Drilling an angled hole *– Mike Brown*

I recently had a little problem to solve involving drilling some lubrication holes at an angle in the end of my Hunslet expansion links as shown (see *fig 1*). (Purely out of interest, *fig 2* shows a link being milled out on my new home made CNC miller.)

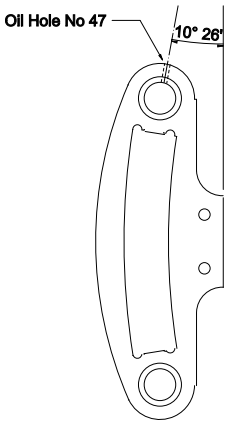

fig 1

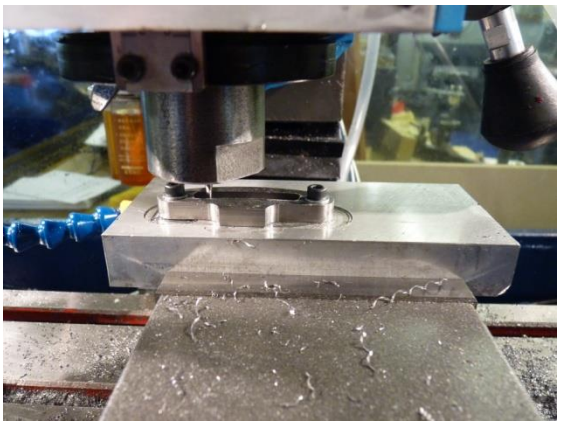

fig 2

Now, how to drill this hole is not the trickiest problem to solve, I am sure that most people can come up with a solution pretty readily. The main reason for writing an article about it is that my solution combines some of my handiest workshop gismos, and some techniques that some of you may find of interest.

The first problem was how to set the link to 10 deg 26 min. Well in this case an angle of 10.5 is close enough so my trusty digital angle gauge was got ready (*n.b. the gauge measures in decimals of a degree*). I first set the gauge to zero on the vice jaw *(see fig 3*). Then I prepared a steel parallel (thinner than the link) by sticking a couple of strips of double sided tape on the back. I then stuck the gauge to the parallel (using the magnets incorporated in the gauge). With a little jiggery it was not too difficult to stick the parallel to the fixed jaw of the vice at the required angle *(see fig 4, n.b. the photo shows the wrong angle!*). It was now easy to position the link against the end of the parallel at the correct angle *(see fig 5*).

fig 3

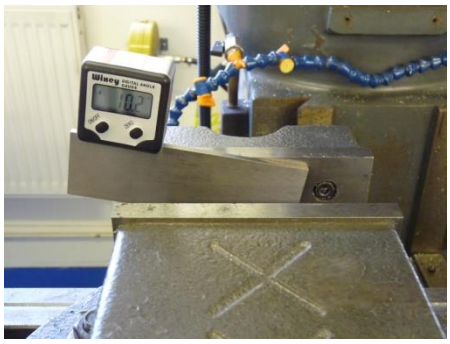

fig 4

fig 5

Now the problem was how to accurately locate the correct drilling location. This was done using a couple of centre finders. The first has a ball end, and is designed to run against flat surfaces. With the spindle running at about 600rpm the ball is gradually brought closer and closer to the face of the vice jaw until it is rubbing on the jaw. If you keep moving the table, the ball will be seen to wobble, with the wobble becoming less and less until the ball is spinning smoothly against the jaw. If you keep moving the table (very slowly), the ball will suddenly jerk to one side jaw *(see fig 6*). At this point the axis of the spindle will be exactly half the diameter of the ball away from the jaw surface. Now I am lucky enough to have a digital readout fitted to my milling machine, so it is an easy matter to zero the Y (cross) axis at this point (just press the zero Y button). The table can then be moved half the diameter of the ball (in my case 2.5mm) further on and the Y axis is

zeroed again. This time the axis will be exactly over the edge of the vice jaw. Now if the table is moved back half the thickness of the link and the display zeroed again, the tool axis will now be exactly in line with the centre of the link.

Finding the centre of the hole in the Z axis (longitudinally) is only slightly more involved. The bearing holes were already drilled and reamed to a standard size (8mm) so I inserted a piece of 8mm silver steel into the hole and changed to my cylindrical centre finder (*see fig 7*). This centre finder has a short cylinder as the locating element (rather than a ball), and it is designed to work against cylindrical objects. Lower the finder until the centre of the locating cylinder is roughly level with the centre of the 8mm bar. Using the same technique it is a simple matter to datum the machine axis to the centre of the axis of the hole. Thus when the X and Y readouts are at zero the hole is accurately located and drilling can commence (*see fig 8*).

fig 6

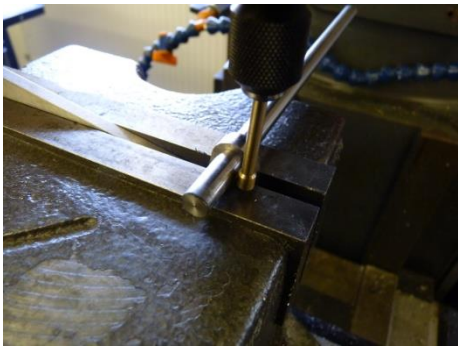

fig 7

fig 8

P.S. Double sided tape is a great workshop aid for setting and locating up all sorts of things, but be careful to get tape that is like ordinary sellotape but with glue both side. It sticks well, holds firmly, and peels off cleanly. Some tapes are just a layer of glue, and it is pain getting rid of it, and some tapes are thick and gungy and have too much movement.