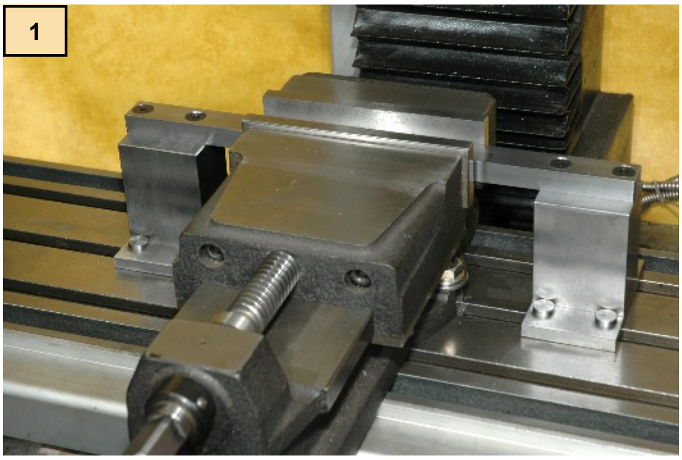
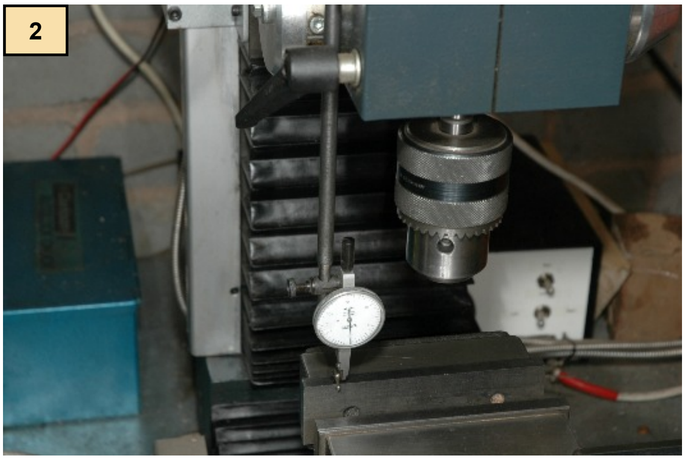
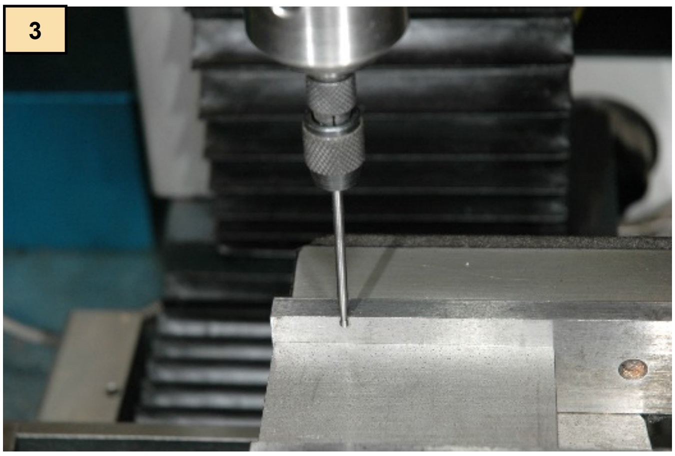


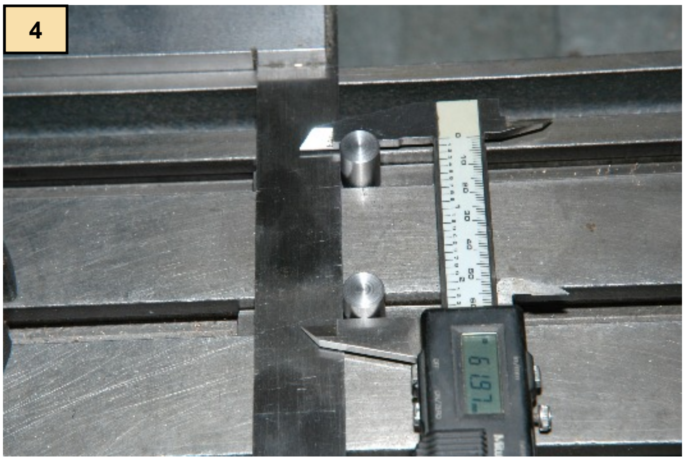
The alignment tool in use



Clocking the fixed jaw of the vice



Using and edge finder



Measuring the Tee slot spacing

ALIGNING A MACHINE VICE

David Haythornthwaite looks at ways of ensuring your milling vice is always aligned to the machine table. Published MEW No.182

Overview

The machine vice is a very adaptable way of holding items for milling and drilling on the milling machine table, but to be at it’s most useful, the vice must be accurately in alignment with the table. I am frequently reluctant to disturb my vice in order to use a rotary table or clamps, due to the necessity of replacing it accurately. Yet another workshop gadget was obviously called for to make vice alignment virtually automatic.

Why Align a Vice in the First Place?

Beginners in engineering, may wonder why it is so important that the milling machine vice is attached to the table exactly in line with the table movement. There are various advantages to having the vice aligned to the table ways. If you wish to chamfer or to rebate the edge of a workpiece that is held in the vice, then if it is not in line with the table “ways” then the chamfer or rebate will vary in size from one end to the other due to the workpiece travelling at an angle to the edge of the workpiece.

Additionally, if you have resettable dials on your machine handles, or better still a digital readout (DRO), then you are able to eliminate the need to carry out much of your marking out, instead, spacing out drilled holes etc. by carefully moving the workpiece by using DRO readings or resetting the machine dials and traversing the table by the distance required between holes. When holes or machining must be done centrally in a workpiece, it is convenient to use an edge finder on one edge, use the finder to find the location of the opposing edge and then simply press the ½ key on the DRO. The reading of zero on your DRO will then indicate the centre of the workpiece, allowing you to calculate your machining positions accordingly.

In order for any of the above to work correctly, your machine vice MUST be aligned EXACTLY to your table ways.

How to Align Your Vice

If your vice base is at right angles to the jaws of the vice, then a simple alignment tool would be an engineers square placed against the edge of the machine table, with the other arm of the square against the vice base. However, few vices are made this way, and the method does not have the accuracy usually required.

On my milling machine, I have arranged for a vertical arm to be available at all times, so that it may be dropped down and a “verdict” dial gauge attached. The sensing probe of the verdict gauge is applied to the fixed jaw of the vice by using the Y travel of the milling machine. The dial reading on the gauge is zeroed and the table is traversed back and forth so that the gauge probe compares the Y position at both ends of the vice jaw. This is done with the fixing bolts of the vice fairly slack, so that the vice may be tapped so that it becomes in line with the table. Be careful not to tap the vice heavi-

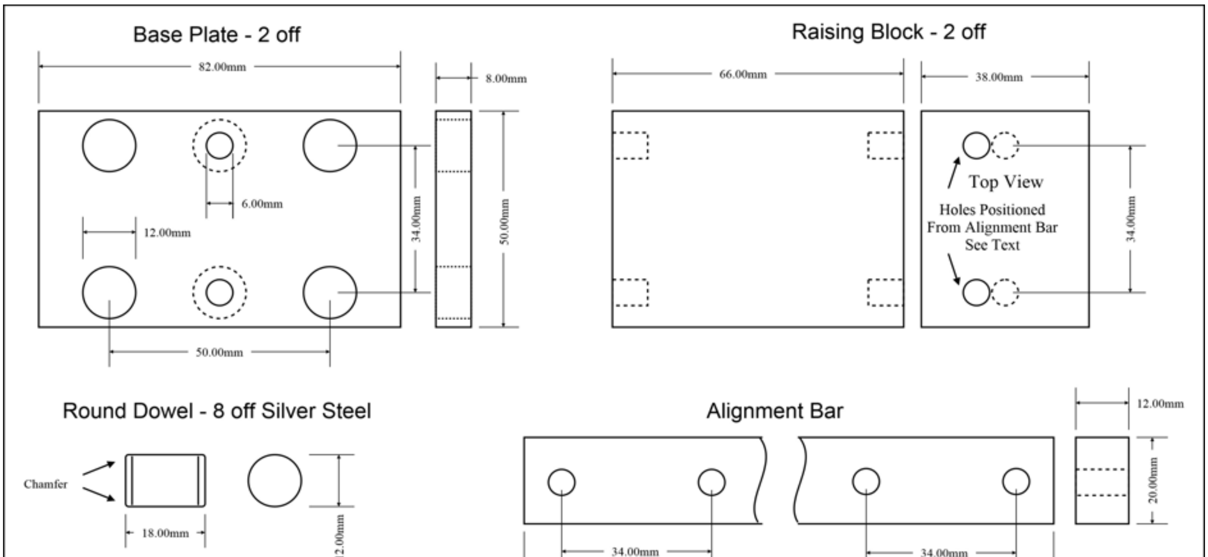


Fig. 1

ly with the gauge in contact with the jaw as the severe vibration may damage the gauge. This process is illustrated in **Photo. 2.**

In the absence of a verdict gauge, this operation may be carried out a little less conveniently by measuring the positions of each end of the vice jaw with an edge finder as shown in **Photo. 3**. However the most cost effective way of testing alignment would be to place a short piece of silver steel rod, or old drill shank in the chuck of the machine and trap a sheet of Rizla (cigarette) paper between the rod and each end of the fixed jaw in turn. This may be done with the machine static, feeling the contact by withdrawing the Rizla paper which is 0.0001" thick, but with a plain smooth rod and the machine running slowly, the rod will take the paper when the rod is one thou away from the vice jaw. In order to keep fingers away from a rotating rod, (even a smooth rotating rod), it is advisable to attach the Rizla paper to the vice jaw by moistening it (good old fashioned spit) and then let the rotating rod snatch the paper away. Edge finders are cheap nowadays, but the test with Rizla paper works well.

Making a Device to Suit Your Vice and Mill

In order to eliminate the need for manually aligning the vice each time it is attached to the table, it is necessary to consider one or two features of your own situation. Actually the making of my attachment was triggered by a mistake on my part. I had quickly fixed the vice to the table, for a simple job, without aligning it, having had a recurrent bout of that bone disease called idle!! I then forgot that the vice had not been aligned and I drilled a line of holes in a component which were not absolutely in the correct line. Yes we all do it sometimes – but hopefully only once.

To design the attachment, I first lined up my vice using the methods shown above and then observed that the line of the fixed jaw fell between two T slots on my machine table. If you find that the jaw sits directly over a T slot, then some redesigning of the attachment will be required. You will see from **Photo. 1** the type of vice that I mainly use, and I did firstly consider setting a square bar into the base of the vice which would be made an exact fit into the 12 mm T slots on my table, but the vice was not suitable for such a modification and additionally it would not then be possible to fix the vice to the swivel mount which is occasionally used. With some vices however, this would be a good method of alignment and the vice could be mounted upside down on the table whilst gripping a well fitting rectangular bar has been inserted into the T slot. The groove for the location bar may then be milled in the underside of the vice base using a slot drill, the vice being well secured to the table with clamps and packing. Attaching a bar in the milled slot would ensure that you always has something on the bottom of the vice to drop into the T slot.

However back to the matter in hand. Having ensured that my vice fixed jaw fell between two T slots, I placed a straight edge between the vice jaws and measured the distance from the table surface. In my case this was 60 mm , so I needed to arrange the attachment to have a horizontal bar, just over 60 mm from the table surface. The T slots measured 12 mm wide so I made two silver steel buttons from 12 mm rod and measured the distance from the outside of one T slot to the outside of the next, as illustrated in **Photo. 4**. This measured 62 mm (actually 61.97 mm in the photo) and as we are measuring over the outsides of the 12 mm buttons, the spacing of the T slot centres are 50 mm apart (62 – 12). You can see that a square was used to ensure that the measurement was taken at right angles to the slots. Having ascertained these measurements, the device was therefore designed as shown in **Fig.1** but no doubt will need to be modified to meet the measurements in each individual case.

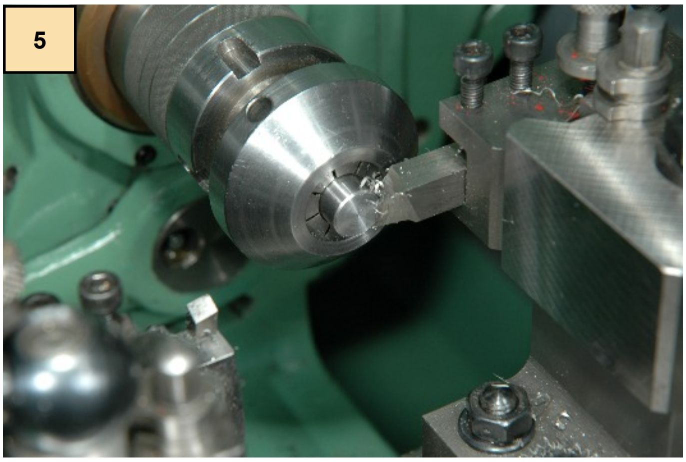
Design Concept

The device was designed to consist of two pillars sitting either side of the vice and carrying a horizontal bar, true to the X movement of the table. The two pillars sit on metal plates into each of which, four 12 mm silver steel dowels are inserted at 50 mm apart to coincide with the T slot positions. Thus by placing the pillars on the table, with the dowels in the T slots, a very stable platform is created which is positively located into the T slots. A piece of 12 mm square bar could have been attached under the base plate instead of each pair of dowels, but the dowels proved easier to construct accurately and I did not have any 12 mm sq. bar in my rack.

Construction

Eight dowels were required 18 mm long. These were cut on the saw, faced in a collet in the lathe and chamfered each end. **Photo. 5** shows one dowel being chamfered from the rear post, the home made tangential tool in the front post being used to face the ends. I used a lathe back stop behind the collet chuck to ensure each dowel was the same length. One point to note is that lathe back stops do not work very well with ER collets such as that illustrated, as when the collet is tightened up, it withdraws into the headstock and the work tries to push the back stop back into the spindle. These dowels were made as the first item as I used two of them to measure the T slot spacing.

The raising block pillars, which are shown as 50 mm x 38 mm on the drawing were actually made from two pieces of 2" x 1.5" bright steel bar which I had previously



Chamfering one of the eight dowels

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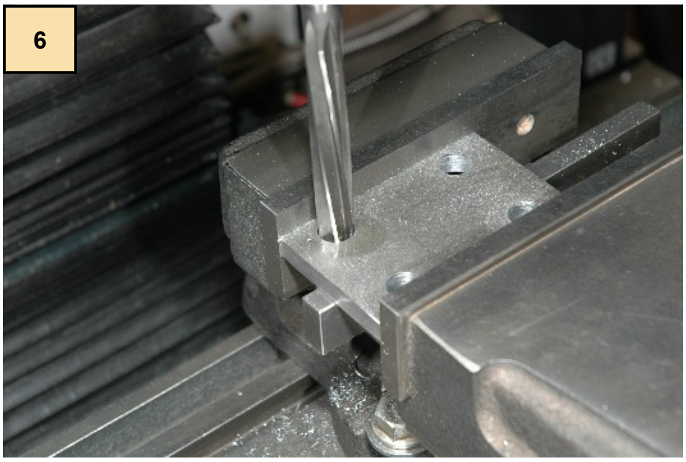
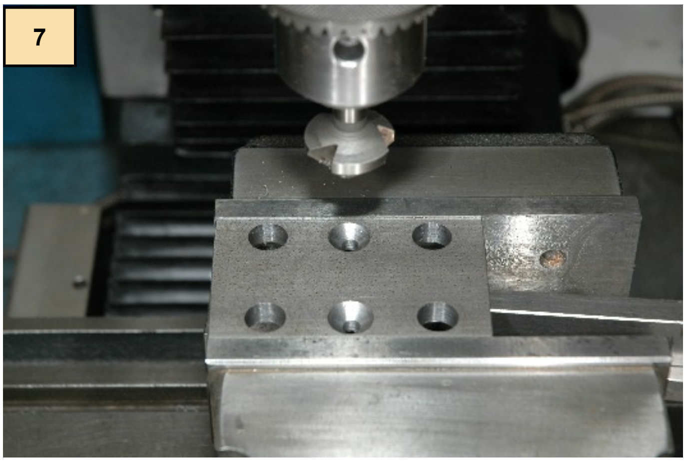
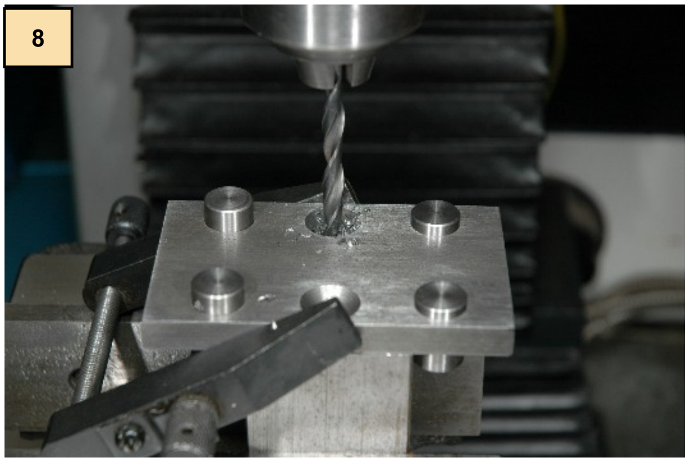


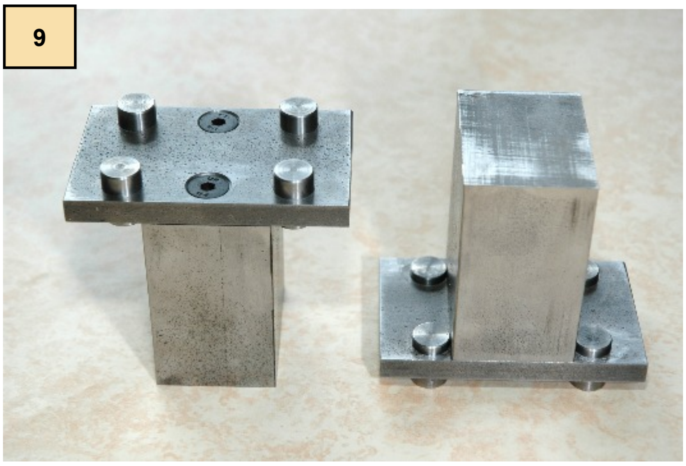
Reaming the silver steel dowels



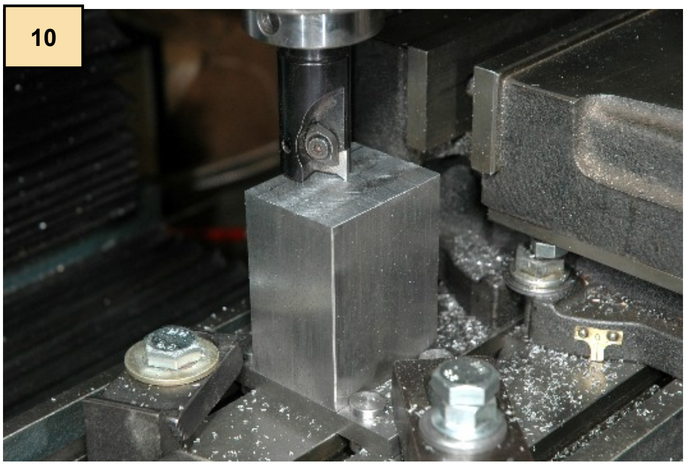
Countersinking the setscrews



Attaching the base plate



The finished raising posts



Milling the pillar tops

used as lathe raising blocks. If I did not have these in stock, I would probably have welded top and bottom plates to a piece of 2” x 1.5” box section steel and used that. As it was, two lengths of bar were sawn off just over 66 mm long and faced off on the milling machine.

The Base Plates were made from some 50mm x 8 mm bar which I had in stock, and I cut two pieces 82 mm long to ensure a nice stable platform for the device which gave plenty of stability and covered two T slots with ease. These were placed in the vice on parallels and four location holes were successively centre drilled then drilled 5 mm , 10 mm and finally 11.5 mm before reaming 12 mm as shown in Photo.6. These holes were simply positioned using the DRO and illustrate the advantages of having a correctly aligned vice. Two holes were similarly created to take two 6 mm countersunk machine setscrews to attach the baseplate to the raising block. These were drilled 5.2 mm (tapping size for 6 mm) and then countersunk to 12 mm dia. to take the screw heads as shown in Photo.7

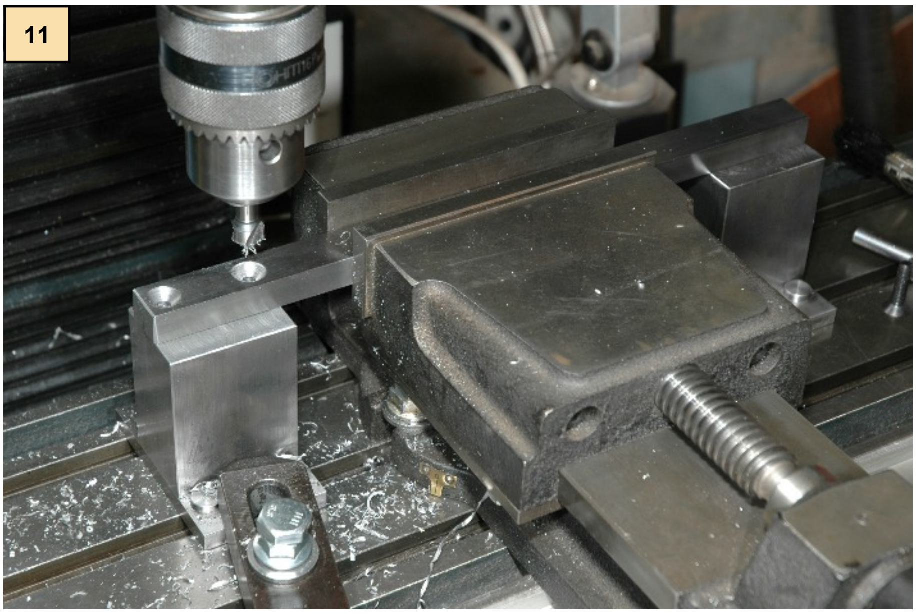
Once the base plate was finished, the dowels were slotted temporarily into the holes, a sliding fit. The pillar was fitted snugly between the dowels and aligned to the edges of the base plate with an engineers clamp and the setscrew hole positions were transferred to the raising block using a 5.2 mm drill as shown in **Photo 8.**

The screw holes in the base plate were opened up to 6 mm, the raising block holes tapped and the two pieces fitted snugly together. Finally the dowel holes and the dowels were degreased and the dowels were fitted using a small smear of Araldite 2 part epoxy on each dowel. The pillars were stood upon a parallel placed on a surface plate and the dowels tapped down to give a standard depth of dowel on the underside. Once the epoxy has set you will have something similar to the two items illustrated in **Photo. 9**

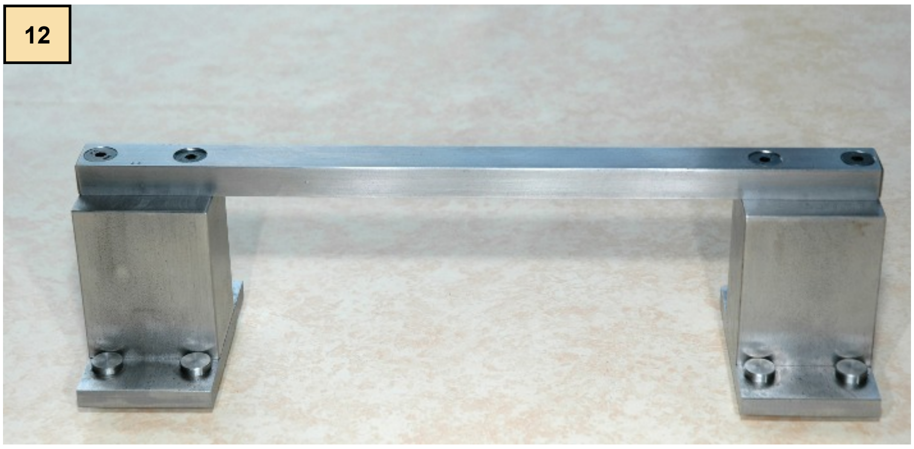
Having completed the pillars, they were clamped onto the milling table with the dowels sitting securely in the T slots and the tops were faced to ensure they were absolutely flat and of identical heights as shown in Photo.10.

The alignment bar was drilled 5.2 mm (6 mm tapping size) and countersunk ready for fixing to the raising pillars. I wondered whether it would have been better not to use countersunk setscrews here but to use ordinary hexagon head setscrews as they would have allowed a small measure of adjustment to take place. In retrospect I think that non countersunk setscrews would have been better, as the countersinking locates the setscrews very positively and if the countersink is a few thou off centre, then the device will be off centre also – see later.

Both pillars were clamped to the table, the alignment bar was clamped in the (already aligned) vice, and the holes were spotted through and drilled in the pillars. The pillars were then tapped 6 mm. You will see that the holes determine their own positions on the pillars according to the relative locations of the vice and the pillars. Once assembled the unit looks as shown in **Photo.12**.



Attaching the alignment bar



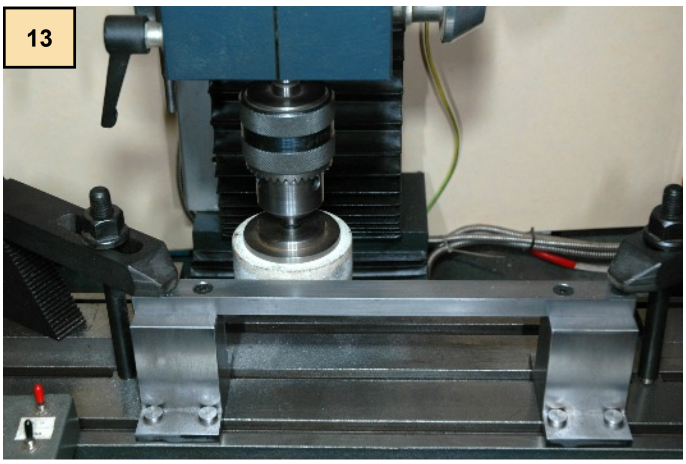
The finished attachment

Using the Alignment Tool

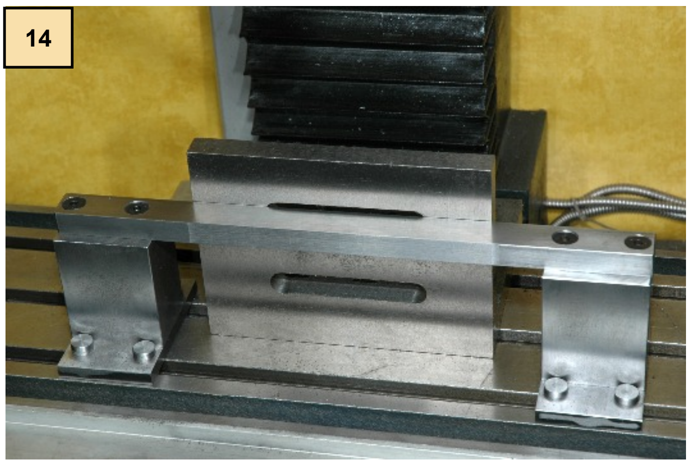
In use, the machine table is wiped clean of swarf and dirt. The vice is placed on the machine table with the jaws open and the fixing bolts loose. The alignment tool is placed between the vice jaws and located firmly in the T slots. The alignment tool is pressed firmly onto the table with one hand and the vice is slid towards the operator with the other hand until the fixed jaw is in firm contact with the alignment bar, or alternatively the vice may be closed to clamp the bar. The vice fixing bolts are then tightened. It takes roughly 30 seconds.

Happy with the operation of “my new toy”, I re-checked the alignment of my vice and found it to be out of true by approximately. 2-3 thou. (0.07 mm) and this is undoubtedly due to using countersunk setscrews. I was definitely not happy about this, so I ground the alignment bar in situ on the milling machine table using one of my tool and cutter grinder stones, running the mill at top speed. This is shown in **Photo. 12**, and it cured the problem, but if I had used hex head bolts to attach the alignment bar, then simply slackening and re-tightening the bolts would most probably have cured the problem.

I find that I am no longer reluctant to remove the vice from my mill as it is so easy to replace the vice and know that it is absolutely true to the table ways. The attachment may also be used to align angle plates as shown in **Photo.14** and the device is proving to be a most useful accessory to my workshop. Obviously all dimensions will need to be adjusted to individual requirements. When deciding on the length of the alignment bar, do be aware that you need sufficient room to tighten the vice fixing bolts. My bar is 300 mm long and works well with my 130 mm wide vice jaws.



Grinding the alignment bar to be in line



Aligning an angle plate