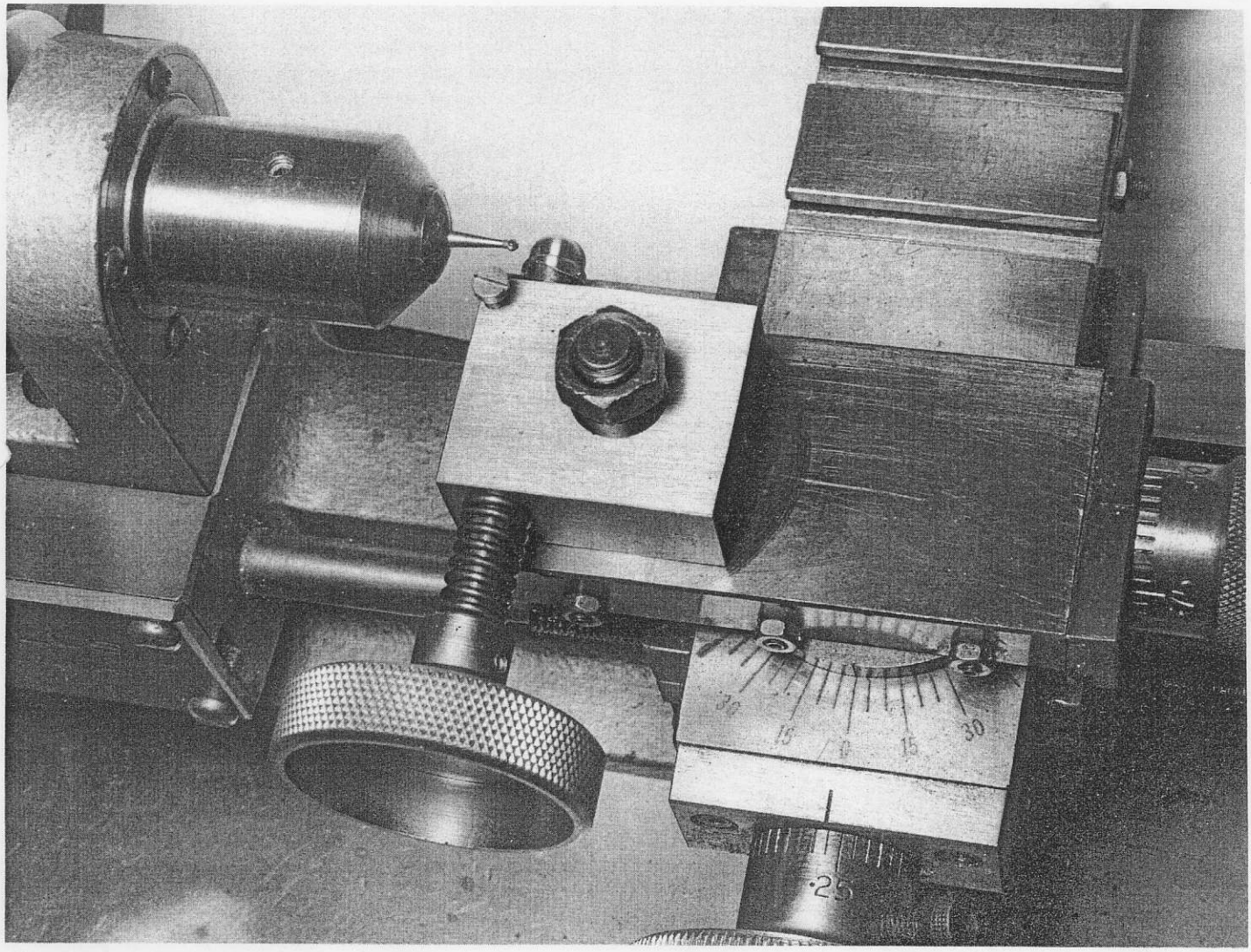
Forming the flange

GEOFF HELLIWELL, a stalwart of the 3mm Society, has found a successful way of forming flanges on chimneys and domes:



Way back in MRJ No. 50, Paul Berntsen described his method of making chimneys and domes. This kind of article is just the sort of thing I look for in MRJ. However, I was a little disappointed that when it came to forming the base flange on a steam dome, Paul reverted to a hand-held rotary burr and rat-tail files. I nevertheless followed his teachings when making the dome for my GWR '517' which subsequently gained me a bronze medal at the Model Engineer Exhibition. Stewart Hine, one of the judges, commented in his subsequent write-up that I had lost marks because the dome base flange was poorly formed. This stuck in my mind, so when the 3mm Society asked me to make some casting masters for a range of L & Y steam domes, I began to seriously consider how Paul's method of forming the flange could be improved upon. I felt sure there must be a way of machining the profile and eventually came up with the following solution.

My technique for cutting the underside of the dome is very similar to Paul Berntsen's – that is, mount the work on the toolpost of a lathe or on a milling machine and use a flycutter to form the face that mates with the boiler. Great care must be taken to see that the cutter is exactly on the centre line of the workpiece otherwise the finished dome will sit off-centre on the boiler. The next stage also follows fairly closely the teachings of the Antipodean master in that the work is held in the lathe chuck, to be spotfaced



General view showing the jig in place, ready to machine the flange profile.

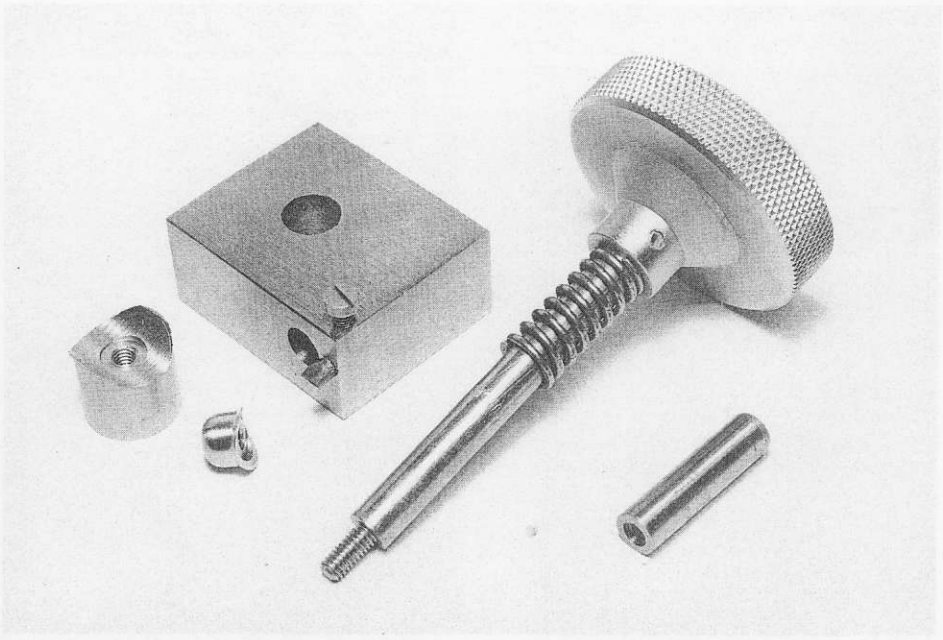
using a ¼in slot drill and then tapped to take a mandrel. So far I have adopted 4BA thread as standard – a little large for 3mm scale perhaps, but it at least gives a good strong mount for the part-finished dome.

I have made two mandrels – a short one for mounting the blank in the lathe and a longer one with a hand wheel for use with the jig. Both are made of ¼in silver steel and each has a removable stud rather than a fixed spigot. This allows the length to be varied according to how tall the dome is. Ideally the mandrels should be bored right through and a much longer stud used as a drawbar but I fought shy of drilling deep holes in silver steel! I dare say that mild steel would have been quite adequate but I didn't have any to hand. In fact, all that is really needed is one mandrel with a removable handle but I fixed the handle on mine before I realised is.

The next step is to reduce the blank to the final size, both the flange and the body of the dome are reduced to final diameter on the lathe. Contrary to the example shown in the photographs, the 'ball' of the dome is best left parallel at this stage as it gives something to grip when removing the work from the mandrel.

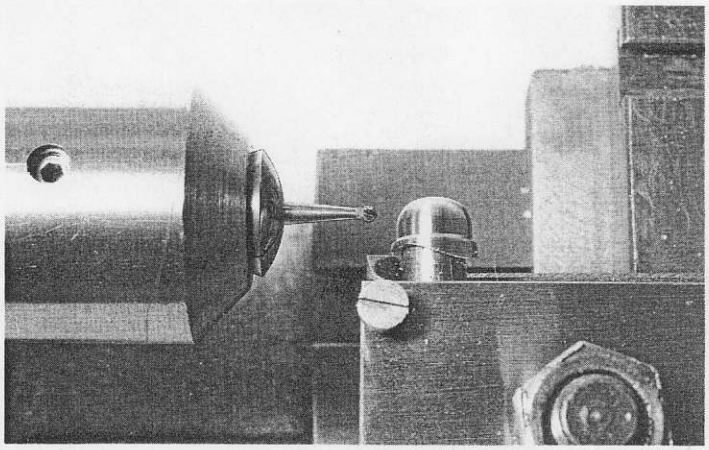
Next comes the clever bit. The profile that we need to follow has already been created by the flycut base. What is needed is a means of mounting the work and moving it in sympathy with that profile. This is achieved by a block which replaces the toolpost of the lathe, bored to take a mandrel at centre height and at a right-angle to the axis of the lathe. A pin, also exactly at centre height, is fitted. This acts as a sort of cam-follower against the curved base of the hand-rotated workpiece and is best fitted on the side rest the lathe chuck. It must act against the extreme edge of the flange otherwise the correct amount of lift will not be achieved. On my jig, the pin is wedge-shaped so as to cover a range of dome sizes. The work is held against the pin by a fairly stiff spring placed between the block and the handle.

I won't go into too much detail about the jig itself as the photographs make its construction self-evident and dimensions will vary with the machinery available and the size of the domes required. However, one or two constructional notes would not go amiss: the easy way to ensure that the holes in the jig are bored at exactly centre height is to drill at least the centres using the lathe itself – simply fix the block in place of the toolpost, drill the holes and then rotate the block by 90°. The wedge-shaped pin and mandrel with the hand wheel can then be fitted. The pin has a tendency to rotate so it needs to be either glued or held with a locking screw. When making the pin, if the end is faced with the lathe tool slightly below centre height, the resulting centre pip can be used as a reference to file the wedge equally on both sides.

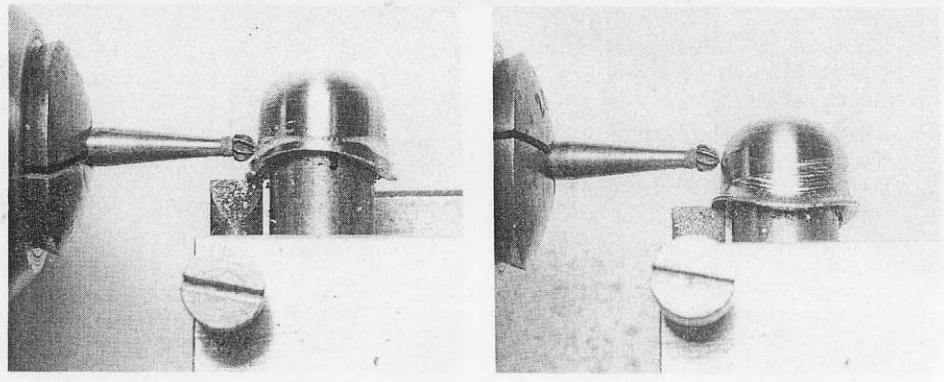


'Studio' shot showing the component parts as well as a flycut blank and a finished dome.

The actual cutting is carried out by a dental burr held in the lathe chuck. Run the machine as fast as you dare without needing take-off clearance from Air Traffic Control in order to get the best possible finish. (You can actually get burrs free if you ask the tooth doctor nicely – all you have to say is: "Ay gonc shucosh yuy hash engy olg gurs yuy gonc need?" But I digress.) The work is set to the high point of the cam and traversed



A close-up of the part-finished dome in position on the jig.

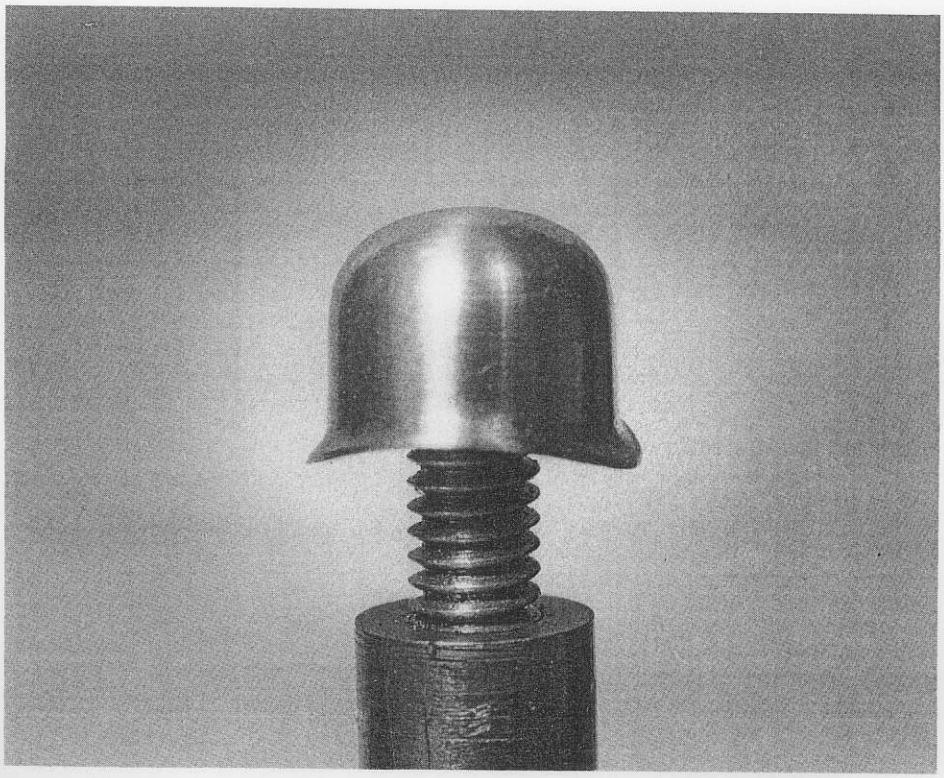


Left: *The flange taking shape.* Right: *The flange more or less finished, needing only fine finishing.*

until the burr just touches the work. The crossfeed is then used to move the burr into contact with the base flange. As the hand wheel of the jig is turned, the burr cuts a path which follows exactly the profile of the base. Always rotate the handle clockwise otherwise the work will tend to unscrew. The diameter of the burr used will, of course, vary according to the scale and the prototype.

Two fundamental rules need to be followed to ensure success: the flycutting of the base must exactly bisect the bar; and the holes for both the mandrel and the cam-follower must be exactly at centre height.

That really concludes the clever bit. The work can now be transferred to the plain mandrel and the ball of the dome finished on the lathe. With the best will in the world, the burr will not create the highly polished finish that we require, so some light work with fine files is still needed to remove the machining marks prior to polishing with emery cloth. Most domes to be found on Brunswick green engines have spherical tops which I will form using files so what I need now is someone to design a nice simple ball turning device for small lathes.



The finished article (five times full size).