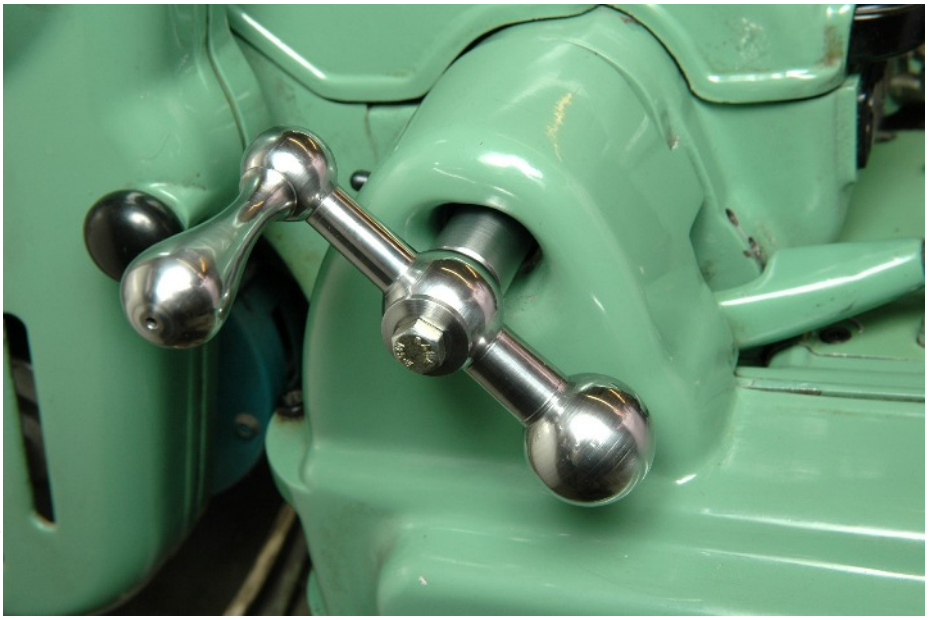
David Haythornthwaite Turns his lathe mandrel safely with this pretty balanced handle attachment.



Don't Fly Off The Handle !!

Many years ago I saw some scrap yard breakers smashing up an old lathe with sledgehammers and I rescued the cross slide handle for the price of a pint of beer. On taking it home, I found it to be an ideal size for turning the mandrel on my Myford Super7B and it simply looks as though "it grew on the Myford". Our noble Editor spotted it on my website www.Haythornthwaite.com and suggested that I wrote it up for the magazine. That would have been easy if I had made the original, but he spotted the one thing that I had not made myself. I have now made a second identical handle (**Photo. Above**) and found it to be an interesting turning exercise which would benefit many lathe owners.

Handle Details

As stated in the introduction, I first used this design of handle simply because it was there and of the correct size. However when I started to use the handle, the fact that it was almost perfectly balanced proved to be a massive advantage. Although I cannot officially recommend the practice, when you are alone in the workshop, it is very nice to be able to spin the lathe up to full speed, with the balanced handle still in place, but do take measures to keep others away if you do this. On the Myford ML7 the handle also looks as though Myford had designed it themselves. It looks like a fitted handle as opposed to a workshop made accessory.

Order of Machining

As the handle is comprised almost totally of curves and tapers, it is an interesting and challenging item to make, but I do suggest that you use leaded free cutting mild steel and not just any piece of metal which was lying around, as I did. I apologise for the fact that the measurements are mostly imperial, but I was copying the handle of an old imperial lathe.

The main (radial) part of the handle is made from a 5.5" length of 1.625" Dia. mild steel and needs to be machined in a carefully controlled sequence, otherwise you will finish up with no means of holding the item for the final sections. Cut off a length of bar just over 5.5" long, face one end and put a small centre in this end. I used a fixed steady for this. Remove from the chuck, fit the other end in the chuck and face the second end, bringing the length to 5.5". Centre this end again with a small centre drill. I did consider making this item without centres in the ends, but centering the bar makes machining so much easier and a small centre does not detract from the finished appearance at all, in my opinion.

Roughing Out

First of all turn the bar down to a thou or two over 1.3" diameter for a length of 4.0". this will reduce most of the bar to the diameter of the middle ball, but leave a piece on the end to make the large ball. . Then turn the end of the bar down to a 1.0" for 2.11" i.e. reduce to the diameter of the small ball in order to form the small ball and the thinner tapered part. At this stage it should look like **Photo 2.** Now it is necessary to make grooves in the bar down to the points where the spherical parts of the item will adjoin the tapered parts. This will give space for the

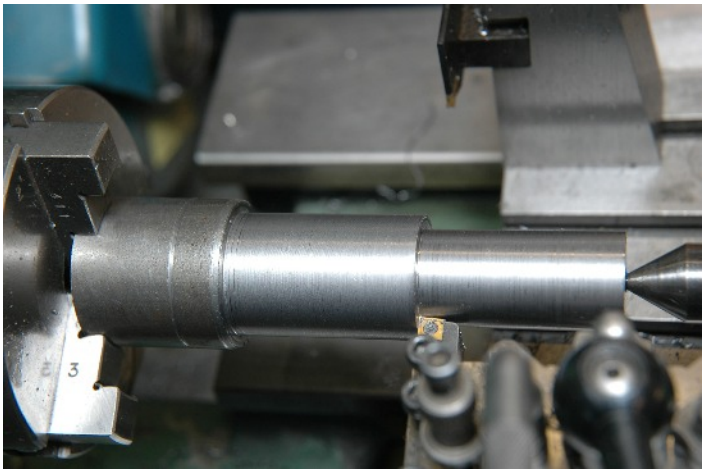


Photo. 2 Roughing Out

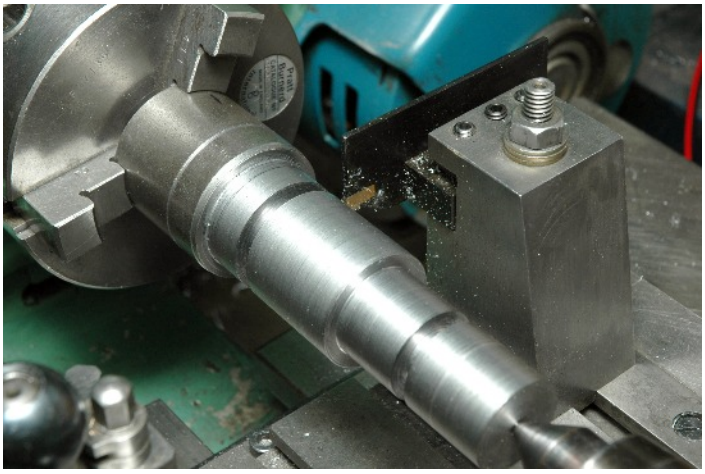


Photo. 3 Turning the Grooves

ball turning attachment tool to swing round to complete the edges of the balls.

First make a cylinder 1" wide and 1" diameter on the end of the bar in which to make the 1" ball. Line up a the left edge of a parting tool with the end of the bar and then move the saddle down the lathe bed by 1" plus the width of the parting tool. Lock the saddle and make a groove with the parting tool until the diameter at the bottom of the groove is .510". This will leave you a cylinder 1"x 1" for the small ball and a section that is just larger than the diameter of the small end of the taper where it meets the small ball. I actually then widened this groove by taking a second cut to a slightly larger diameter. Release the saddle and move it left so that the left side of the parting tool is now 2.11" from the end, i.e. the parting tool is up against the previously made shoulder. Lock the saddle and make another groove with the parting tool at this point until the groove diameter is .63" which is the diameter of the tapered section at the junction with the middle ball. In the same manner make a groove of .72" diameter with the tailstock edge (right edge) of the parting tool 3.41" from the end of the bar and a final groove of .78" Dia. Which has it's left edge 4" from the end of the bar. The process is illustrated in **Photo 3.** but you will see that I did not follow the same order, having just cut grooves 1 and 3 at this stage.

Turning the Balls

The first ball to turn is the small ball, so leave the bar in the 3 jaw and fit a fixed steady so that the end is left clear to use a ball turning attachment. I used my boring head as described in MEW issue 133 to turn all the balls. I do not use suds on my lathe being frightened of rust, but I drip neat cutting oil onto the work instead. Some sort of cutting oil or suds is definitely recommended for a good finish. **Photo 4.** shows the setup and for all those readers who feel upset when looking at photos of clinically clean lathes, when they, themselves, are actually knee deep in swarf, I have left some of the swarf in place in the photo to illustrate that ball turning makes lots of fine swarf.

You can use either an "up and over" attachment or "round the houses" (vertical axis) type of ball turner, but I shall describe the procedure using an up and over type as illustrated. First of all set the ball turning attachment exactly at centre height. Do this by adjusting the ball size of the tool in the ball

Photo. 4 Turning The Small Ball

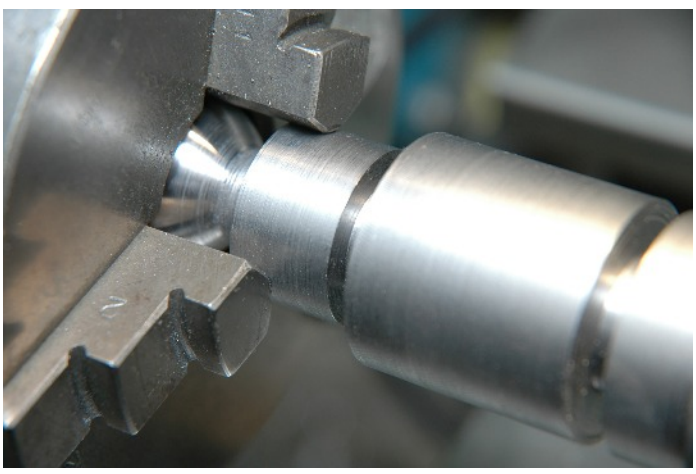


Photo. 5 Holding the Work for Turning the Large End

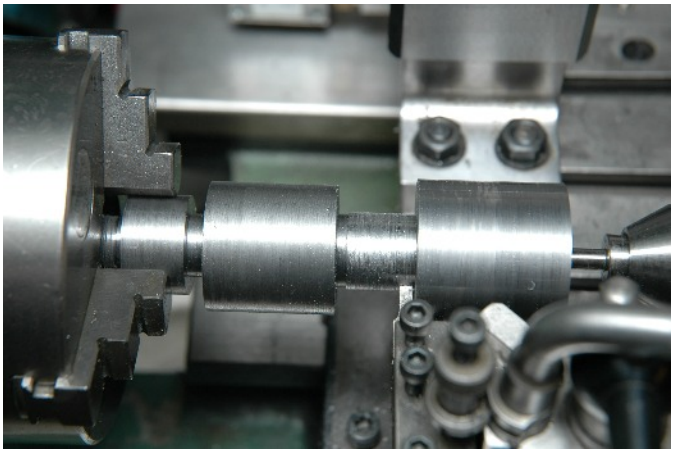


Photo. 6 Ready to Turn The Large Ball

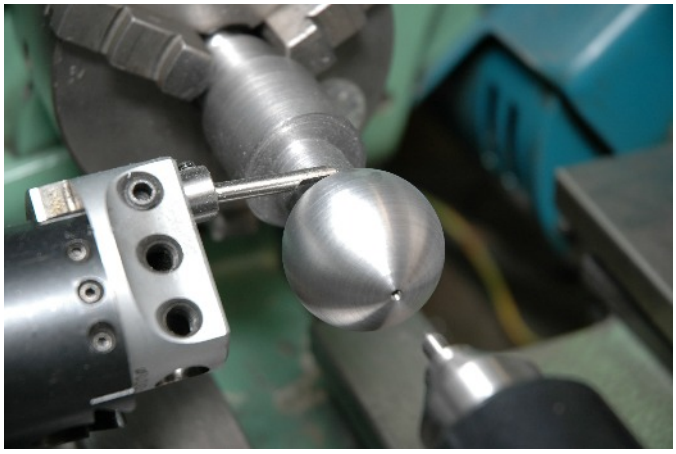


Photo. 7 Finishing the Large Ball With Tailstock Withdrawn

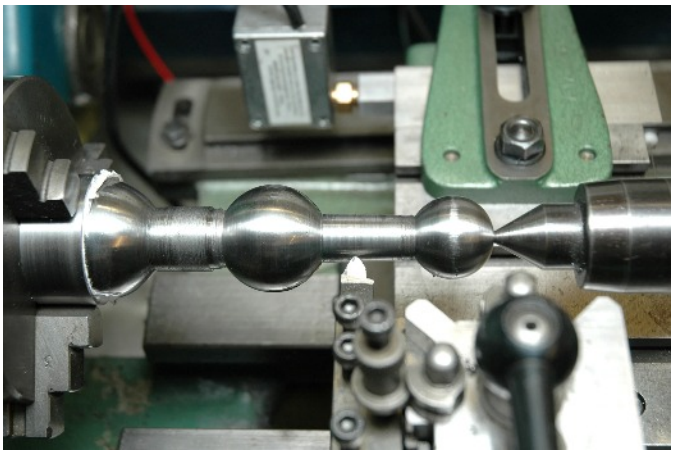


Photo. 8 Turning the Smaller Taper

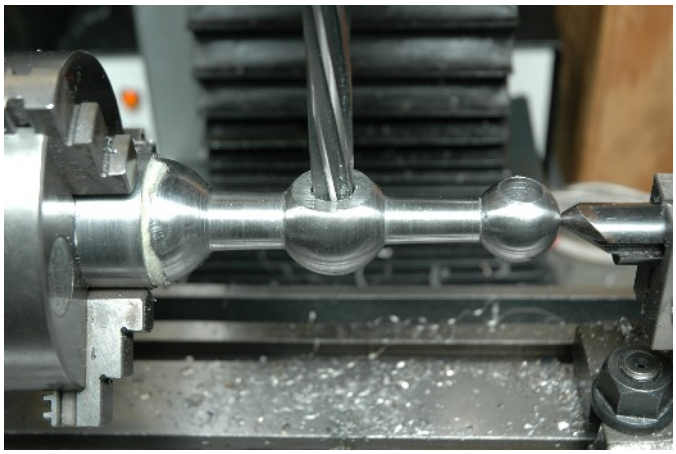


Photo. 9 Milling the Flats and Reaming the Holes

turner so that the tool just touches the top of the work. Move the saddle right, swing the ball turner 180 degrees so that the tool is underneath the work and return the saddle. If the ball turner is exactly at centre height, the tool will just touch the underside of the work. If not, then adjust the height of the tool, adjust the "ball size" of the tool and test again until it is correct. Once you have set this correctly, rotate the ball turner 90 degrees and move the saddle so that the tool just touches the end of the work. You have now proved that the centre of rotation of the tool is ½" below the top of the work, ½" above the bottom and ½" from the end of the work. The correct position for turning a 1" ball. If you get this position wrong vertically, you will turn oval balls. Wrong horizontally and they will be in the wrong place.

Lock the saddle and cross slide. Open up the jaws of the ball turner to allow the tool to clear the shoulders of the work and begin the satisfying work of turning the ball. Take the size of the ball to a few thou under 1" diameter for reasons explained later.

Once the first ball is finished, bring up the tailstock to support the end of the bar and remove the fixed steady. Using either dials or, in my case, the DRO, move the saddle left by 2.26" to bring the centre of rotation to the centre line of the middle ball. Turn the middle ball in the same manner ensuring that you do not cut too deep at the ends of the "swing" as you will cut into the tapered portion of the handle. From the photos you will see that I left the middle ball until later, but it is possibly best to do it now.

Having formed the two smaller balls, reverse the work in the 3 jaw chuck. As shown in **Photo 5.** You will see from the photo the reason for making the small ball a couple of thou under 1" – it will pass into the centre hole of a 4" Pratt Burnerd scroll chuck, so that the work can be held by the 1" diameter section that you have left just behind it. Bring up the tailstock to support the work, and bring the end of the bar to a diameter of 1.5" in readiness to form the large ball. Remove the majority of the metal between the large ball and the middle ball by turning it down to 0.8" Diameter. And the result should look like **Photo.6** although you may have the centre ball already formed.

Set up for the large ball as you did for the small one and turn as before. I left the middle ball until last, so that I could use a fixed steady, but in fact I found that it was less cluttered if I used a fine rotating centre to support the end

for most of the turning, and that the bar was secure enough to withdraw the centre and take light cuts when finishing off the end of the ball as in **Photo 7.**. There is not a lot to choose between the two methods. If you haven't yet done so, now turn the middle ball.

Turning the Tapers

We are now ready to turn the tapered parts of the handle. However, with a ball on each end, it is difficult to hold the item. I turned a steel tube, 0.75" long, 1.61" O.D. and 1.501" I.D. so that it was a sliding fit over the large ball. I then wrapped a strip of 80gm paper round the large ball and used the tailstock to press it into the tube with the tube against the chuck. The result was as shown in **Photo 8.** which allowed me to drive the work. The walls of the tube were thin enough to ensure that they deformed in the chuck jaws and gripped the work. The paper ensured that the work was not marked by the tube and gave grip. This worked well. A calculation of the original taper showed it to be 2.4 degrees so set the top slide - or taper turning attachment to the correct angle and turn the tapers as shown in **Photo 8.**

When using a taper turning attachment, do remember, first, to disconnect the cross slide lead screw. Also, I always push the top slide to the back of the lathe when starting the cut to take up the backlash in the taper turning device. Of course if you are cutting with the smaller taper on the left, you have to pull the top slide to take up the backlash. Use a round nosed tool with side angles sufficiently acute to ensure that it will clear the sides of the balls and will cut right into the corner. You will note that the larger taper is only roughed out at this stage. Eagle eyed readers will note the die-cast box on the lathe behind the middle ball. This is a B&W DRO for the cross slide. Unfortunately this device is no longer made, which is a shame as it is very compact, does not interfere with the taper turning attachment, and is great on a smaller lathe such as the ML7.

Remember that we are only interested in the aesthetic appearance here providing that we are able to ensure a correct balance at the end of the job.

Milling & Drilling

Once the ball turning and taper turning is finished we now need to mill the flats on the centre ball and to drill holes for the centre spindle and the axial handle. Leave the work in the chuck and transfer both work and chuck to the rotary table or dividing head on the milling machine table, supporting the end with a tailstock. Alternatively if you have a drilling/milling spindle on the lathe, you can use that but a ½" hole is asking a lot of most of these devices.

Touch the milling cutter onto the top of the middle ball and zero the Z axis dial/DRO. Gradually mill a flat, dropping the cutter until your Z axis reads 0.1825". Rotate the work by 180 degrees, lock the dividing head and carry out the same operation on the other side. This should leave a centre boss of 0.935" thickness.

Drill a hole through the centre of the boss either 12.5mm or $^{31}/_{64}$" depending on your drill set and ream ½". Do the same with the small ball, but making a blind hole 0.7" deep, as in **Photo 9.**

Turning the Axial Handle Part B

Turning the axial part of the handle proved to be one of those jobs where scratching my head only cause splinters in the end of the fingers !! I did it by a combination of various techniques including hand turning and turning with a profile tool. Both worked ok, but in the end I preferred using the profile tool and executing much coordinated "knob twiddling". **Photo 10** and **Photo 11** illustrate the two methods. Start with a piece of 1" diameter FCMS of around 4" long and then reduce the diameter in appropriate places as much as possible by normal turning methods. I also part-made the ½" spigot at this stage to re-

Photo.10 Using a Hand Turning Rest

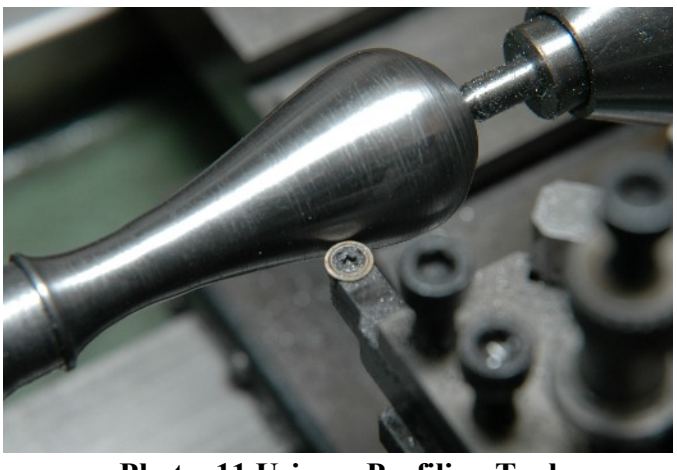
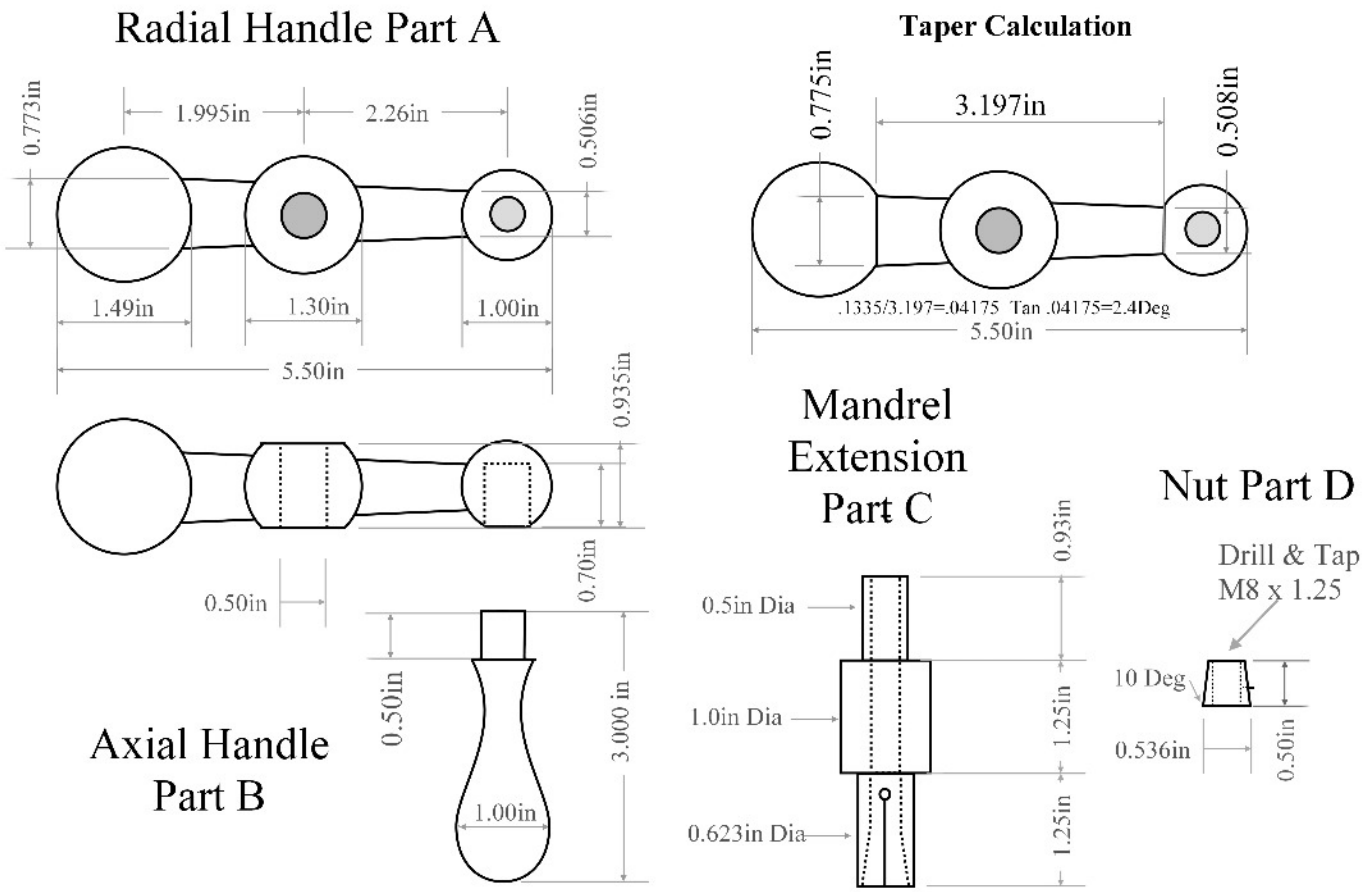


Photo. 11 Using a Profiling Tool

Fig 1



mind me where the end of the handle was to be. Once you arrive at the need for curved surfaces, then the fun begins.

The hand turning rest that I used is one made from the George Thomas design and from a Hemmingway kit. The hand graver is fitted into a long handle and the left hand is guiding the tool across the work, or pivoting it, whilst the tool handle is held in the right hand. This is quite satisfying to do, but slow going with light cuts. Using the profiling tool in the top slide required careful coordination of the left hand on the cross slide hand wheel and the right hand on the saddle handle. If you falter for a moment and don't keep cutting, then the result will be chatter – and consequentially "mutter" as you have to get rid of the chatter marks !! – so be positive with your feed rates. Once you are happy with the shape, finish the spigot to 0.498" diameter and part off. I regret to say that I resorted to emery paper to finish this item after carefully covering the lathe bed and slide ways

Balancing

The balance is not critical, but the better it is balanced and the smoother it will run at speed if you (inadvertently) run it at speed. Temporarily fit the two parts together, put a ½" bar through the centre hole and balance it between two horizontal parallels (vice jaws if horizontal). I recommend that you make the axial handle heavy as it is easy to return this to the lathe and take another few thou off the diameter, or to drill a hole down the centre of the spigot to lighten it. I was not pleased to find that mine was heavy at the large ball end. Faced with making another (heavier) axial part or filling it with lead, I decided to make a tube to hold the small ball, put the radial part back in the lathe, with a steady on the tapered section, and take a few thou off the large ball – twice actually. Much to my surprise it worked fine, but it would probably have been easier to have used tailstock support and reduce the taper on the large end. Once balanced, fit together with Araldite Epoxy Resin, clamp and leave in a warm place, or, with permission from the domestic authority, cook at 50°C to cure.

Making the Mandrel Extension Part C

The initial part is a straightforward turning job. Cut off a 3.5" length of 1" diameter FCMS bar, chuck in the 3 jaw, face and centre the end , and clean up the outside for 2.75". Turn down to 0.498" diam-

Photo. 12 Slitting the Mandrel Extension

Photo. 13 The Finished Parts

eter for a distance of 0.92" (just less than the thickness of the centre boss of the handle) making it an interference fit in the handle centre hole. Chamfer the shoulder. And then drill though the centre as far as you can with an 8 mm drill for the 8mm bolt.

Turn the item in the chuck and hold by the section you have just turned. I used a ½" collet to ensure concentricity. If you are using the 3 jaw chuck and it is worn, I suggest that you start with a 4.5" length and try to turn the whole thing at one chuck setting. Turn the second end to 0.623" diameter for 1.25" which will leave a boss in the middle of around 1.25" long. Chamfer the shoulder. Drill 8mm from this end to meet up with the already drilled hole from the other end. My Myford always meets up perfectly when I do this, but I know that some lathes struggle to drill long centre holes straight. If yours is such a lathe, you will have to drill smaller and tackle a very fiddly boring job, or finish with a reamer or D bit.

Now set the top slide over to 10° and bore the inside taper until the mouth of the bore is 0.536". You will remember to use the top slide handle for boring won't you? If you once use the saddle handle out of habit then you are making another piece. Transfer the chuck / collet to the dividing head on the milling machine and cut the 4 slits with a slitting saw as in **Photo 12.** If you are better than me with a hack saw, you can use that as there are 4 slits. Finally finish off the end of each slit with a drilled hole as in **Fig 1.** Clean up the slits with a triangular needle file both inside and out.

Tapered Nut Part D

With the top slide still set over at 10° from boring the taper, chuck a short length of 0.625" silver steel and turn a taper, large at the end, until the end diameter is 0.536". Using the same setting of the top slide ensures a good fit into the tapered socket. Drill from the tailstock 6.9mm and tap for an 8 mm bolt. Measure ½" from the end and part off.

Before hardening this item, select a piece of fine piano wire or a fine moulding pin that will fit through the slots in the mandrel extension and drill a small radial hole in the nut so that a short length of the wire can be epoxied into the side of the nut, after hardening. In use, this pin will engage with one of the slots, to stop the nut turning when tightening or slackening the bolt. Finally heat up the nut to 770 °C and quench in oil. I also tempered my nut by heating in the domestic oven at 200 °C. A standard 8 mm heavy duty washer would suffice between the bolt head and the handle, but I preferred to turn a shaped washer, 23 mm diameter, with a nice bevel that finished off the job. **Photo 13** illustrates the various parts.

Assembly

Fit the pin into the nut with Epoxy or Loctite. Opinions vary as to whether turned steel objects benefit from polishing, but personally I spent a few minutes buffing the parts on the buffing wheel and I consider the result to be most satisfying and in keeping with a handle of this type. I used Epoxy Resin to fit the two parts of the handle together and fitted the handle onto the mandrel extension with the help of a little nut lock, in case I needed to separate these at some time. The bolt is a standard 8 mm plated bolt 95 mm in length.

I have to say that, although not easy to make, the handle is very tactile and this makes it a joy to use.