

Fly cutters - Baz Butcher

At the November club night Mick Bell discussed the use of several tools in the model engineer's workshop. One of them was the fly cutter which might allow large holes to be cut in sheet materials (by trepanning) using a milling or drilling machine and/or facing of flat surfaces on a milling machine or, usefully, on the cross-slide of a lathe. Mike Grossmith asked a question on their use which Baz has attempted to answer more fully.

A tank cutter (TC) and fly cutter (FC) are related in general appearance but opposing, or is it complimentary, cutting action. The TC can be used in a drilling machine because it cuts downwards never sideways. The FC cannot be used in a drill because it cuts sideways never downwards. As a result of their differing cutting directions they need a different approach to tool design and what 'looks right' in a FC leads to incorrect set-up and poor results. This is a common misunderstanding and often asked about on forums.

The TC is a form of trepanning tool and as such is one of the oldest man made devices after the invention of the hammer. Trepanned human skulls have been found from the stone age possibly used to relieve headaches or let out devils owing to the discovery that surgery on the skull does not always lead to bleeding to death. The TC has a central drill bit or spigot for a pre-drilled hole which becomes an axle about which the tool turns. An arm of adjustable length holds the tool relative to this axle and may be simple clamps or a complex screw adjusting type. The tool



This is a tank cutter (or trepanning) tool. It cuts only downwards, never sideways, and is used to cut holes in sheet materials. The point on the cutting tool can be toward the inside or outside depending on whether you want to keep the disc cut out (on the inside, as here) or the material surrounding the disc.

cuts a narrow groove in a circle moving downwards through the material until it breaks through. The width of the groove is a compromise between tool strength and effort expended to cut the groove. The tool shape therefore is just what is needed to cut a groove. A bit like a lathe parting tool it will be a chisel with top rake say 10 - 15 degrees for steel but only 0-3 degrees for brass or 15-20 degrees for aluminium. What would be front rake on a parting tool is the face vertically at the bottom in this tool and of say 10 degrees. Side clearance is needed

at each side and thought needs to be given that it is moving in a circle so may be lopsided, i.e. more on the inside than the outside. Depth, or is it thickness, is provided to give strength and will be most of the tool stock thickness.

A refinement can be to make the end of the tool at an angle so that the first breakthrough is either at the outside or inside depending on what gives a better finish to the part you want to keep.

In use the speed needs to be kept low - appropriate for the diameter being cut, and really a back geared pillar drill is needed or it is all a bit fast and violent. Often the best power source is human using an old carpenter's brace. The biggest problem comes on completion - the first breakthrough which will snatch as the slop in the drill down-feed allows the tool to dig in. A firm hard backing will help as will tightening up a quill lock if the machine has one or setting depth limit stop. Milling machines are sometimes better but most do also have slop in the quill feed. A knee type mill is probably the best solution as gravity is then on your side.

To understand a fly cutter the simplest thing might be to take a photo of it in action and turn it on its side so that it looks more like a lathe operation that is facing off the material rather than a longitudinal lathe cut. In a lathe facing can be done (not optimally as the geometry is definitely wrong) with a right hand knife tool at right angles to the axis of rotation with a slight twist to give some space for the toolpost, or a left hand knife tool aligned with the axis. Fly cutters with both configurations are equally common though a popular style, sold in sets of 3 sizes adopts the roughly right angle orientation. Just to be awkward the normal direction of rotation of the spindle of a vertical mill is clockwise from above (think drilling) which means things are reversed with a lathe so a left hand tool is used in a fly cutter at right angles to the axis. It will work but the geometry of a left hand knife tool in this configuration is oriented for downward cutting, just what we are not doing. It needs a bit of thought to shape it more like a fat parting tool.



This is a fly cutter tool. It is most often used cutting sideways for flat surface facing operations. It is never used cutting downwards to cut holes. However, model engineers often use it cutting downwards to cut curved surfaces such as on a smokebox saddle or the under-side of a chimney.