Drilling the piston valve blocks

Just a few additional notes on the drilling of the main bore (6mm dia) on these blocks.

It is essential that this bore is absolutely parallel with the face which mates with the cylinder block (the one with the small slots machined in it) and also the adjacent face containing the steam ports.
In other words, the bore must be perfectly vertical to the engine centre line.

It has already been mentioned (during the crankshaft web making instalment) about the tendency for the drill to wander off centre when drilling deep holes, and it is something to avoid wherever possible, especially with small drills.

Here we have a case where it is unavoidable so I felt what follows would be interest/help to anyone perhaps building one of John's engines as a first project.

First off, do not try to drill these holes directly with a 5.5mm drill; this will inevitably end in disaster.
After carefully centre drilling, start the bore drilling with a 2mm – 2.5mm dia drill and do not drill to deep in one go, but withdraw the drill every 1mm or so of depth to clear the swarf from the flutes…. Swarf build up is a major factors in diverting the drill from it's correct path…. Continue drilling until the bore is say 32mm – 33mm deep.
Next change the drill for say a 4mm – 4.5mm dia, and repeat the drilling to the same depth, again withdrawing repeatedly to remove the swarf.
Repeat the above with a 5.2 – 5.3mm drill, but, this time, take it down to the full 36mm depth (including the length of the drill point).

Keep a close eye on the drill during this pass, and it will be obvious if the drill is trying to wander (it will appear to wiggle in the bore).
If this occurs, stop drilling.
To remedy this situation, it will be necessary to use a small boring tool (yes they do exist) to continue further. (See below).

Providing the drilled hole remains true, then use successively larger drills to open out the bore to **5.9mm** dia.

Why 5.9mm, when John says 5.5mm?

This is to do with the final reaming of the bore…… a reamer should only be used to remove the last 0.1mm, or less, from the bore… they are not really designed to take relatively heavy cuts….. and the 0.5mm which would be left after the 5.5mm drill is, in my opinion, to heavy, especially if you are using a small ,light, lathe.
In this case, attempting such a heavy cut could result in overloading the machine, possibly damaging the drive gears (which are often plastic on small machines) and may even result in the reamer jamming in the workpiece.
Worse still, the reamer could easily shatter due to the applied torque…. Not good for the job, or the wallet….. good quality reamers are not the cheapest of tools.

I am sure John will agree with me on this score.

A final word about reamers….. for this job you will need to use a MACHINE REAMER; not the more usual hand reamer.
The more generally purchased hand reamer, whilst absolutely fine for reaming holes through small pieces where the hole goes right through, and is of short length relative to the length of the reamer, such as big end bores or bearing blocks, they are not suitable for this job which is a deep BLIND hole.

To explain….. Hand reamers are designed with a slight taper on the leading edge; often extending perhaps 25% of the total reamer length, whereas, MACHINE REAMERS are parallel for their whole length.
If a hand reamer were to be used for this bore, then the piston valve bobbin (John's next component) would jam in the resulting bore.

The other thing to watch here is the type of end on the reamer….. some have quite a long pointed end (like the point of a drill, but often longer) if this is the case then this will need to be ground off (leaving just a very small lead in…0.5mm or so) otherwise the reamer will not get to the bottom of the bore.

SMALL BORING TOOL.

If the need arises, due to drill wander, to resort to correction with a boring tool then don't panic…. These are available from sources such as Arc Euro Trading, who can supply small solid carbide boring tools down to 2mm dia.

Alternatively, one can be ground from tool steel, if you don't feel you have the ability to do this, then perhaps a word with a friendly engineering workshop would be of help.

The method employed should be to take very light cuts, gradually opening the hole dia, until the bore runs true….. continue boring until the next largest drill, to the one you were last using, just fits the bore….. you can then return to using this drill size for the remaining depth.

These small boring tools do, unfortunately, have a maximum boring depth associated with them, typically 15mm – 16mm for the 4mm dia tool, however this would be more than deep enough to guide the drill.

General notes.

A final point regarding this matter…. Deep hole drilling is, as I am sure John will agree, a tricky subject, and many tomes have been written on the subject, however, often the cause of the wandering is the drill bit being used.
It is essential that the drill be sharpened correctly, i.e, it's cutting edges must be absolutely of equal length, and of equal angle. Do not think for one minute that a brand new drill will be accurate…. They should be, of course, but I have yet to come across very many that are….. in most cases they would need some correction.

The other thing that is helpful is to use what are known as STUB DRILLS…. These are considerably shorter than the more usual twist drill, and are very much stiffer, hence less likely to wander off the true path due to bending action often the result of applying to much drilling pressure.
If you are planning on making more engines in the future, then it could be a wise investment to obtain a set of these in your more used sizes.
The same consideration regarding correct sharpening still applies though.

Happy Drilling/Boring.

Sandy.