

No.118

AUGUST/SEPTEMBER 2006

MODEL ENGINEERS' WORKSHOP

THE PRACTICAL HOBBY MAGAZINE

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CNC conversion**

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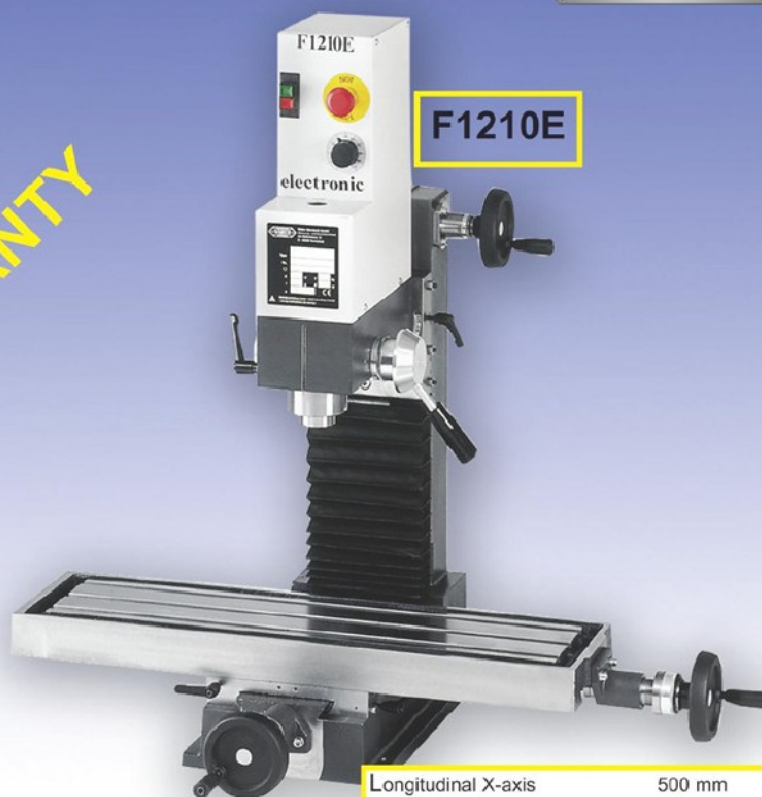
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CNC



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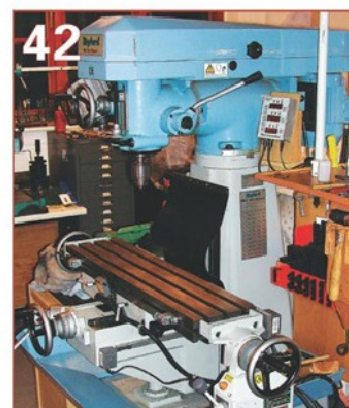
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*The Myford VM-E, a highly desirable machine in
standard form, is treated to a CNC conversion by Peter
Edwards, see page 42*

See page 57 for our special subscription offer!

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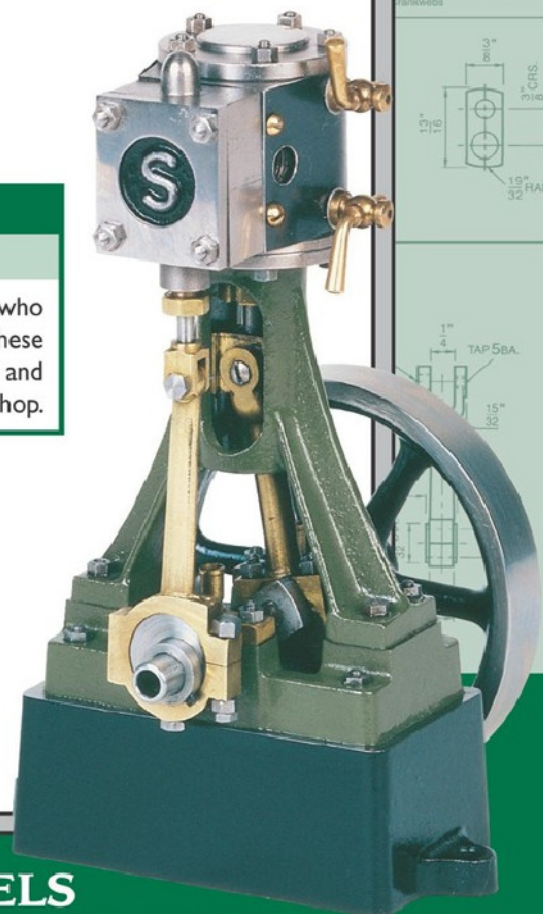
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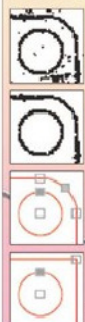
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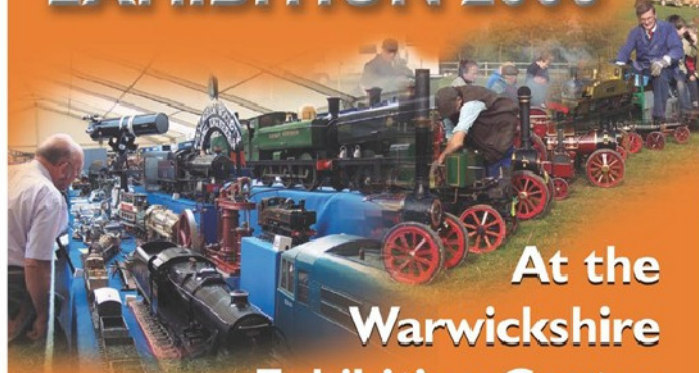
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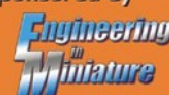
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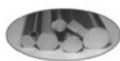
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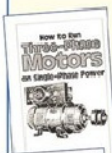
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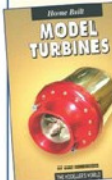
The Shop Wisdom of Rudy Kouhouth Vol. 4 - The Micro Machinist's Legacy • £14.30

The late Rudy Kouhouth gave a huge amount to the model engineering hobby, both through articles in magazines, and the films he made with Joe Rice. Many of the articles found their way in to the 3 large volumes of *The Shop Wisdom of Rudy Kouhouth*. Before Rudy's death it had been planned to alter the format of this series to thinner, wire-bound and cheaper volumes and, sadly, this is both the first and last of these. What you have here are: A Compact, Double-action Indicator, An Atlas Mill Update (following on from Vol. 3), Build a Q.C. Toolholder, Raising the Lathe Axis, Build the Radial Five (a compressed-air radial engine), Make a Holiday Nutcracker and then *The Micro Machinist's Legacy* - 5 pages of photos of Rudy and his models. Great stuff in a well produced 76 page wirebound book with card covers.



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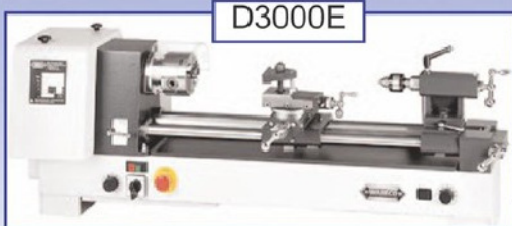
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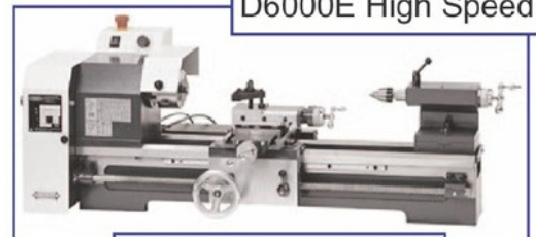
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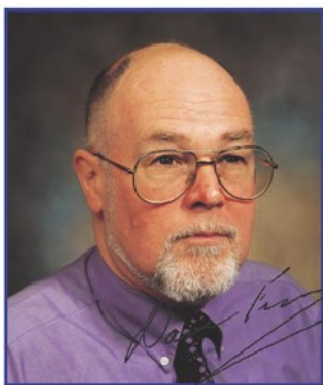


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ON THE EDITOR'S BENCH

Out and about - Lathalmond and Glamis

Summer brings with it the regular shows for classic vehicles and two recent events I have been able to visit are the "2006 Motoring Cavalcade" organised by the Fife Historic Vehicle Club, meeting up at the Scottish Vintage Bus Museum, Lathalmond by Dunfermline, in June, and the "32nd Scottish Transport Extravaganza" at Glamis Castle in July. The first of these is very much the smaller but nevertheless most enjoyable, also giving the opportunity to look at the bus restoration work in progress. All a bit bigger and heavier than the typical home workshop. Friend Gordon Mackie was exhibiting his Triumph T21 and was rewarded with a class win.

At Glamis, Gordon chose to show his Morris 1000 drop head, but occasional rain meant the hood was up for most of the day. Over a thousand exhibits were noted in the catalogue, ranging from an 1867 Bone Shaker bicycle through cars and motorcycles to steam, heavy commercial, military, and earthmoving equipment. Steam models were represented by Harry Clyne with his 4in. scale Tasker Little Giant, and George Mackay with his 3in. scale Burrell. George had also set up a fascinating display of historic photos of full size traction engines, taken from the family album when they were involved with such machines in the early 1900's.



Class winning Triumph T21 entered by Gordon Mackie.

In the workshop

The article by Ken Thornton (issue 116) on making chuck jaws stirred my brain cells to re examine a five inch Griptru Chuck acquired with the Chipmaster, but minus jaws. The cost of a set of hard jaws is typically about the same as the cost of a complete chuck, but in the past I have bought soft jaws for industrial purposes from Rotagrip. I did consider making set, but after checking availability and price, decided to buy. I had by this time also thought about a modification to give enhanced versatility.

The procedure was to first centre up the GripTru body, then grip a bar in the jaws, set slightly back from the front faces and lightly



Drilling the holes in the mill.

machine the outer jaw ends and the front faces in the lathe.

The jaws were then transferred to the mill and a row of four holes 0.250in. dia. spaced at 0.500in. and about $\frac{1}{16}$ in. deep drilled using each machined outer end as a datum. Three silver steel pins were then cut and fitted to one set of the holes, allowing a scrap bearing race to be gripped, leaving a reasonable space at the centre. Taking a light cut with a boring bar, from the inner ends of the jaws then ensured accurate concentricity. The four sets of holes will allow ring type components of various diameters to be gripped whilst keeping the jaws in complete engagement with the scroll.



Gripping a ring via the pins allows the jaws to be trued up with a boring bar.

Peter Rawlinson collected works

Well known as a regular contributor, Peter is now printing and publishing a collection of his articles describing workshop devices. A review of Volume 1 may be found elsewhere in this issue.

Variable pitch worms

An article by Steve Whitehead of Holroyd Gears, which appeared in a recent copy of "Industrial Technology" magazine discussed high accuracy worm drives. Three methods were considered, first varying the shaft centreline spacing, (as frequently used on small rotary tables) second having a two part worm, one part integral with the shaft, the other splined or keyed and able to be adjusted axially, and third, a technique which was certainly new to me and may well be to others. This relied on the worm being machined so that

the thickness of the worm thread increases gradually over its length. Thus the backlash can be adjusted by moving the worm axially along its centreline. From the Holroyd description, this means that the two flanks of the thread are cut to slightly different leads. While I have not thought this through in complete detail, it may be that for our amateur applications, something similar might be achieved by cutting worm threads on a slight taper. Again not the easiest operation but possibly an alternative approach to cutting flanks with differing leads. Of course given modern CNC production equipment, such complexities become trivial.

Dates for the Diary

October 13th to 18th, Midlands Model Engineering Exhibition, Warwickshire Exhibition Centre, Nr. Leamington Spa.
December 29th to 31st The Model Engineer Exhibition, Olympia

LOW PROFILE WO

1. A commercially available low profile clamp



Harold Hall offers suggestions for workholding where height restrictions apply

very early machine from the far east that leads me to consider that standards were not being worked to at that time. Because of this situation it is likely that you will need to modify the dimensions to suit your machine.

Changing the dimensions should not prove a problem as these are not that critical. I would though add that the top surface of the T nut (22 mm dimension on my drawings) should be nominally level with the table's surface when clamped in position. Also, in the case of clamps 1 and 2, do ensure that the clamp piece does not obscure access to the T nut fixing screw. If however, the clamps are to be used with shallow T slots, such as those on a Myford Series Seven, then some changes to the design may be worth considering. This is discussed in detail later in the article.

Clamp 1

Clamp 1 follows very closely the principle of the commercial item in **Photo 1** except for the method of providing the cam action that provides the clamping pressure. In this a cam is fixed to a standard socket cap screw using a two part resin adhesive, **Photo 5**. Do use the slow setting variety and apply gentle heat (on top of a hot water tank typically) to obtain maximum strength. If you are hesitant regarding the strength of the bond you could drill across the join using a centre drill and insert a short pin, again using adhesive, see **Sk. 3**. In my case I have applied considerable force to the screw without any sign of the bond failing so have not added the pin at this stage.

You will see that the material quoted for the clamp piece (1/1) is brass. My reason for doing this is that it is my understanding where one part moves on another, dissimilar metals are preferable. How relevant this is in this particular situation, I am not sure, but perhaps there is some reader, more knowledgeable on tribology and related topics who may care to enlighten us. Of course, brass will also

Having passed to the editor some time ago, an earlier article on workpiece clamping, the suggestion came back that a constructional article for a low profile clamp similar to that shown in **Photo 1** would be worthwhile for the magazine. Having agreed, it occurred to me that there would be other ways of performing the same task and decided to include some alternative designs.

Not having researched the subject in great depth for this article, I cannot be sure whether the designs I am suggesting are original. Certainly one design is available commercially (one version under the trade name "Mitee Bite" if my memory is correct), and I suspect that at least some of the others are ones that I have seen previously, which have now resurfaced as a result of my considering the possibilities. I am as a result including designs for the five clamps, seen assembled in **Photo 2** and dismantled in **Photo 3**. These all use the same basic principle of a T nut that is fixed in position using a grub screw, **Sk. 1** should make this clear.

Workpiece shape

Due to the clamping member being able to rotate, clamps 1 and 2 have the benefit of being able to clamp surfaces that are not at right angles to the T slot in which the clamp is fitted. **Photo 4** shows a simple example (using clamp 2) but more complex shapes could also be held in many cases. However, as in **Photo 4**, in most cases the clamps will only be applied to one side of the workpiece with fixed supports on the other. These will provide some scope to work with non rectangular shapes using any of the five clamps, as **Sk. 2** illustrates.

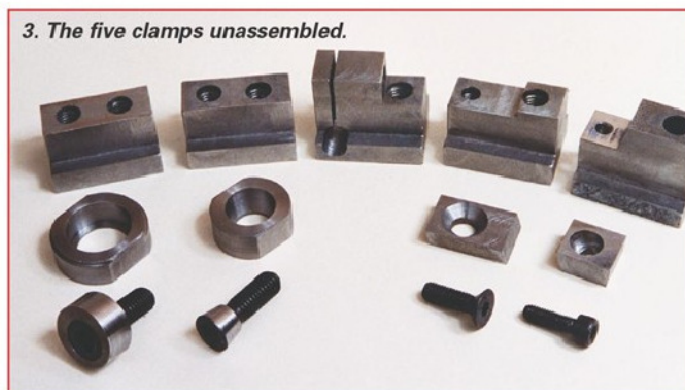
Clamp sizes

The drawings published with this article are for clamps that suit the T slots on my milling machine. These measure 15 mm in width, that, from reference to catalogues I have for machine accessories, would appear a non standard dimension. It is a

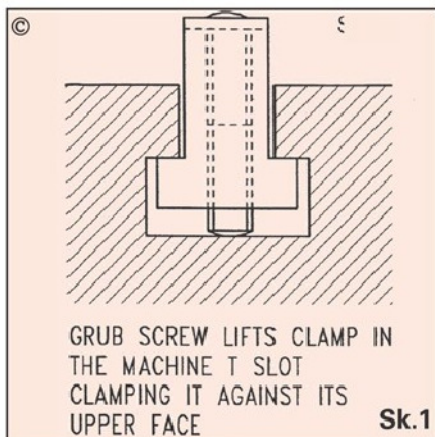


2. The five shop made clamps detailed in this article. One to 5, left to right.

3. The five clamps unassembled.



RKPIECE CLAMPS



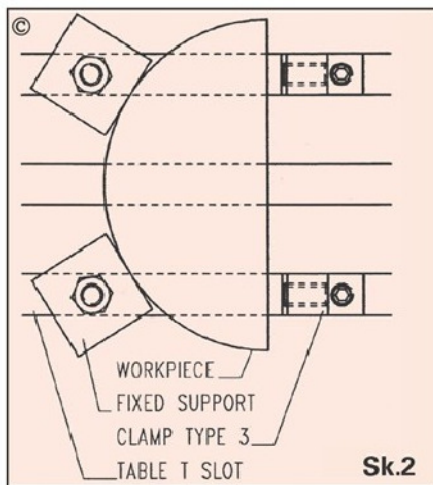
provide a measure of protection for the item being clamped.

Having made those comments it will be seen from the photographs that I actually made mine from steel. Regular readers will be aware that I have over the years provided many designs for items made from stock materials, obtaining and using the sizes quoted on my drawings. This has resulted in me building up a large stock of material ends. I have therefore decided that it is time to reduce the stock pile and items are not necessarily made from the sizes given. For example, the T nuts have been made from odd sizes and do as a result show machining marks where you would expect the normal drawn finish. Actually, **Photo 6** shows a piece of metal from the scrap box being machined to thickness in preparation for making two of clamp 5. In this photo, clamp 1 is being put to use and illustrates how these can cope with irregular shapes.

Having used steel for both the clamp piece (1/1) and the cam (1/2) I did use a graphite grease to lubricate the working surfaces.

Clamp 2

This is very similar to clamp 1 but with the cam action being replaced with a tapered head screw to provide the clamping force. Actually, the T nuts (2/3) are identical, just used the other way round. If you intend,



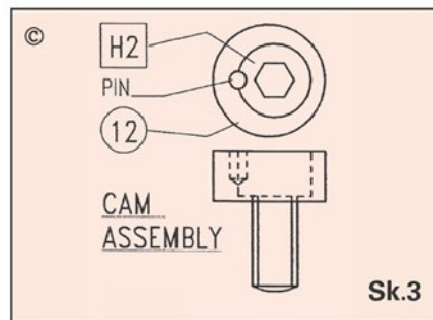
perhaps initially, only to experiment with the two methods, just a pair of nuts will be usable with either clamp. **Photo 7** shows a close up of this clamp being used, see also **Photo 4**.

Place a piece of 25 mm brass in the three jaw chuck and with the top slide set to 10 degrees bore the 12 mm parallel diameter and the taper. Leave the top slide set at the ten degree angle for machining the clamp screws.

Now with a scrap of material in the three jaw, drill and tap this M8 and fit the clamp screw (2/2) and turn its head outer diameter to 10 degrees. I polished the tapered surface using 1200 grit wet and dry so as to reduce friction with the bore of the clamp piece.

Clamp 3

This clamp, **Photo 8**, is quite different to the other four in that it is just a one piece item and probably as a result the easiest to manufacture. Except for the fact that it will only hold a surface that is at right angles to the T slot it is probably also the easiest to use. It is though less able to cope with minor dimensional differences where a number of similar workpieces are to be held. Even so, it is so simple to use that loosening the complete clamp and refitting



to suit the new workpiece is only a minor inconvenience.

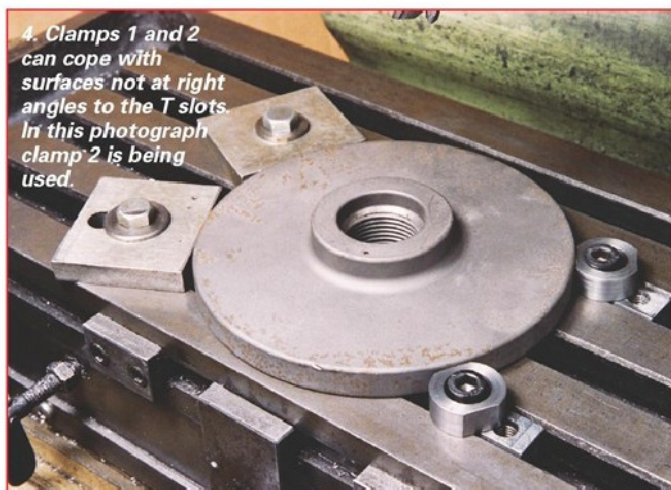
Having sawn the piece of metal (**Photo 6**) into two pieces for making clamp 5, **Photo 9** shows clamps 3 being used to hold one piece for machining it to the required height.

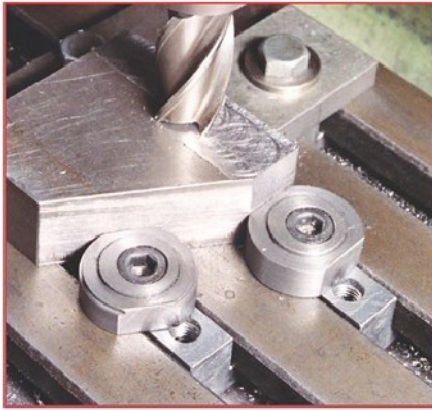
Clamp 4

This clamp works differently to the others and is probably a little more critical in terms of its manufacture. My suggestion is to make the clamp (4/1) with the 24 and 16 mm dimensions say a millimetre or so on the long side, reducing it gradually at the end furthest from the hole until the required clamping action results. Clamp 4 can be seen in close up in **Photo 10**, (see also **Photo 12**)

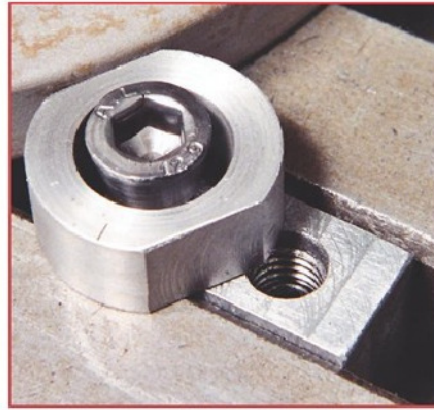
Clamp 5

Working on the basis of a sloping surface this clamp, **Photo 11**, (see also **Photo 13**) has similarities with clamp 2 though it will only work on surfaces at right angles to the T slots. Alignment of the tapped hole in the T nut with the hole in the clamp piece (5/1) is important though clearance in this provides a small margin for error but using the following method should give an adequate result. Make the clamp piece complete with the holes and holding this in place on the T nut scribe though the hole onto the T nut to establish the position for the M5 tapped hole.

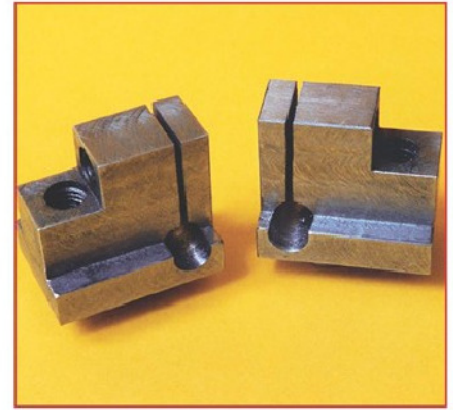




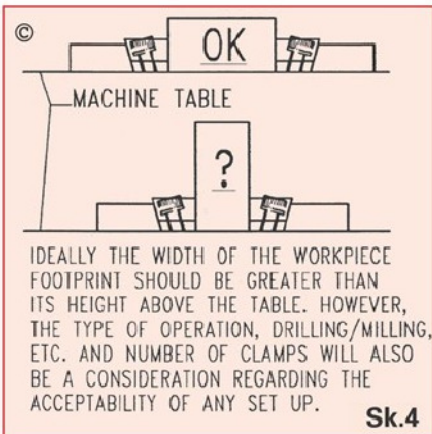
6. Clamp 1 being used to hold an irregular piece of metal.



7. Clamp 2.



8. Clamp 3 has a one piece construction.

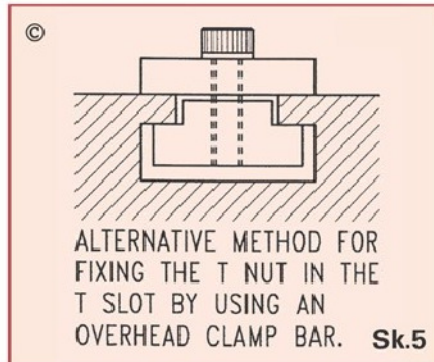


Sk.4

In use

Some experimentation will be needed to establish the precise process for using each clamp but the following will provide a basis on which to start. With clamp 1, set the cam at 90 degrees from the fully clamped position and move the clamp up to the workpiece, fastening it in position using the grub screw and operate the cam. You may consider from the result that the 90 degree starting position should be reduced a little.

In the case of clamp 2, position the clamp screw with it projecting 3 mm out of the clamp piece and bring the assembly up to the workpiece again fastening the clamp using the grub screw. Turn the clamp screw and observe the result, change the 3 mm dimension, in or out, if considered necessary.



Clamp 3 is without doubt the easiest to set up, bring it up to the workpiece, fix in position and operate the clamp screw. If you are working with a number of identical parts then initially a piece of paper between the workpiece and the clamp, being removed prior to clamping, will give some leeway to enable it to cope with very small differences in size of subsequent workpieces.

Clamp 4 works quite differently from the others. Set the top edge of the clamp at about 10 mm above the table surface and bring the clamp up to the part to be held and fix the clamp in position. Use the screw (H2) to clamp the component to be machined. As with the other clamps some variation to the starting position (the 10 mm dimension in this case) may be considered beneficial. An advantage of this form of clamp is that it will in addition to holding the part against the fixed jaw will also provide some downward pressure to hold the component against the machine's

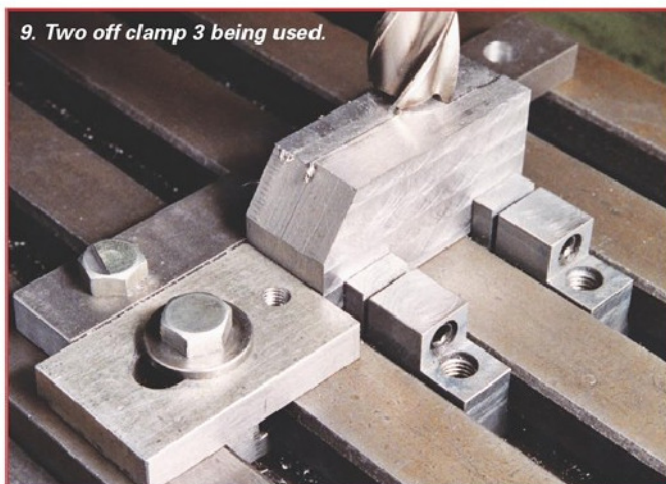
table. If you frequently use this clamp a minor modification would be worth considering. A short compression spring under the clamp (4/1) would automatically hold it up in the starting position. You will though need a washer below the clamp and a counterbore in the T nut to house the spring.

Whilst the emphasis has been on clamping relatively thin workpieces there is no reason why they should not be used with thicker parts. This would be especially so if requiring to hold an irregular shape component where clamps 1 or 2 would fill the bill admirably. However, the height above the table at which machining can take place will depend on the size of the footprint of the workpiece, as a very rough rule of thumb the width of the workpiece in contact with the table should be greater than the height above it. See Sk. 4, and Photo 12 which shows clamp 4 being used in such a situation.

Clamp 5 works in a similar fashion to clamp 2, however, as the clamp piece (5/1) also moves down as clamping takes place, this will assist in holding the workpiece against the machine table. Photo 13 shows a ten millimetre thick piece of steel being held using this clamp. Start with the top of the clamp piece about 3 mm above the top of the T nut.

Fixed jaw

I should emphasise that this should be firmly clamped to the machine table using screws passing through holes drilled into it. If an overhead clamp is applied the pressure created by the low profile clamps



9. Two off clamp 3 being used.



10. Clamp 4.

may move the jaw along the table. Making a jaw that spans the width of the machine table with fixings at each T slot as seen in **Photo 14** would be a good idea, though using separate jaws or stops at two or more slots is a possibility as some of the previous photographs show. It would though be preferable to make the jaw wider than seen in the photograph so that the screws can be set back further from the edge. This will provide space for the cutter should a shallow workpiece require to be machined completely to its edge.

Impossible tasks

Without doubt these clamps will cope with tasks that would otherwise be difficult or perhaps even impossible. Because of this making a number of at least one design would be very worthwhile.

How many

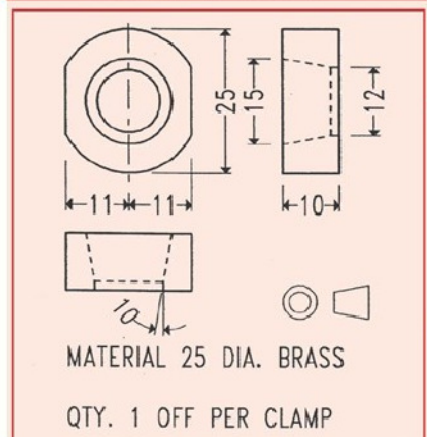
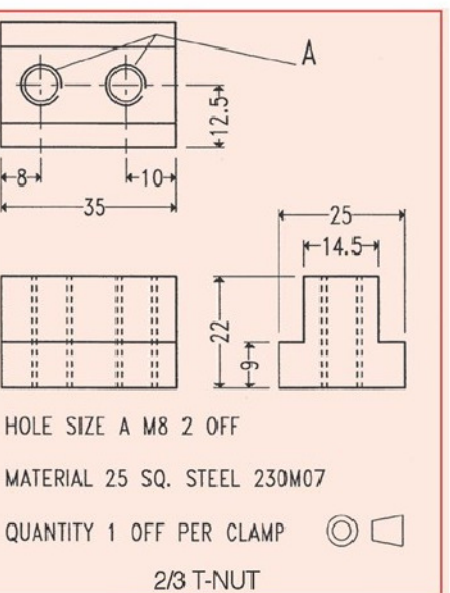
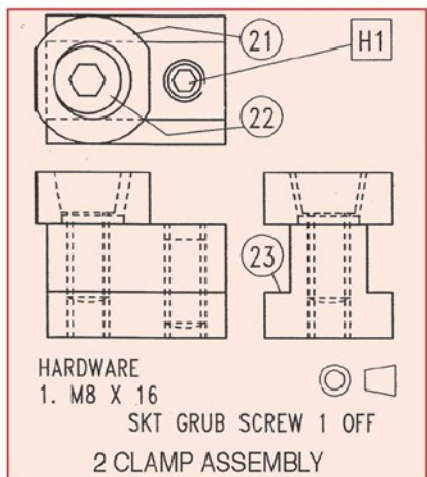
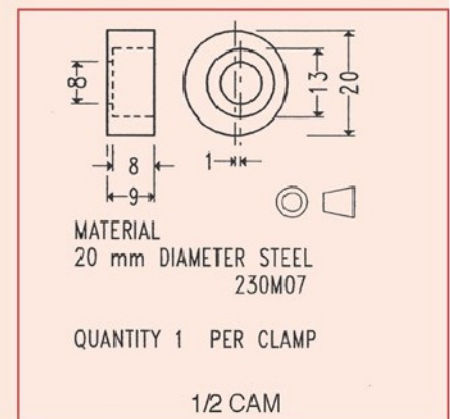
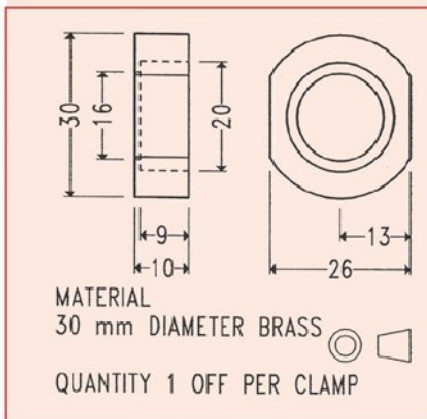
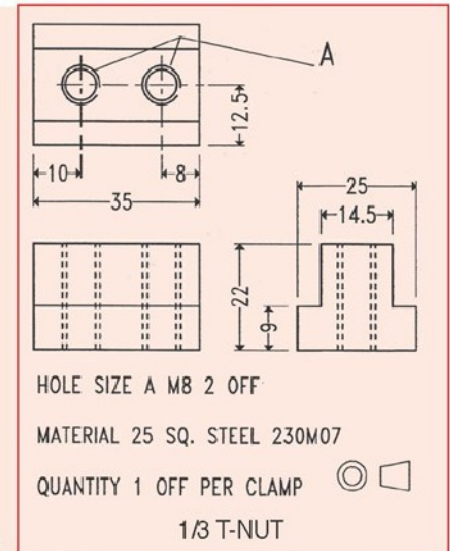
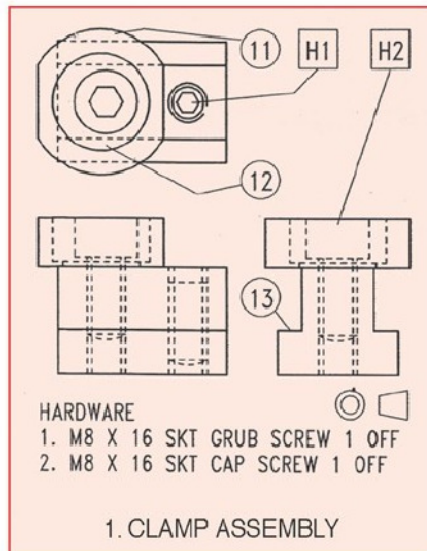
Having said above that a number of clamps should be made, how many is "a number"? Well, I would not anticipate that readers would make the five designs in this article, probably choosing to make just one. In this case I would suggest a minimum of four. Having made all five for this article I have made just two of each but can of course mix and match where more than two would be beneficial. Readers may like to take this approach by say making three off of two designs. Of course, if you wish to experiment and make all five, two of each should be more than adequate.

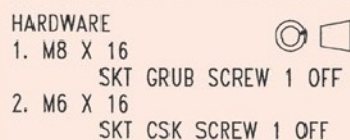
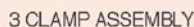
Which one

In the most likely situation where a reader will chose to make just one design, which one will be the decision requiring to be made. Unfortunately, in that respect, no one design stands out as better than the others. Designs 1 and 2 have a major advantage of being able to clamp surfaces that are not at right angles to the machine T slot, whilst 4 and 5 will provide downward pressure to hold the workpiece against the machine table. Clamp 5 is though the easiest to make and use. Whilst I have not tested the idea I also feel a much larger, (longer and higher) version of clamp 5 would make a possible alternative to a small machine vice if used with a suitable fixed jaw.

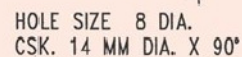
Lightweight T slots

Earlier in the article I mentioned possible problems if the designs were made to suit light weight slots such as those found on lathe cross slides and the like, typically those on a Myford Series 7. The question is whether or not the thin section of the upper part of the slot would strong enough to withstand the force applied using the grub screw into the base of the slot. In theory this would be no more than the force created by a standard T nut with stud and overhead clamp. However, over enthusiastic tightening of the grub screw to prevent the clamp moving along the T slot may in the worse case cause the top webs to break out. If you feel uneasy about this possibility then changing the design to that in **Sk. 5** would





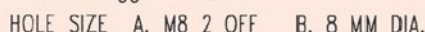
4 CLAMP ASSEMBLY



MATERIAL
16 X 6 STEEL 070M20

QUANTITY
1 OFF PER CLAMP

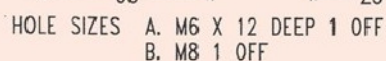
4/1 CLAMP



MATERIAL 32 X 25 STEEL 070M20

QUANTITY 1 OFF PER CLAMP

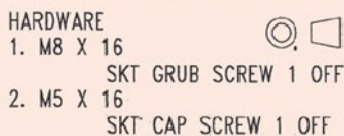
3/1 T-NUT



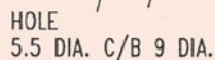
MATERIAL 25 SQ. STEEL 230M07

QUANTITY 1 OFF PER CLAMP

4/2 T-NUT



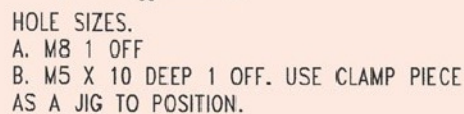
5 CLAMP ASSEMBLY



MATERIAL
16 X 8 STEEL 070M20

QUANTITY
1 OFF PER CLAMP

5/1 CLAMP PIECE

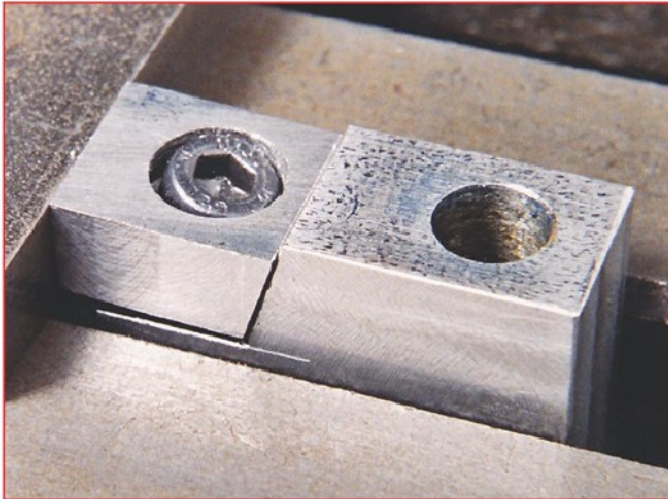


MATERIAL 32 X 25 STEEL 070M20

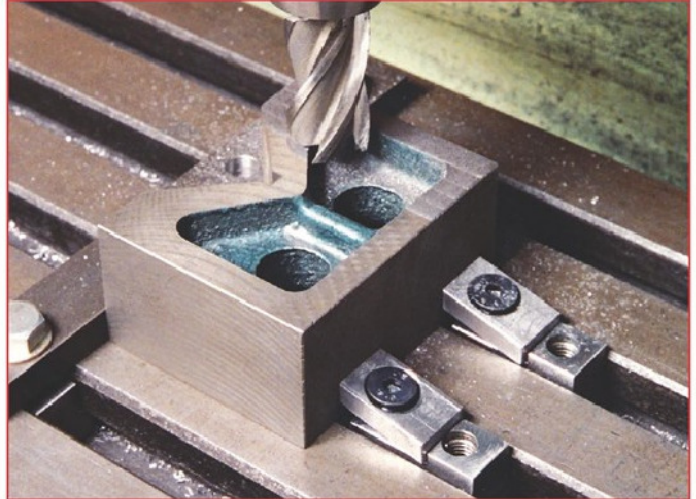
QUANTITY 1 OFF PER CLAMP

5/2 T-NUT

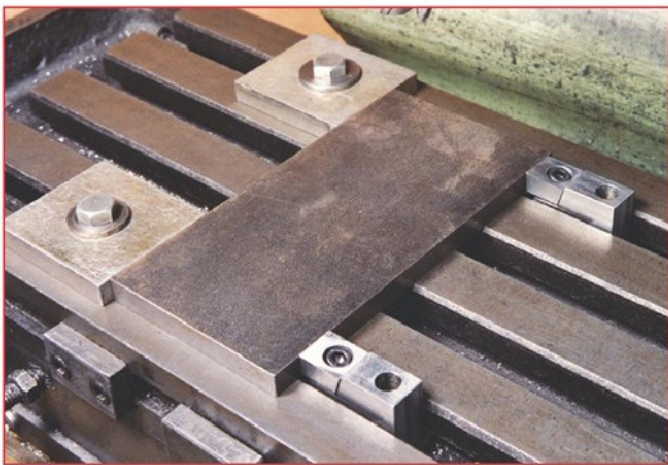
no bearing on this article other than that I used it extensively myself whilst making these clamps. It was whilst wearing my cabinet making cap that I came across in the woodworking section of a tool catalogue, a device for marking out mortises and tenons and



11. Clamp 5.



12. Whilst the clamps are low profile they are not limited to low profile workpieces. Clamp 4 being used in this example.



13. Two off clamp 5 holding a 10 mm thick plate.



14. A typical fixed jaw for use with the low profile clamps.

the like, Ref. 1. Having since purchased this I have used it extensively in my metalworking activities and as a result has been appropriated from my woodworking workshop.

The device, **Photo 15**, is used for marking out a distance from the edge of a workpiece. In the past I would have used my height gauge on my surface plate for such a requirement. Being a precision item this is safely stored in its storage box making it a chore to make it available. Whilst the vernier facility provided accuracy this was invariably to a finer

degree than the task required and the device in the photograph is sufficiently accurate for all but the occasional application. **Photo 16** shows it being used to mark out the cutting line on the piece of metal seen in **Photo 6**.

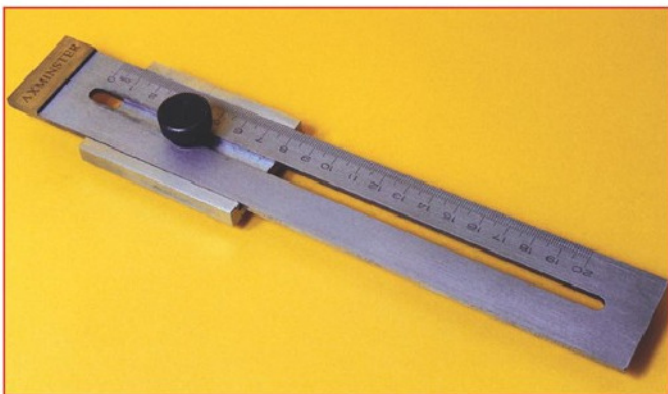
Especially when dealing with small components such as the clamps in this article it is far easier to use than an engineer's square, rule and a scriber. The calibrations are easy to read being on a satin chrome finish and the edge used by the scriber is hardened, all told it is well made. Of all the none essential items in

my workshop it now rates a close second to the compound table on my drilling machine.



References

Layout Square, order number SMT010, from **Axminster Power and Tool Centre Ltd.** Axminster, Devon, EX13 5PH. tel. 0800 371822. E-mail orders@axminster.co.uk Web Site www.axminster.co.uk



15. A marking out device used extensively whilst making these clamps, both to mark out positions of holes and machining lines.



16. Marking out the cutting line to make two off clamp 5 from a piece of waste steel.



1. The micrometer with instructions, charger and fitted case.

FIXING A MOORE & WRIGHT MICRO 2000

Malcolm Leafe dabbles and discovers how to (almost) fix a digital micrometer, aided and abetted by Mike Crossman.

It all started one night a couple of years ago. It had been a stygian, stormy and somehow, different, night, the atmosphere was almost a physical presence. The crackling of the lightning and the sonorous rolling of the thunder was interrupting the chatter of a milling cutter and the splashing of feet in the overflow from a leaky suds pump. The oppressive atmosphere was sundered, not by an emphatic banging on the workshop door or by an eldritch screech from some night creature but by the ringing of the

telephone. A wood-working friend had called with the news that he had discovered, a used Moore and Wright digital micrometer at a near to bargain price – was I interested? A couple of questions sufficed to establish that this was not a “digitalised screw operated micrometer” but the real thing. After but a few seconds thought I said, “Yes please”, the device was purchased and eventually arrived in my oily palm. My pal had already tried the device and I was assured that it worked but the battery seemed to

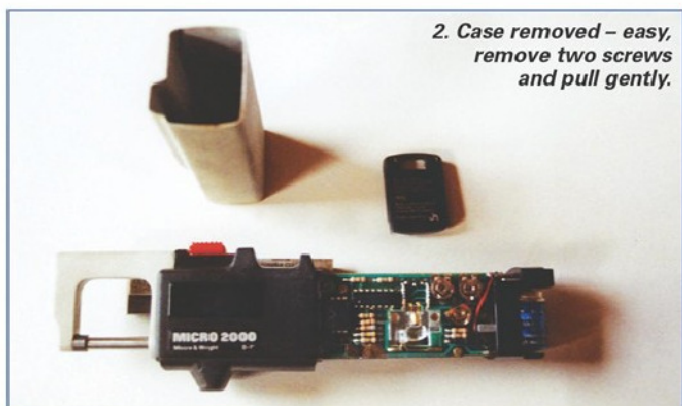
be rather lacking in electrons. Having faint memories of adverts for the device, the battery condition didn’t seem so surprising as the gadget must be about 20 odd years old – but how “state of the art” it still looked. A few quick trials showed that it indeed did work – “how useful” was the general feeling – at that euphoric moment. I was regaled with examples of just how useful it was – matches, nails; woodscrews; plywood; paper and even veneer had been measured and the thickness of a crisp packet established – was there anything it could not do?

A week or two passed and serious use was attempted, the bulk of the device seemed to destine it for bench use rather than lying on the table of a some machine or other – no, I know that leaving measuring instruments in the swarf and oil on a machine isn’t good practice, but it does happen. Doubts began to arise in my mind about the probity of measurements.

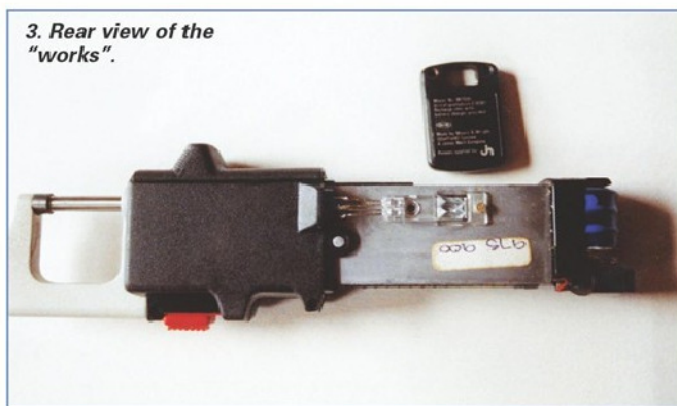
Euphoria diminishes

At that time it was being used to determine things in the region of 0.1 to 0.3 in. I resorted to my set of slip gauges to check the thing out. The errors became immediately apparent, up to about 0.3 in. it over-read by about 1 to 4 thou i.e. 0.001 to 0.004. So I re-charged the battery, a 15 hr job as specified in the maker’s brochure and tried again. Dismay turned to despair as further checks were made – at 0.5 to 0.7 in. the errors were in the region of 10 to 20 thou...and more. When a 1in. slip was used the maximum micrometer reading was about 0.93 – not so good. At last I had a reason for the poor fits of most things which I make...it wasn’t all my fault! At this stage the cover of the device was removed to see whether I could see anything obviously wrong.

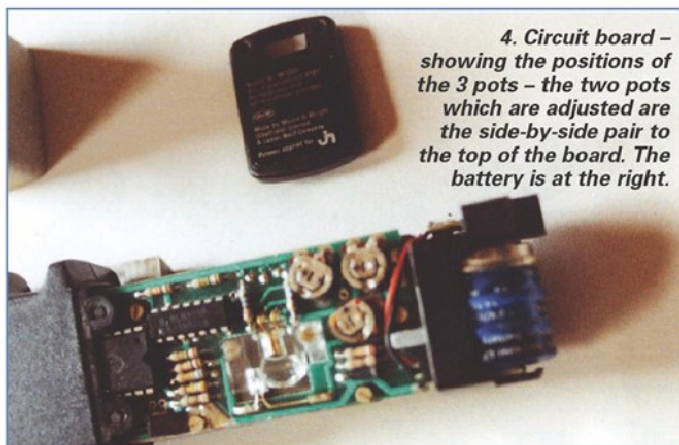
The cover is retained by two recessed screws in the end of the case, the plastic moulded charger plug housing/ case end comes away and the metal case is removed by gently pulling. As my knowledge of electronics started with the Mullard valve amplifier circuits and ended with the early op amps, the internals meant nothing at all to me except for what looked like a very vaguely opto-isolator sort of set-up – no 6V6s in here! Further, it appeared that someone had “been there before me” with a soldering iron, and not very neatly at that. I took some comfort in the thought of now possessing a most esoteric paperweight.



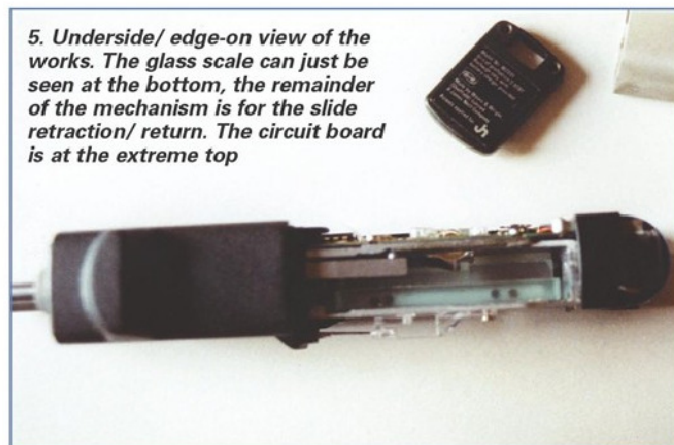
2. Case removed – easy, remove two screws and pull gently.



3. Rear view of the “works”.



4. Circuit board – showing the positions of the 3 pots – the two pots which are adjusted are the side-by-side pair to the top of the board. The battery is at the right.



5. Underside/ edge-on view of the works. The glass scale can just be seen at the bottom, the remainder of the mechanism is for the slide retraction/ return. The circuit board is at the extreme top

The internet and MEW to the rescue

As many others have done, I turned to the magic of the internet – thus I met other people with Micro 2000 problems and gleaned some, possibly theoretical, information about how the device worked, but no-one seemed to have any practical know-how to offer. Desultory fiddling in odd moments soon became tedious and the smart device in its fitted case was relegated to the dusty shelves of rarely used kit. Time passed and, as I was temporarily indisposed, not beaver away in the workshop and had oil-free hands I wrote to the editor of MEW and asked if he would place my plea in Link-Up. I received a gratifying number of replies, some concerning the theory of the thing, a few from folk in similar situations and even a few trying to sell me another one – but I was more than satisfied (perhaps satisfied is the wrong word) with the one which I had already bought. Incidentally, at the same time I sought information about a set of apparently peculiar gauge blocks about which I received a lot of replies – thank you to everyone who helped, the problem was solved.

Then, I had a call from Mike Crossman a fellow ME who, actually works with such things and runs a company called “521 Automation Engineering Services Ltd” dealing with Heidenhain and other makes of similar equipment. The explanation of what I did and why the thing now sort-of/ more or less works is due to Mike with the caveat that his knowledge/ experience/ suggestions are solely based on my very non-technical description of what the insides of the thing look like. Working on my description, which follows, Mike explained what the electronics does and what to do about it.

Appearance of the “works” – or a chemist looks under the bonnet

The inner works are built around two engraved/ divided glass scales. One scale has an “L” shaped cross-section with the second scale nestling inside the angle of the “L” and kept there by a bronze spring, the sliding of the micrometer anvil is

directly linked to this scale movement. The opening of the two anvils is done manually but their return is catered for by a plunger/ spring with some form of drag/ rate control so that the closing action operates within a set time limit and, probably a set pressure. A small lamp, probably an LED is focussed by a prism through the scales on to a detector. On the other side of the glass scales there is another prism which has two smaller prisms moulded into it, this has two recesses at its base which contain, what I presume are two detectors which are wired with one connection in common. The photographs show the layout. The circuit board which is squeezed into the case (squeezed is appropriate as the case even has a small bulge to accommodate the prism –space is tight) is to my (valve era) mind uncomfortably cramped. Obvious on the board are three sub-miniature preset potentiometers (“pots”) an IC and a battery. The battery is (in mine) a Varta NiCad type 4/150 DK which looks like the sort of battery used in RC aircraft 30 years ago. The battery has 4 cells (1.2v/cell as usual) marked with the information that it should be charged at 15ma for 14 hrs. That is as technical as it gets from me –now for Mike Crossman’s interpretation of my observations.

The “Science Bit” by Mike Crossman

The light source will be read by a set of photo diodes, normally four, which are laid out in a slightly offset square arrangement forming two sets. However, in this device there is apparently a dual prism

arrangement with just two diodes. These probably give two waveforms with a phase shift of 90 degrees. It is the phase shift, which passes information on the direction of movement to the processor, whichever signal comes first decides whether the display will count up or down. It is probable that the signals are formed as sine waves i.e. the light intensity falling on the detector diodes will vary as a sine wave as the gaps between the lines of the gratings ruled on the glass scales open or close up. It is this sine wave, which triggers a chip when the threshold voltage from the diode reaches a certain value, turning on or off a square wave and which, in turn triggers the counts.

In an earlier conversation Mike was of the opinion that the layout of the pots on the circuit board, when compared to other equipment with which he is more familiar, suggested that the two pots arranged “in-line” were the two which adjusted/ controlled the relative spacing of the square wave signals. The third pot would possibly control the signal intensity and should be left strictly alone as all sorts of problems may arise if I fiddled with it. This latter comment has turned out to be very important indeed. He suggested that, if it worked as he thought, then the two “in-line” pots would have to be adjusted in step – as far as possible.

Adjusting the micrometer

I had imagined or possibly just hoped that I would be able to stick a slip gauge between the jaws of the micrometer and twiddle the pots until I had the correct

TABLE 1 TYPICAL ERRORS – measured using Johansson slips

Slip size	Error (tenths thous)										Mean error (tenths)
0.900 in.	-16	-17	-15	-12	-15	-15	-9	-9	-11	-11	-13
0.150	0	+5	+6	+5	+6	+6	+5	+4	+3	+6	+4.6
0.100 wide w/d	+8	+4	+7	+4	+3	+8	+5	+4	+7	+5	+5.5
0.100 small w/d	+8	+6	+6	+8	-1	+7	+3	+4	+1	+6	+4.9

The comment in the table : wide w/d, small w/d refers to whether the micrometer was opened to 0.7/ 0.8 ins or to 0.2 ins before allowing it to close on the slip – I became so annoyed with the thing, I was convinced that the opening gap was affecting the readings – judge for yourself.

TABLE 2
"FINAL" ADJUSTMENT

after much fiddling the device was left with these settings

Slip size (inches)	Error (tenths)	% error
0.2	0	0.0
0.3	-3	-0.1
0.4	+1	+0.025
0.5	+/- 1	+/- 0.02
0.6	-3	-0.05
0.7	-11	-0.16
0.8	-8	-0.1
0.9	-14	-0.16

reading – it was not to be. The procedure which was used is time consuming and tedious in the extreme: clean micro jaws, re-zero reading, insert slip, release moving jaw, read; note error; remove slip, adjust pot(s); open jaws; allow to close; re-zero and repeat...

I obviously do not properly appreciate the sophistication of the electronics as the adjustment of the pots appears, to me, to be rather hit and miss. Small adjustments of one pot will make small changes to the readings – do not rely on changes to the zero reading. After a few small changes, a few degrees of rotation of the pot at a time, the zero reading will suddenly become huge, at this stage the zero reading is useful as an indicator that the

two pots are out of step. Now, return the first pot to its approximate previous setting and carry out adjustment with the other pot –until the same thing happens –then change back and adjust with the first used pot... ad nauseum.

Eventually I arrived at a state where the errors were reduced at the central position to almost correct. At 0.4 to 0.5 in. readings were almost correct and 2 to 3 tenths out at the low end and 3 to 4 tenths out at the high end. I never did get it to read to a full 1 in. but at 0.93xx or so it was correct to 4 tenths. Although I am not too sure about the technical correctness of what I did, especially with Mike having to rely on my non-electronic descriptions and then interpreting them via the phone and email, the results do not seem too bad. Our joint efforts may not be up to the standards of the maker's original claims but, I have left well alone...it's ok for a modeller. Some sample results of my adjusted micrometer are given in the tables. I have fiddled with the device so much that I have forgotten whether these are the final results or not but they are a representative sample.

I suspect that the micrometer was a brave step into the future – and an expensive one considering the new price, I believe that the device had a limited production life possibly on the grounds of price and awkward handling. Even now, when cheaper electronics are available, the sophistication of the optics and the sliding retraction and controlled return mechanism for the anvils would probably mitigate against it ever having become a cheap device. My micrometer is, by no means, perfect but it works and as, it is not

the most convenient thing to wave about due to its weight and bulk I am quite happy to use it on occasion and to keep it as a sample of a groundbreaking product.

All this and the weather is still stygian and threatening...and the suds pump is still leaking.

Caution

The scant information in this article is the result of collaboration between an engineering electronics service engineer and a chemist. The electronics professional worked from a sketchy description of the circuitry provided by the chemist (who's only electronics experience concerns ancient audio circuits) – and who twiddled the circuitry. So please do not take my comments as gospel...Information on these fascinating gadgets seems to be thin on the ground and who knows, this may prompt someone who built the things to "own up".

Mike has indicated that he is prepared to help other modellers with allied problems, time permitting, as he does have a business to run supplying and servicing DROs and machine tool measuring systems (521 Automation Engineering Services Ltd.) – he may be contacted at mike@auto521.demon.co.uk Generously he has offered to supply Heidenhain brochures to enquirers –they contain an explanatory text covering digital read-outs (and lots of delicious equipment) – but he will need an A4 envelope and stamps for 250 grammes.



MODIFICATION TO A QUICK CHANGE TOOL POST

Mick Harris suggests an improvement to a new Chronos product.

Background

I have a Clarke CL300M lathe that I have had for several years, and have often thought that I would make myself a quick change tool post but as is usually the case have never found the time, like so many other jobs that "need doing when time permits". Having retired several years ago I now find I don't know how I managed to go to work and do my hobbies as well. Any way in issue 115 of MEW, the Chronos advert illustrated a QCTP suitable for my lathe, so I bought one. For the price I really only expected one tool holder but actually got three. Problem solved! However I found that tool holder changing was not as slick and quick as I wanted, so I decided to modify it.

Symptom and cause

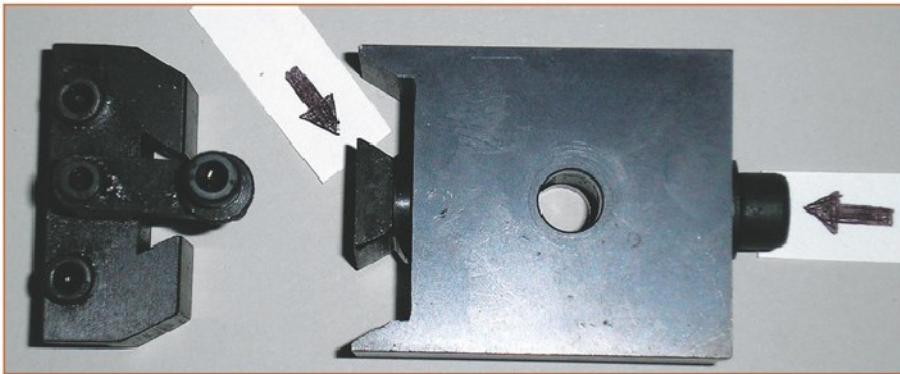
The difficulty arises because the dovetail part, which performs the clamping job can, as manufactured, rotate several degrees

either side of the vertical position. This then interferes with sliding in the tool holder, when you try to line it up. My modification aims to stop this rotary movement. It has achieved this

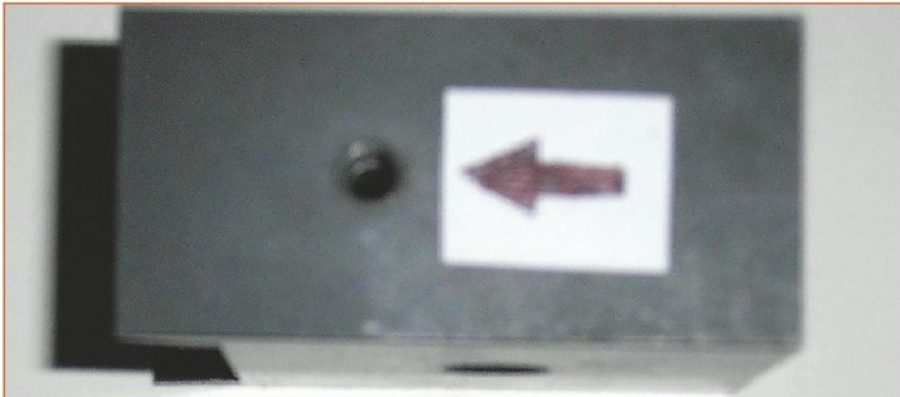
successfully and now the tool holders drop straight in. **Photo 1** shows the tool as received, the arrows showing the clamp and draw bolt

Procedure

Start by dismantling the tool; mark and drill the side hole in the block as per the drawing **Fig 1**. (I drilled it on the side away from me.) Drill the hole 4mm through to the inside, then reassemble with a tool holder and clamp it up. Now drill into the tool clamp 4.5mm deep then disassemble. Now open the hole up in the body to 4.2mm dia. for a depth of 7mm. Next tap M5 making sure the tap is upright. I made a start by rotating the tap in my pillar drill.

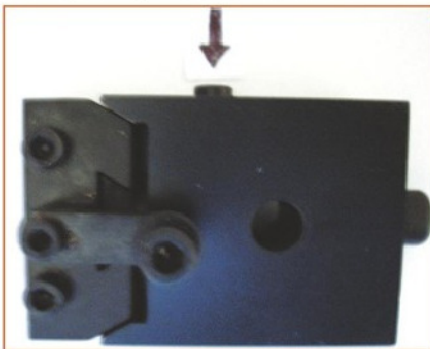


1. Chronos QC Tool Post. The arrows indicate the clamp and draw bolt.



2. Body viewed from side. Arrow denotes new hole.

Use cutting paste or fluid to reduce the load on the tap and avoid breakage. Finish the hole with a plug tap that is flat on the end so that it goes right to the bottom of the hole.



3. Assembled unit, arrow shows new guide bolt.

Photo 2 shows the tapped hole in the body.

The next job is to mill the slot in the clamp. Much of this part is round so take care with the positioning and workholding. I set it up in my small Proxxon mill, and to make sure that the position was as near as dead on, I put a 4mm cutter in the mill collet and dropped this into the hole drilled as described

above. I then slotted the hole towards the rear by 2mm, then extended the slot towards the front of the clamp to make the slot 12mm long by 4.5mm deep. This finishes the clamp, and photo 2 shows the slot machined in the clamp.

The final job is to make the guide bolt. This can be made from a M5x20mm cap head screw or from hexagon silver steel hardened and tempered. (I happened to have a cap screw this size.) Turn down a 13.5mm length of the threaded part to 4.1mm dia. Do not cut more off until you try it in the slot you have made in the clamp. If you have the means to grind it accurately to fit the slot then this could give you added precision. Now check that the bolt screws in and bottoms on the head not the slot. If not, turn just sufficient off the thread to allow it to fit correctly. When this is done, reassemble it and make sure that the clamp slides freely and that the tool holders fit in easily. You may find as I did, that a small chamfer on the leading edges of the sides at the top of the clamp helps the tool holders to drop straight in. Photo 3 shows the guide bolt in position while Photos 4 and 5 show the finished item in use on my lathe.

Postscript

As I said at the outset, this toolholder is excellent value for money, and with this improvement is now an absolute delight to work with. I am now in the process of making a new rear (Q.C.) tool post holder for my Myford for use with this tool. And, believe or not, it has actually taken me longer to write this article than to do the mod on the tool!

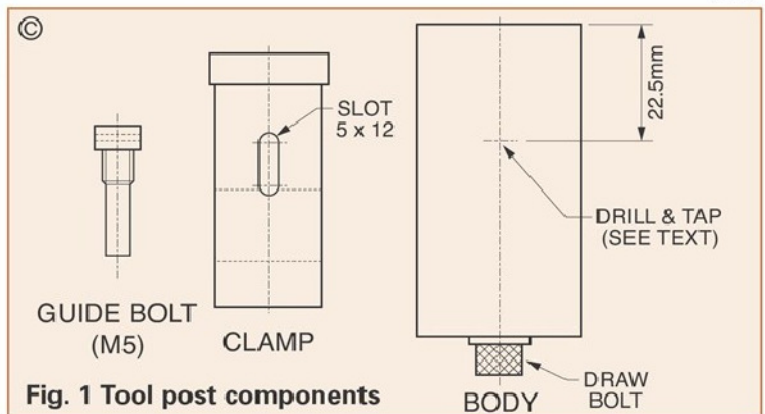


Fig. 1 Tool post components



4. Device in use viewed from operator side.



5. Device fitted, viewed from tailstock.

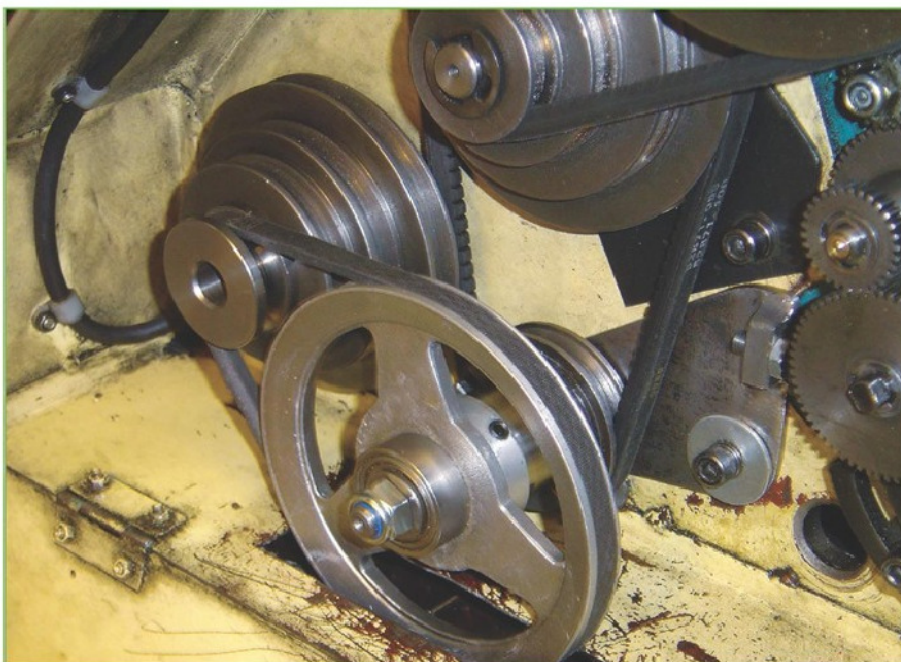
IMPROVEMENTS TO THE CLARKE CL500M



1. Standard countershaft arrangement.

When I was a lad I used to dream about owning a Myford lathe (amongst other things!) but somehow I never got around to it. When I retired, I finally purchased a lathe to keep me busy in winter and keep me out of my wife's hair. However the only available space where I could install it was half of a double garage, so space was somewhat limited. I must

admit, I didn't do my homework very well, and I didn't start taking the Model Engineers' Workshop magazine until after I had made the improvements to my machine, otherwise perhaps I would have recorded the modifications and taken photographs as the work proceeded. Consequently, the photographs are, as cookery programmes say, "one I made earlier!"



2. Modified drive with "Countershaft 2".

In this first instalment, Jim Wilks describes a couple of useful modifications to this popular machine.

1

I saw the Clarke CL500M Lathe / Mill Drill advertised in Machine Mart and it appeared to have the features I was looking for. I wanted a machine large enough to do some fairly serious work viz. skimming brake discs, flywheels, etc. as well as model engineering. Because of the limitations on space, I didn't think I could squeeze in a milling machine as well as a lathe in my garage, to say nothing of the additional cost! I thought that a milling head on a lathe was a reasonable compromise and I must say that I have been fairly satisfied with its performance in that regard. The machine is also reasonably powerful, and certainly a far cry from the old days when a lathe came without a motor, and a "quarter horse" motor and flat belt drive was about all you could run to.

The lathe part of the machine is obviously a compromise to allow for the milling function, e.g. there are no vee bed ways, and also there is no split nut to disengage the saddle from the leadscrew. The latter drawback only becomes obvious when screw cutting; more about that later. Although the Clarke machine and its clones are good value for money and are well-made where it counts, there are a few drawbacks, some of which thankfully are fairly easy to rectify with limited workshop facilities. Most of the modifications carried out so far have been to overcome specific problems, as opposed to "nice to have" modifications.

An article in MEW some time ago mentioned the difficulty of machining close to the tailstock centre, due to the small overhang of the tailstock on these machines. That article proposed turning the tailstock around and making a new leadscrew. The writer has found that this is less of a problem if a live centre is used due to the extra length of the centre. The topslide needs to be wound well back to reach the end of the workpiece. The lathe tool also needs to project further from the tool-holder, to avoid interference between the topslide body and the tailstock. The article mentioned remaking the tailstock leadscrew with a right hand thread instead of the original left hand thread owing to the lack of a left hand threading facility. Later in this article a left hand screw-cutting modification is described, which overcomes this omission.

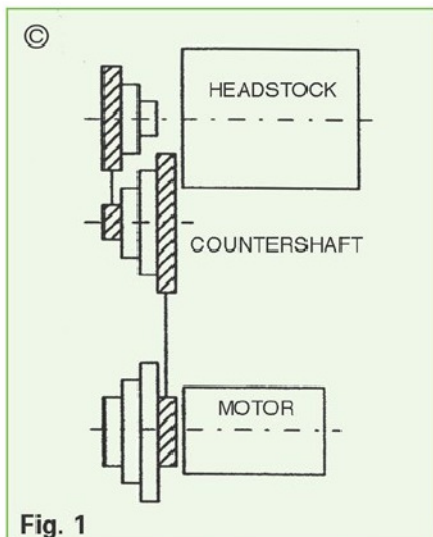


Fig. 1

Modifications carried out

© The modifications carried out so far on this machine are as follows:

- A lower minimum headstock speed.
- A new Rotary Forward / Reverse switch with clear markings.
- A finer self-acting feed for a better surface finish.
- A modification to allow left hand screw-cutting.
- A new calibrated Hand Wheel on the Mill Drill Head.

In this article, the first two items are covered. The remainder will be described in the next issue.

1. Lower Minimum Headstock Speed

Background

Soon after receiving the machine, some screw-cutting was attempted. However, a couple of drawbacks immediately manifested themselves, viz. a permanently-engaged leadscrew nut and a

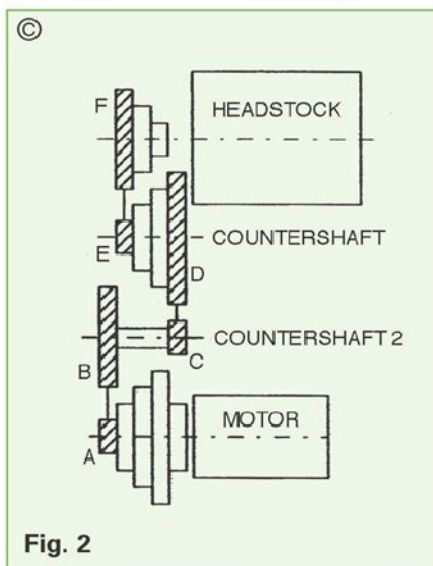


Fig. 2



3. Revised switchgear.

fairly fast minimum headstock speed.

The lead screw nut is permanently engaged presumably to allow a more robust drive to the saddle for milling purposes. The leadscrew could be disengaged from the headstock drive at the end of the thread to allow the saddle to be returned to the start of the thread.

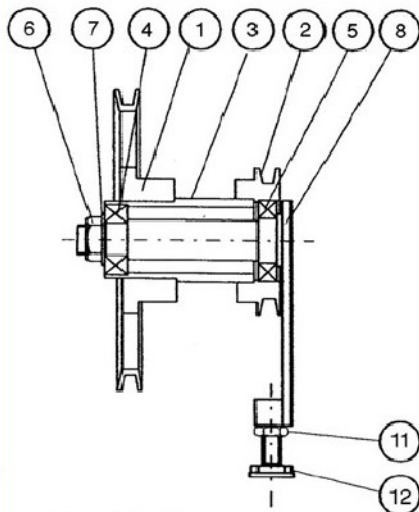
However, the leadscrew dog clutch could be engaged in any one of six orientations, making this option impracticable, unless some kind of screw-cutting dial could be arranged to ensure the dog clutch is engaged in the correct orientation. The writer worked out the following procedure for screw-cutting, which has been found very convenient to use, bearing in mind the lower headstock

speed and clearly-marked rotary switch which, are described in this article.

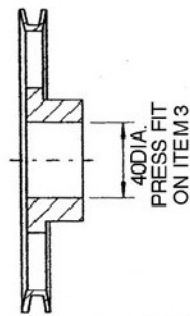
- Set up the lathe for the lowest headstock speed, viz. 160 rpm.
- Set up the gear train for the thread to be cut.
- Move the cross slide until the screw-cutting tool just touches the workpiece and then apply a cut of (say) 0.001 in. and set the cross slide thimble to zero.
- Take the tool back to the start of the section where the thread starts and engage the leadscrew.
- Start the lathe in the forward direction.
- Before the end of the thread is

Construction Notes

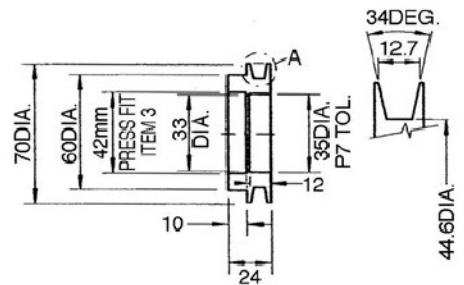
1. 6in. aluminium Picador pulley available from Millhill Supplies, The Barn, Russells Road, Halstead, Essex C09 1 SP. Tel. 01787 472236, or 150mm Aluminium single 'A' section pulley from Machine Mart; stores countrywide. Press pulley onto Housing (item 3), and secure with M8 x 12 hexagon socket set screw. Note: "Set Screw" is a metric designation; (most people of my generation know it as a grub screw!)
2. Press small pulley onto Housing (item 3) and secure with (say) 4 spring pins equally spaced around the circumference.
3. Diameter 35 tolerance P7. Diameter = 34.983 / 34.958 mm.
4. Bearing Designation SKF 6202 - Z (single seal) or similar.
5. Bearing Designation RHP 6003 - Z (single seal) or similar.
6. Item 8 Shaft Assembly was made as a welded assembly and has been dimensioned as such. However, bolted fabrication or silver soldering could be considered if welding is not available. The suggested method of manufacture of the Shaft Assembly is as follows: Make Back Plate from (say) 3/16in. plate roughly cut to size, and drill the 8mm and 19mm holes. Take a piece of 1in. diameter mild steel bar x 155mm long, centre both ends and turn one end 19mm diameter x 45mm long to be a press fit in the 19mm drilled hole. Press the bar into the plate as shown in Sketch 5 and fillet weld in from both sides getting as much weld penetration as possible. Weld on the small block as shown Sketch 5. After all welding is finished, stress relieve the assembly if facilities exist. Then tap the M8 hole in the small block. Next, hold the 19mm diameter section in a 3-jaw chuck with a centre in the other end. Then machine the shaft to size. Reverse the shaft in the chuck and grip on the 16.9mm diameter. Bolt a piece of metal to the M8 tapped hole in the small block on the back plate to engage one of the chuck jaws. This is to provide sufficient torque for facing the plate without the shaft slipping in the chuck. Part off the 19mm diameter and face off the back face of the plate square to the shaft axis to 6mm thick. Then finish plate periphery to size.
7. Press item 9 into motor cone pulley and secure with (say) 2 hexagon socket head set screws M5 x 12 long, deeply dimpled into item 9.



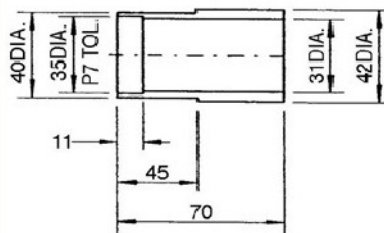
SKETCH 1
COUNTERSHAFT ASSEMBLY



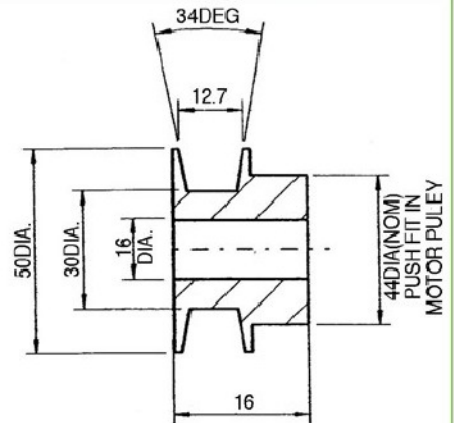
SKETCH 2
ITEM 1, PULLEY LARGE
MAT'L: D1A CAST ALUMINIUM ALLOY



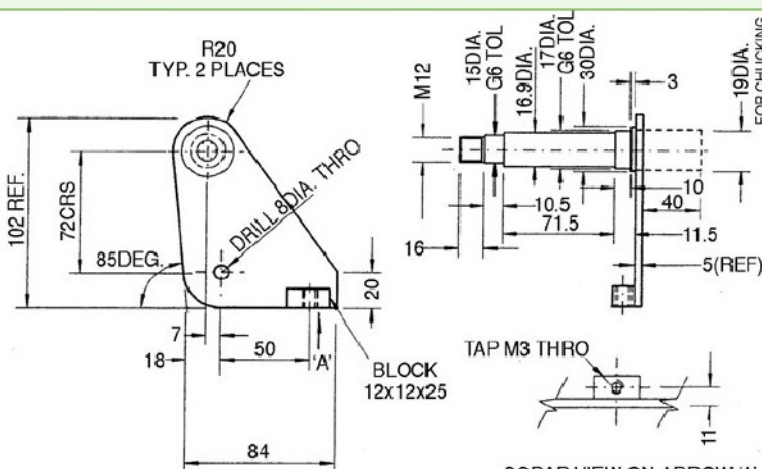
SKETCH 3
ITEM 2, PULLEY SMALL
MAT'L: MILD STEEL



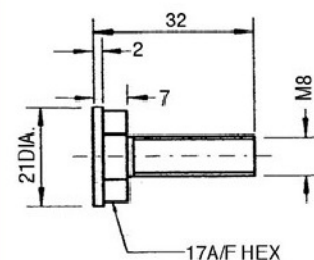
SKETCH 4
ITEM 3, HOUSING
MAT'L: MILD STEEL SEAMLESS PIPE
1 1/4" X-STG OR SCHED. 160



SKETCH 6
ITEM 9, SMALL MOTOR PULLEY
MAT'L: MILD STEEL



SKETCH 5
ITEM 8, SHAFT ASSY
MAT'L: MILD STEEL, WELDED CONSTRUCTION
AS AN ALTERNATIVE TO WELDING, SCREWED
CONNECTIONS OR SILVER SOLDERING CAN BE
CONSIDERED



SKETCH 7
ITEM 12, THRUST SCREW
MAT'L: MILD STEEL

reached, switch off the lathe and retract the tool.

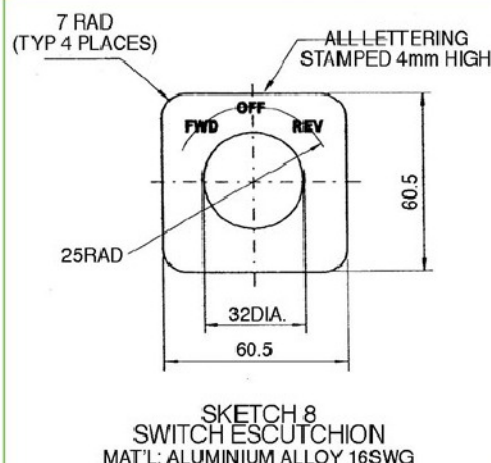
- This requires judgement to allow for the machine's inertia.
- Switch the lathe into reverse rotation and go back to the start of the thread.
- Apply another cut and again set the cross slide thimble to zero.
- Switch the lathe into forward motion

and start again.

- Repeat until the full depth of thread is reached.

It was immediately obvious that the minimum headstock speed of 160 rpm was far too fast, and switching off and allowing for over-run at the end of the thread before hitting the chuck was decidedly hazardous.

The headstock drive is by means of A-section V- belts and cone pulleys. The existing headstock speeds available are 160, 250 and 400 rpm with the countershaft installed. Fig. 1 shows the set up for 160 rpm with the appropriate diameters of the cone pulleys cross-hatched. Also available are headstock speeds of 630, 1000 and 1600



rpm with the countershaft unbolted. It was obvious that a lower minimum headstock speed was required. Back-gearing was an option that was considered, but quite large-diameter gears would be necessary because of the required spacing between the motor shaft and the idler shaft. Also, cutting large Module gears seemed unnecessarily complicated given my gear-cutting facilities at the time.

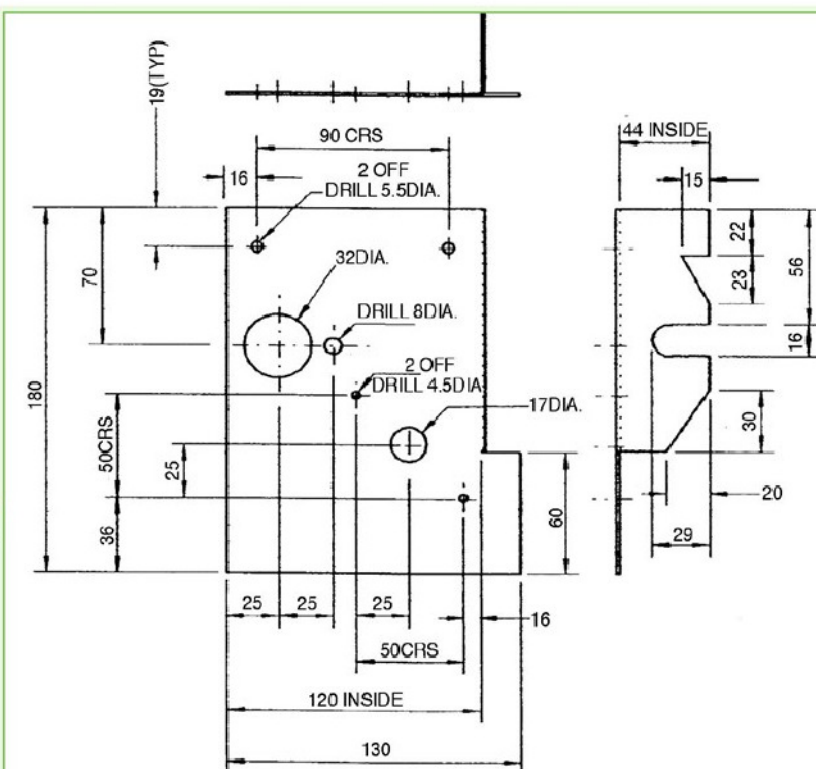
All things considered the simplest option seemed to be to add another countershaft. Although, it is admitted that backgearing would probably be quicker to change from normal to low speed and vice versa.

A diagrammatic view of the set-up with the new Countershaft 2 installed is as shown in **fig. 2**. As the existing countershaft is bolted in, it did not appear to be too much of a hardship for the second countershaft also to be bolted in. The layout and dimensioning of the new countershaft was chosen to ensure that the belt transmitting the power from the motor to the original countershaft could also be used to transmit power from the new countershaft to the original countershaft.

There appeared to be just about enough room within the belt guard / gear case to install this new countershaft allowing clearance for the gear-cutting change gears and clearance for adjustment of belt tension. (see **photo 1** for the machine as-received and **photo 2** for the machine set-up with Countershaft 2 installed.) However, a small cut-out is needed in the bottom of the belt guard to allow clearance for part of the Countershaft 2 large pulley to project. This projection is covered with a separate guard for safety. An extra-length replacement screwed eye for adjusting motor belt tension was also made up to allow more flexibility in the length of the drive belts. More readily-available motor car fan belts could then be used as a replacement for the existing drive belts.

The design and installation of the second countershaft was based on the following criteria:

- It should be possible to bolt it in and remove it quickly.
- It should preferably be bolted in using existing attachments, as the headstock has an oil bath, and it was feared that holes added with an electric drill might break through the casing,



©

- allowing oil to escape.
- The countershaft needs to move to adjust the belt tension between the countershaft and the new countershaft 2.

The new countershaft has a thrust screw which bears against the leadscrew bearing housing to adjust the tension in the belt between the new countershaft and the original countershaft. The belt tensions are adjusted in the following sequence:

1. The belt between the headstock pulley and the original countershaft is adjusted by moving the countershaft along a slot in the belt guard and tightening the M 12 nut.
2. The belt between the original countershaft and the new countershaft is adjusted by leaving the pivot Allen cap screw just finger tight and screwing out the Thrust Screw until the correct tension is reached, then locking the M8 lock nut, and then tightening the pivot Allen Cap Screw.
3. Finally, the nuts on the threaded eye on the motor are adjusted to produce the correct tension in the motor-to-countershaft belt.

The existing motor cone pulley as supplied has a handy recess 44mm diameter x 20mm deep, which is concentric to the pulley grooves, is accurately machined and of a good surface finish. This was possibly provided for chucking when the pulley was machined. This provides a suitable diameter for fitting another small pulley outboard of the existing cone pulley. For details of this

pulley, see **Sketch 6**. This then drives a 150mm pulley on the new countershaft, then the 70mm diameter pulley on the same countershaft drives a large pulley on the existing countershaft, and thence to the headstock pulley. For A-section V-belts, the pitch diameter for standard groove dimensions equals the pulley outside diameter in inches minus 0.25 in.

$$\text{The new minimum headstock speed} = \frac{\text{motor rpm} \times \text{dia A} \times \text{dia C} \times \text{dia E}}{\text{dia B} \times \text{dia D} \times \text{dia F}}$$

(see **Fig 2**)

Where: motor rpm=1500; dia A = 50 - 6.35 = 43.65mm; dia B=152.4 - 6.35 = 146.05mm; dia C=70 - 6.35 = 63.65mm; dia D = 127 - 6.35 = 120.65mm; dia E = 48.5 - 6.35 = 42.15mm; dia F = 150 - 6.35 = 143.65mm

$$\text{Therefore new minimum speed} = \frac{1500 \times 43.65 \times 63.65 \times 42.15}{146.05 \times 120.65 \times 143.65} = 69 \text{ rpm}$$

This speed is fine for screw-cutting, even for large pitch threads.

Note that the sizes of the ball races and many of the dimensions of the parts are based on material sizes in the "Stores" viz. the ubiquitous Scrap Box.

See **sketch 1** for the assembly, **sketches 2 to 5** inclusive and **sketch 7** for details of Countershaft 2 and **sketch 6** for the small motor pulley.

Naturally, this reduced speed also applies to the milling head, which gives

a more suitable speed for use with larger milling cutters and fly cutters.

2. Rotary Forward / Reverse Switch (clearly marked)

Background

Bearing in mind the method of screw-cutting with this machine, it is necessary to know clearly to which direction of rotation the machine has been set. The machine as-supplied has a rocker switch mounted high up on the belt guard gear case for controlling the direction of rotation. Shortly after receiving the machine, screw-cutting was attempted on a workpiece between centres. Part way through screw-cutting, the operation was interrupted for lunch. On returning to the work, the saddle was found to be at the tailstock end and the forward / reverse switch was checked and found to be in the FWD position. The machine was started up (at 160 rpm!) and the saddle immediately struck the tailstock, shearing the teeth off the 60-tooth screwcutting gear. The machine was supplied with the switch wired wrongly, i.e. the headstock rotated clockwise viewed on the chuck face when the switch marking was FWD. Be warned! It is not known how many machines were delivered wired this way.

This rocker switch is small, and is covered with a yellow hinged cover and a flexible clear plastic membrane to keep out oil and debris. This membrane rapidly becomes dirty, and the marking on the switch (viz. FWD and REV) becomes impossible to read. Incidentally, the Milling Head rotates the opposite way to the headstock due to the pair of bevel gears driving the Milling Head vertical shaft, i.e. the switch needs to be set as 'reverse' for the spindle to rotate in a clockwise direction. The direction of rotation to which the machine has been set is not immediately obvious, especially when breaking off from work and then returning.

For ease of screw-cutting, it should be possible to see at a glance the direction of rotation, for obvious reasons. It was thought that the simplest method of seeing the direction of rotation was to fit a fairly large rotary switch with prominent easy-to-read markings. A suitable switch was found at a trade stall at a local steam fair, although many other suitable switches are available. The following description applies to this switch, but is deliberately kept in general terms as the switches chosen by others will depend on personal preferences and what is available.

The switch used was a Kraus & Naimer double-throw 4 pole with centre "off", 60deg. switching, model no A213. The operating knob was large enough to easily see the setting of the switch. A new escutcheon plate was made up with FWD and REV stamped on. (See Sketch 8 for details). To avoid having to completely trace out the wiring, the wiring to the existing 2 pole double-throw switch was transferred to the new double-throw 4 pole switch, and the 'no-volt' release switch was retained. The existing 2 pole switch was retained in position for controlling a future suds pump.



ROTARY SWITCH CONTACT ARRANGEMENT

KRAUS & NAIMER MODEL A213 4-POLE
DOUBLE THROW SWITCH WITH CENTRE 'OFF'

NUMBERS ARE TERMINAL NO'S MOULDED INTO SWITCH BODY



SWITCH POSITIONS AS FOLLOWS:

FORWARD: TERMINAL 2 CONNECTED TO TERMINAL 3
TERMINAL 6 CONNECTED TO TERMINAL 7
REVERSE: TERMINAL 2 CONNECTED TO TERMINAL 1
TERMINAL 6 CONNECTED TO TERMINAL 5

IDENTIFY BELT GUARD MICROSWITCH CABLE COLOUR-CODED BLUE LINK TERMINALS 9 & 11 ON ROTARY SWITCH. WIRE ROTARY SWITCH IN SERIES WITH THIS BLUE CABLE, TERMINALS 9 & 11 TO ONE SIDE, TERMINAL 10 TO THE OTHER

FOURTH POLE COULD BE USED FOR INDICATOR LIGHTS, ETC. ASSOCIATED WITH THE DIRECTION OF ROTATION

The reversing switch controls the starter winding only. Hence, if the switch is inadvertently left in the centre 'off' position and the green 'on' button is pushed, the motor will not start. However, the main windings are still connected, therefore the motor would 'hum' but would not start. For this reason, the wiring to the micro switches on the belt guards is connected through the rotary switch as shown in fig. 3. This then prevents the starter relay from energising if the new reversing switch is in the 'off' position. A switch without a centre 'off' position would not require this refinement. However, in this case, the direction of rotation could not be changed without first pressing the stop button and allowing the motor to come to rest.

The Sealey equivalent of this lathe (Model SM27) has a flush-mounted starter switch alongside the leadscrew engagement lever. The Clarke equivalent has a surface-mounted starter switch installed high up on the belt guard. The new reversing switch is flush-mounted, therefore the 'Sealey' switch position was used as it gives a neater arrangement. To

simplify the wiring, the 'no-volt' release switch and relay was mounted on the home made floor stand in a suitable position alongside the reversing switch. For details of the reversing switch mounting plate see Sketch 9. During this modification, it was found that the wiring between the motor and the starter switch, and between the microswitches and the starter switch was rubber insulated, and was completely perished due to contact with oil. In parts, the insulation was completely missing and the bare copper was visible! For this reason, the rubber-insulated wiring was completely changed for plastic insulated cable. See photo 3 for the installed switch.

This rotary switch, in combination with the low speed drive have transformed the machine, and have been used extensively for screwcutting and turning large diameters.



Part two of this article will appear in issue 119 and will cover the other three modifications viz. a finer self-acting feed, a modification to allow left hand screw-cutting and a new calibrated Hand Wheel for the mill quill feed.

Parts List Associated With Sketch 1 Assembly

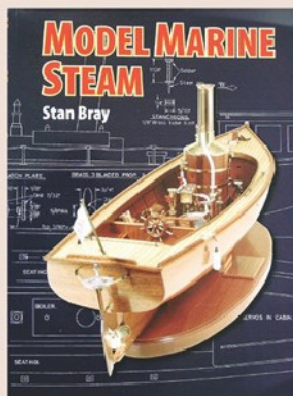
Item No.	Sketch No.	Description	Construction Note
1	2	Pulley - large. made from 6 in. proprietary al alloy pulley	1
2	3	Pulley - small. mild steel	2,3
3	4	Housing. mild steel	3
4	-	Deep groove ball bearing 15 i/d x 35 o/d x 11 wide	4
5	-	Veep groove ball bearing 17 i/d x 35 o/d x 10 wide	5
6	-	Nyloc nut m12 mild steel zn plated	
7	-	Washer m12 form "a" bright mild steel	
8	5	Shaft assembly	6
9	6	Small motor pulley mild steel	7
10	-	Vee belt a-section; 20 in. pitch length; ref a20	
11	-	Lock nut m8 mild steel zn plated	
12	7	Thrust screw mild steel	

FIRESIDE READING

Model Marine Steam

Stan Bray

Stan may have "retired" from editing this magazine a fair number of years ago, but this latest book is evidence that he is not only a highly experienced and accomplished modelmaker, but also still a workaholic at heart. Following a brief introduction, seventeen chapters are entitled; Steam Plant design, Boiler Water, General Construction, Oscillating Engines, Slide Valve engines, Miscellaneous Engines, Model Marine Boilers, Boiler Design and Construction, Boiler Fittings, Boiler Firing Methods, Boiler Feed Pumps, Steam Engine Lubrication, Going Astern, Valve Gear, Steam Turbines, Paddle Steamers, and Automatic Controls. In addition to general information and guidance on manufacture, a number of detailed drawings are given for specific designs with particular reference to engines, boilers, fittings, burners and controls. Whilst aimed at the model boating enthusiast who may wish to progress to steam propulsion, the book is likely to have wider relevance to small scale steam power in general.



Published by:
Special Interest Model Books

Format:
297mm x 210mm paperback,
Model Marine Steam extends to 144
pages and contains some 200
photographs and plans.

Price: £14.95

ISBN: 1-85486-254-6

Tools To Make Life Easier

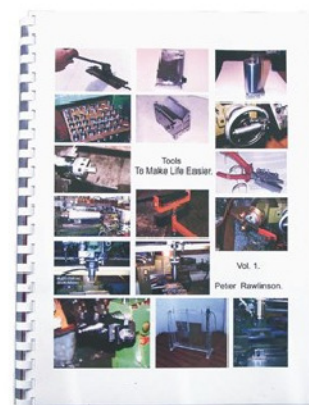
Peter Rawlinson

Peter will be well known to regular readers for his regular articles describing workshop equipment and gadgetry. Newer readers, keen to read up on what has gone before, can encounter problems due to the limited availability of backnumber copies of the magazine. This book addresses that difficulty, and presents no fewer than twenty-three items based on articles published over a number of years.

Printing and publishing for special interest/niche markets can be fraught with uncertainty, so Peter has decided to take the bull by the horns and do the job himself, in a similar manner to Gordon Cornell.

Topics covered, range from Sub Tables to Dividing Head Modifications to Spot Welder to Auto Saddle Stop with many others in between.

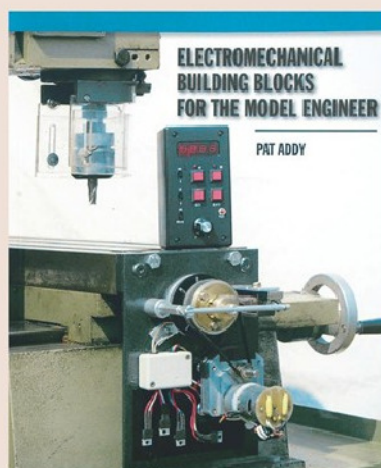
As with his magazine articles Peter gives not only design drawings, but copious photos and descriptive comments to guide would be constructors. For both amateurs and professionals, this publication offers a wealth of devices and techniques which should indeed make workshop life considerably easier.



Electromechanical Building Blocks for the Model Engineer

Pat Addy

Books on mechatronics and associated topics are relatively thin on the ground, and those that are available may be in the form of expensive text books aimed at the student population, sometimes even being tailored for specific courses. This book helps fill this gap for those model engineers and home workshop enthusiasts whose background strength is in the mechanical rather than electrical or electronic disciplines. It is not intended as a "how to convert your Bridgeport to CNC control", in fact the term CNC does not appear in any of the chapter headings. What it does do is (per the title) give some underpinning knowledge and guidance in a wide variety of areas, which can then be combined to create more complex projects. No less than twenty four chapters cover numerous topics including basic theory, stepper and D.C. motors, relays, solenoids, fuses & circuit breakers, LED's, speed measurement, power supplies, pcb etching, and use of stripboard. Useful data is also presented giving comparative figures for a range of electronic devices including MOSFET's, Darlington transistors and diodes, together with useful sources for further information.



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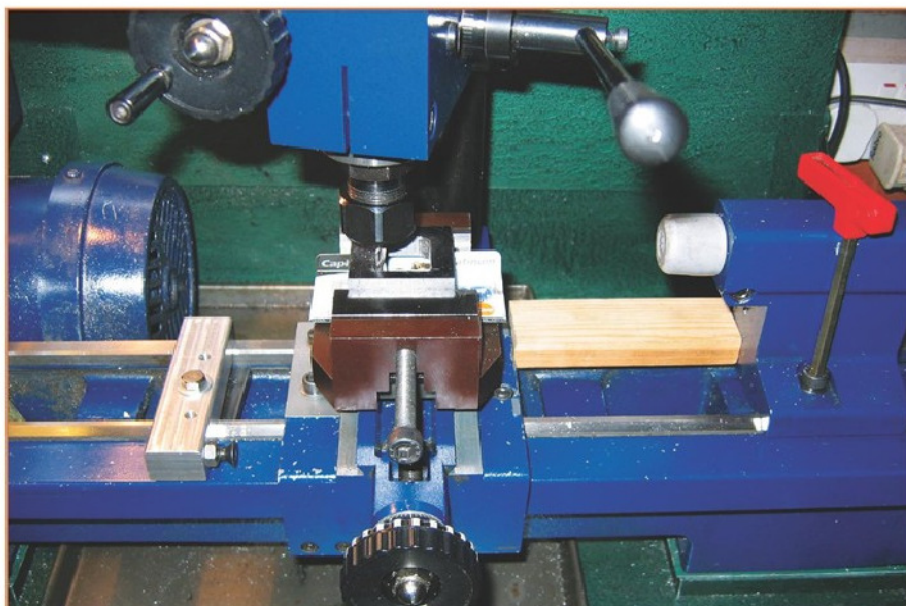
The author Peter Rawlinson, 23
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workshop setting.

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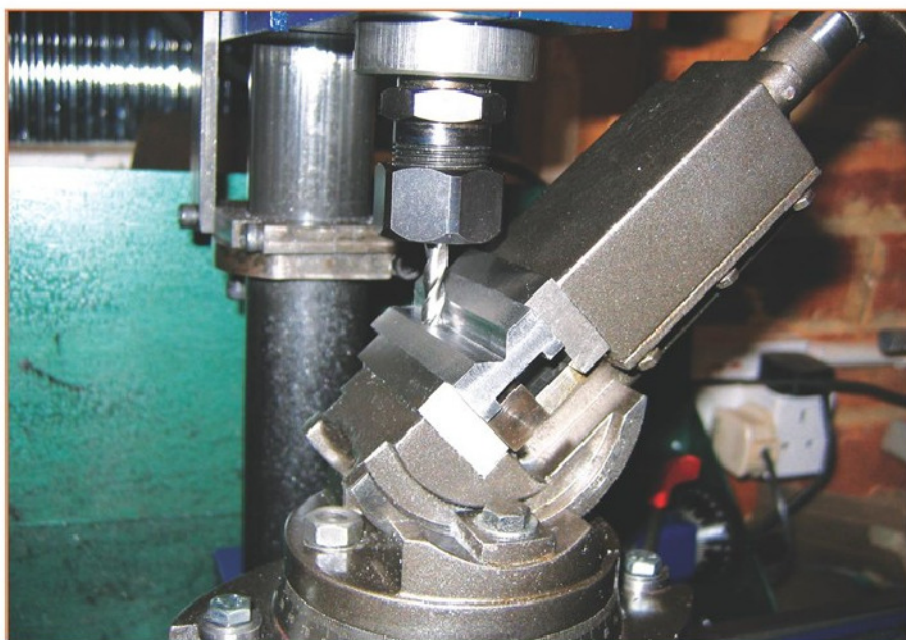
ISBN: 978-0-9553736-0-2



12. Using a wooden stop and conventional saddle stop to control travel.

DRILL SHARPENER ATTACHMENT

Ralph Sparrow describes a device, which may be used with the diamond disc sharpener featured in Issue 117.



13. Milling the Vee with 45degree vice.

This attachment is fairly easy to make and the dimensions of parts can be changed to suit the availability of materials or requirements of the user. However, if you change one dimension you must consider the effect on other parts. With the exception of items 17 and 18 all materials are MS. (I made 17 from brass and 18 from an aluminium extrusion offcut. You may wish to make 18 from steel and harden it, as is normal practice.)

Base, spacer and table

items 1,2,3

Cut to length, mark and drill holes. Tap the holes in item 1. Countersink the holes in item 3 so that the screw heads do not protrude. The aim should be to align the long edges of item 3 parallel to item 1.

Clamp frames

Item 4

Mark outline. Drill 10 mm dia holes to give the inside radii. Chain drill the inside shape, saw out. Mill the inside shape. I used traverse stops to make sure the milling cutter knew where to stop. A squared block of wood trapped against the tailstock is effective (cheaper than DROs).

Photo 12. Clean up the outside, leaving the top shoulders square at this point. Drill and tap the clamp screw hole. Cut and mill the gap at the bottom to pass easily over item 2, the spacer bar. Saw and file the radii if you want to. It isn't essential.

Vee Blocks

Items 5 and 6

Square the outer sides to size. At this stage make the blocks as one item and only part them when all milling operations are complete. Mill the guide recess in the underside so that it slides nicely on item 3, the table. Mill the vee. There are different



14. Spotting holes using a Vee block.

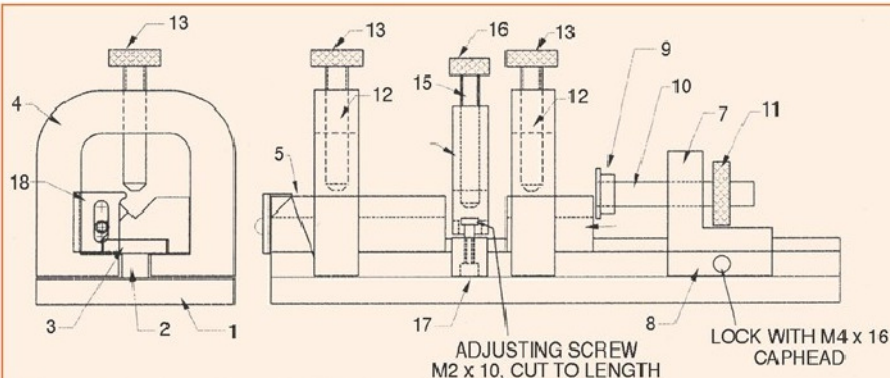


Fig. 1 G.A. drawing of drill sharpening attachment

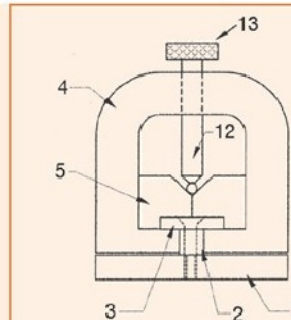


Fig. 2 Assembly showing vee block clamped to table assembly

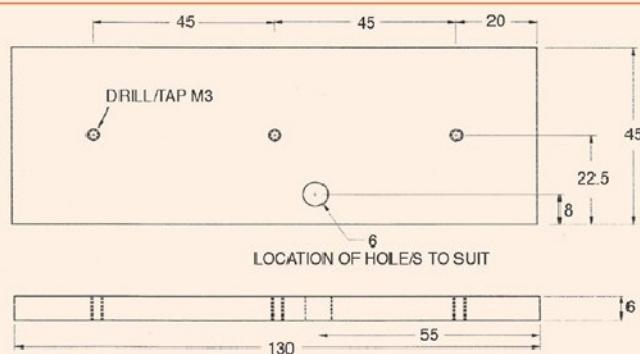


Fig. 3 Base

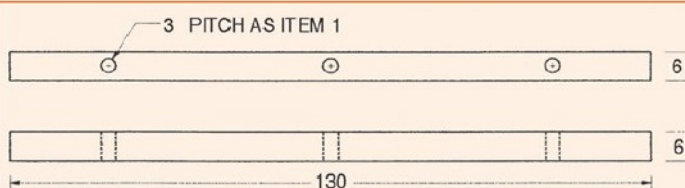


Fig. 4 Spacer

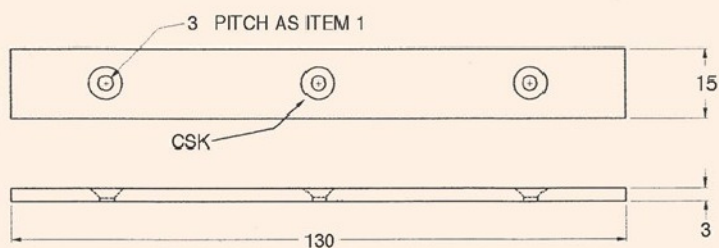


Fig. 5 Item 3 Table

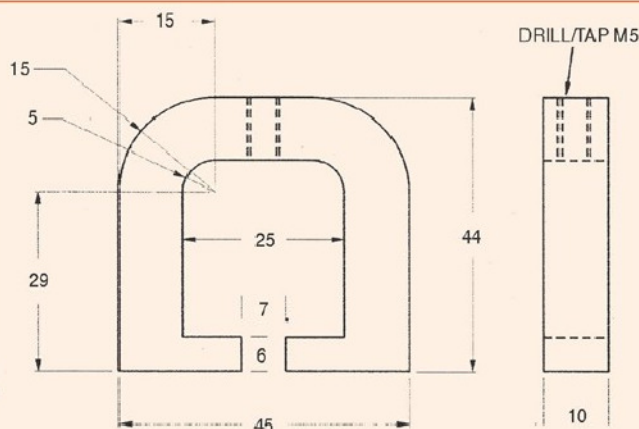
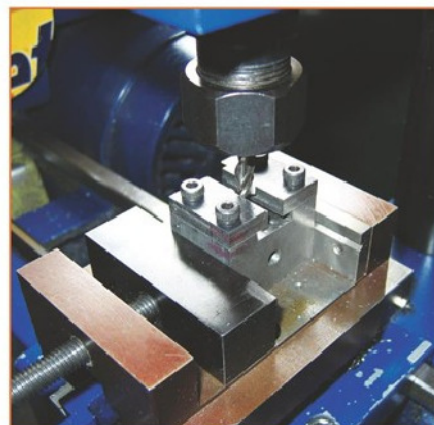


Fig. 6 Item 4 Clamp frame
2 off



15. Machining the slide gap in item 8.

are complete. Mill the guide recess in the underside so that it slides nicely on item 3, the table. Mill the vee. There are different ways of doing this. Although my milling head can be canted there would have to be a serious reason to move it now that I have got it square - so I did it as shown in photo 13 using a tilting vice. The actual depth is not as important as getting it to sit along the centre line. So the cutting corner of the milling cutter was set to the centre line, raised 3.5mm and the cutting started. Mill down 7mm. Just to make sure the two pieces lined up (to cover any inaccuracies in machining) I milled a line along one of the outside edges to provide an easy check. Separate the two parts and clean up the ends. Mark and saw and file the two angles that provide clearance for the cutting discs. These could be milled, but life is too short. Drill the holes, tap and countersink as appropriate.

Backstop frame

Item 7

Square the block. Mill to shape. Then mill the bottom recess to be a good fit on the table, item 3. Do not drill the bottom hole at this stage, but the M6 threaded hole can be completed. (I was originally intending to fit a locking nut in between two flanges seen on some of the photos on this item but realised that having just one flange improved the versatility.)

Backstop clamp plate

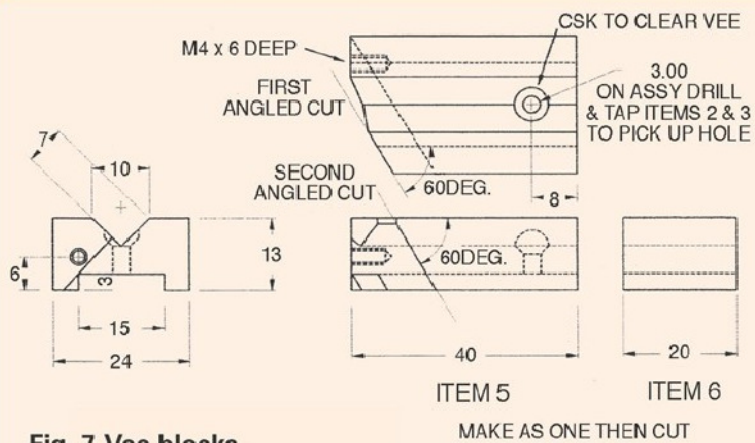


Fig. 7 Vee blocks

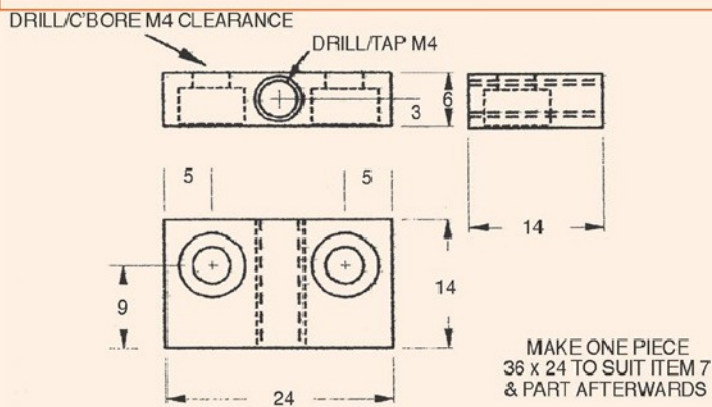


Fig. 9 Backstop clamp plate, Item 8
2 off

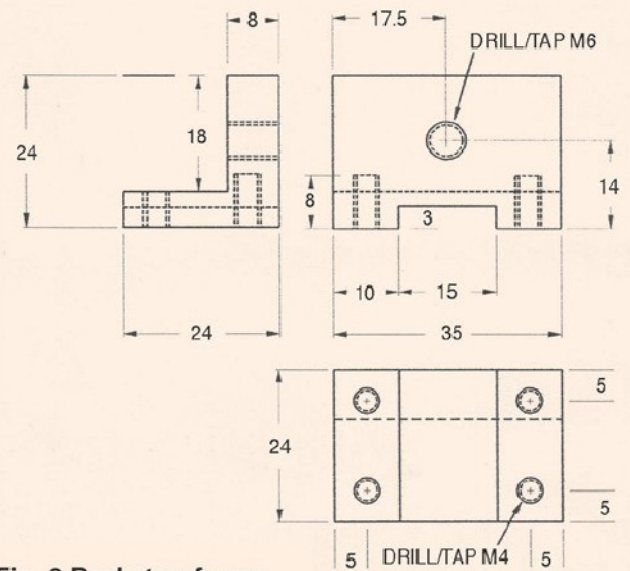


Fig. 8 Backstop frame
Item 7

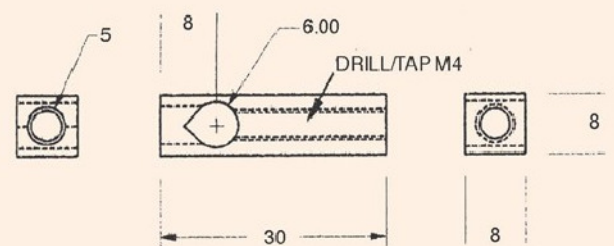


Fig. 10 Flipper arm, Item 14
Mandrel up to 8mm



Fig. 11 Flipper lock screw

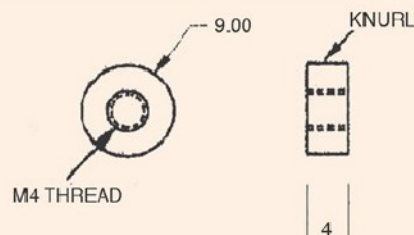


Fig. 12 Flipper lock screw head

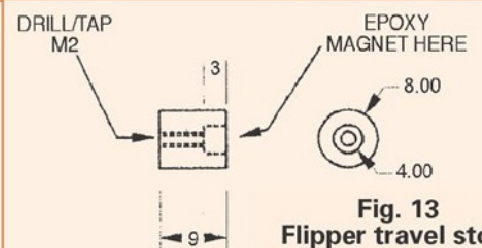


Fig. 13
Flipper travel stop,
item 17
2 off

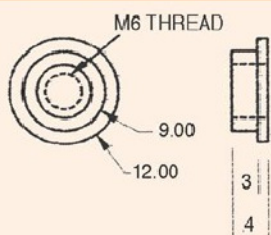


Fig. 14 Backstop, Item 9



Fig. 15 Top screw, Item 10

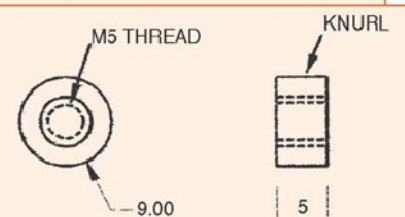
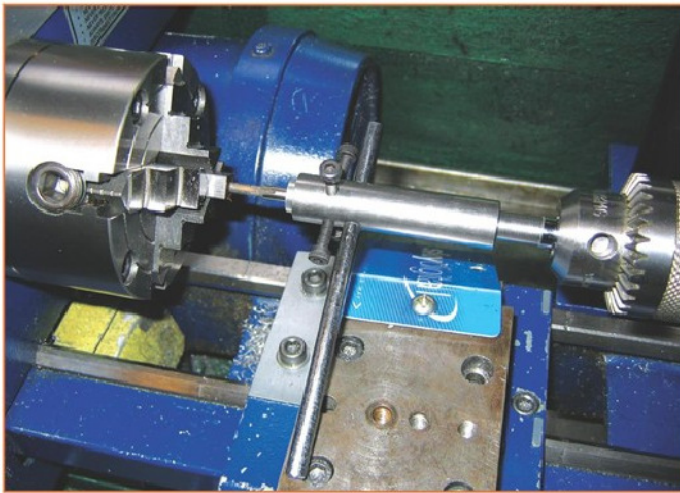
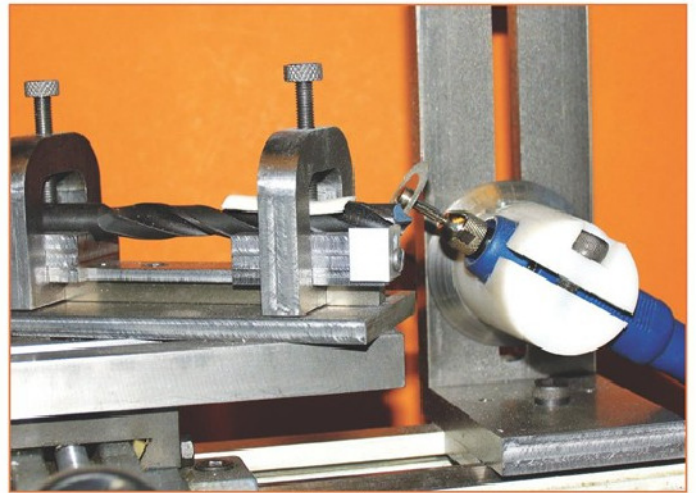


Fig. 16 Clamp screw head
Item 13
2 off



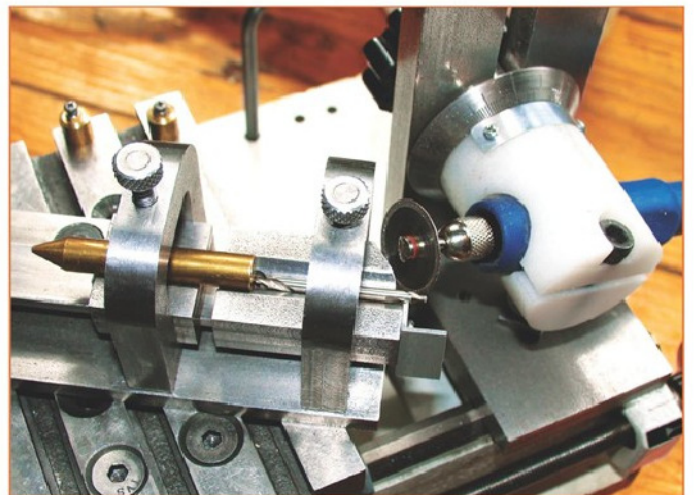
16. Tapping Flipper Arm held in four jaw chuck.



17. Sharpening a drill to four facet geometry



18. Masonry drills can be sharpened, but note the angles.



19. Here's how to extend the life of a Centre Drill.

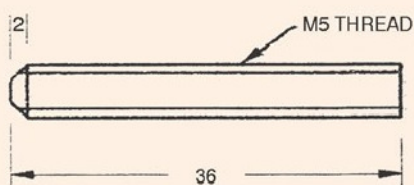


Fig. 17 Clamp screw, Item 12

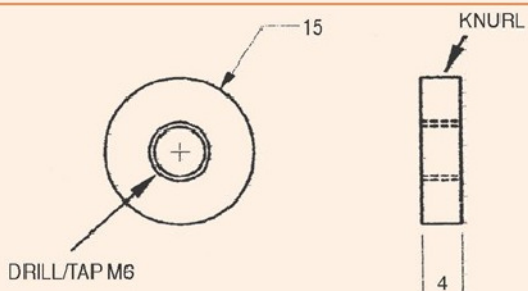


Fig. 18 Backstop nut, Item 21

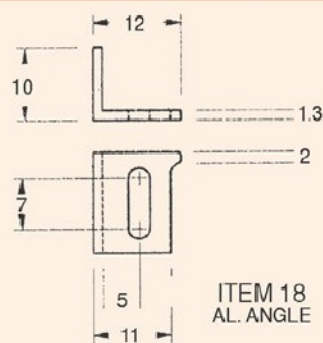


Fig. 19 Front index

Item 8 and assembly to

Item 7

I made item 8 to the same overall size as the base of item 7 and split afterwards. This made it easy to align the holes. So square the piece on two adjoining sides, mark the hole positions and pilot drill. Align parts 7 and 8 in the corner of a vee block and spot through the holes by 1mm deep. **Photo 14**. Mark the adjoining corners of both pieces by centre punching. Finish drilling,

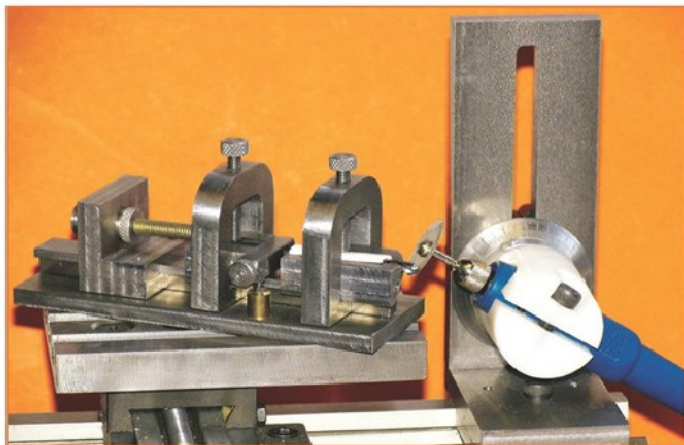
countersinking and tapping.

Assemble with appropriate screws Put back in the milling vice as a unit and clean off the edges of item 8 flush with item 7. Saw the slot in item 8 and mill to give a good clearance. **Photo 15**.

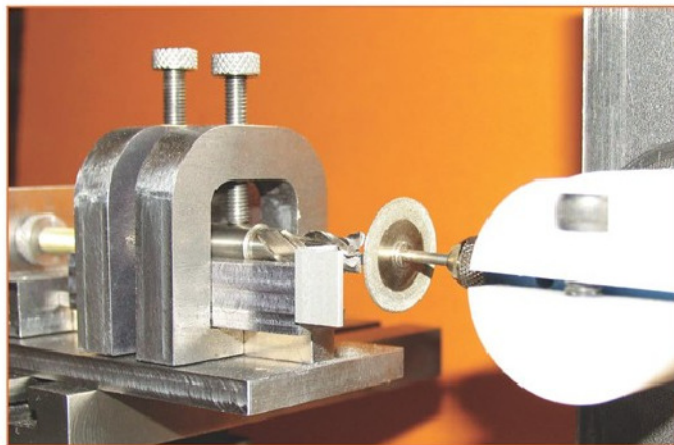
Flipper arm

Item 14

This is the only item needing any real explanation. The use is described below. Cut to length, square and face as necessary. Scribe the centreline fairly heavily as this will help in



20. The Flipper Arm gives 180degree rotation of small drills.



21. A milling cutter may be indexed using the front stop.

M4 tapping size until the drill breaks through into the 6mm hole. Tap M4. (I use a simple home-made tap holder that is interchangeable between mill, drill and lathe as shown in **photo 16**.) Reverse the piece in the chuck and again centralise (not so much care needed this time). Drill 5mm dia until it breaks through into the 6mm hole. When removed from the chuck the square vee can be filed. This locates the various sized drills when sharpening. The purpose of the 5mm hole is to make it easier to file without rounding the surface.

Other parts

All the other bits are simple to make and do not require explanation. On a workshop tool like this I use commercial threaded rod and Loctite (or similar) the various heads on. When the adhesive has set, wrap the thread with a suitable size piece of Coke can, to protect the thread, and face the top surface in the lathe to give a good finish. It saves a lot of time. Make sure that the backstop nut, item 11 is not Loctited on! The flipper travel stops were made from brass and a 4mm dia x 3mm long powerful magnet (obtainable from Squires and perhaps other outlets) is epoxied in the recess.

Assembly

Assemble with appropriate sized screws. Make sure the various bits can slide as needed. Load the front vee, item 5, so that it just projects over the end of the table, mark and drill and tap into parts 2 and 3. Fix with M3 x 10 csk. Ensure the screw head is below the level of the vee.

Using it

This assumes that the flexible drive carrier arrangement described in the last issue is fitted squarely to the bed. Use the 20mm dia bar to check alignment. You will see that the backstop frame and backstop screw can be reversed to cope with different drill lengths whilst keeping the overall length of the attachment to the minimum. I designed it to accept drills from 2.5mm dia to 10mm dia.

I have found that I had trouble using the conventional front index arrangement on drill sharpeners on small drills. Derek Brown's positive indexing on his small drill

sharpeners, previously referred to, has encouraged me to do something similar. In this case the drill is clamped in the flipper arm and the cutting edges aligned with the scribed line by eye. It can help if the flipper arm with the drill is clamped to a piece of flat so that when viewed through a magnifying glass the cutting edge can be seen to be parallel to the flat. More sophisticated arrangements can be envisaged. At this point check that the drill is aligned centrally in the arm. If necessary try several different sized drills and if there was any discrepancy in holding the arm in the four jaw chuck it may be necessary to skim a bit off one side of the arm so that it indexes perfectly when flipped from one side to the other.

It may be better to start with a bigger drill of say 8mm dia. In this case the front index seems adequate. Set the attachment on the cross slide table (I put a milling table on to give a bigger surface). Set the base, item 1, at the appropriate slew angle to give the usual 59 degrees for the drill.

Set the drill on the vees so that it projects slightly, just sufficient for the grinding operation. Get the cutting edge horizontal. Clamp the drill shank onto the rear vee. Adjust and clamp the rear backstop. Put the front clamp on the drill using a piece of PVC water pipe to give a good grip. Adjust the front index, item 18. Set the diamond disc at 10 degrees. Put on mask and safety glasses. Start the drill at low speed. Adjust longitudinal and cross traverse to bring the drill to just touch the disc. Wind the cross traverse in and out and have a look at the result (a 2x magnifying glass is useful and you can also use a small mirror to view the result). Adjust the traverse to add not more than .025mm (one thou) and repeat the pass. Do this until the edge is just past the centre line of the drill. Mark (or note) the longitudinal traverse reading. Slacken the clamps and turn the drill to reposition for the other edge, making sure it is tight against the backstop. Repeat the above until the same traverse point has been achieved. Look at the result to check that both edges look similar. If necessary adjust the drill alignment and reprocess. Change the drill motor speed to find the best cutting speed. If OK then change the flexible drive angle to between 30 and 35 degrees. Repeat the process until you have cut the 10 degree edge back to as near the centre line as possible. Turn the drill and repeat. **Photo 17**. Masonry bits can also be sharpened. **Photo 18**. These have

different angles to conventional drills. Check a large new drill to see angles.

Centre drills can be sharpened using the same 59 degree drill angle on the attachment but with 20 degrees on the disc. **Photo 19**.

Check that there is sufficient travel on the cross traverse motion. It may be necessary to use a small milling table or similar to mount the attachments. The attachments and the disc head can be angled any way to enable the grinding to be done with or against rotation.

For small drills below 6mm dia I use the flipper arm instead of the front index. Set the drill as above, load drill and flipper arm to the vee. The smaller drills are too short to use the rear vee. Adjust the backstop. Set the flipper travel stop so that the drill cutting edges are level. The magnet allows these stops to be moved along the base to suit any length of drill. You can use just one and move it over or set and use two. Repeat the process as above. **Photo 20**. A magnifying glass will, most likely, be essential.

It is possible to sharpen large milling cutters using the drilling attachment with the front indexing stop. This procedure is illustrated in **Photo 21**. However, small cutters, like small drills are difficult to index accurately, and the milling cutter attachment mentioned in the previous article, and based on the Harold Hall design must be considered a worthwhile addition.

Once set up, the sharpening process takes a few seconds. It is best to have a good sharpening session so that all drills, cutters and tools are sharp and ready for that next big project. Discs are available, in different grades, from a variety of suppliers. The sharpening process leaves a small burr that can be easily removed with a craft knife used as a scraper, followed by a gentle honing using a fine stone wetted with white spirits or similar.

If you have any queries I will try to answer them.

ralph@sparrowr.freemove.co.uk
Or phone 0161 439 8021.



Suppliers

Squires Model and Craft Tools.
Phone - 01243 842424.

Arc Euro Trade. Phone - 0116 269 4436.
arceurotrade@bopenworld.com

INDEX FOR ISSUES 105 TO 116 OF MEW

The information contained in this index supplements that published in issue 106, and brings the information up to issue 116. A computer based index is also available for those with suitable equipment to run the software.

Subject Index

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1	Summer	1990	30	July/August	1995	59	July	1999	88	February/March	2003
2	Autumn	1990	31	Sept/Oct	1995	60	August	1999	89	April	2003
3	Winter	1990/91	32	Nov/Dec	1995	61	October	1999	90	May/June	2003
4	April/May	1991	33	Jan/Feb	1996	62	Oct/Nov	1999	91	July	2003
5	June/July	1991	34	March/April	1996	63	November	1999	92	August/September	2003
6	Aug/Sept	1991	35	May/June	1996	64	February	2000	93	October	2003
7	Oct/Nov	1991	36	July/August	1996	65	April	2000	94	November	2003
8	Dec 1991/Jan	1992	37	Sept/Oct	1996	66	June	2000	95	Dec 2003/Jan	2004
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10	April/May	1992	39	December	1996	68	October	2000	97	April	2004
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12	Aug/Sept	1992	41	March/April	1997	70	December	2000	99	July	2004
13	Oct/Nov	1992	42	May/June	1997	71	January/February	2001	100	August/September	2004
14	Dec 1992/Jan	1993	43	July/August	1997	72	March/April	2001	101	October	2004
15	February/March	1993	44	Aug/Sept	1997	73	May	2001	102	November	2004
16	April/May	1993	45	Oct/Nov	1997	74	June	2001	103	Dec 2004/Jan	2005
17	June/July	1993	46	November	1997	75	July/August	2001	104	February/March	2005
18	Aug/Sept	1993	47	December	1997	76	September	2001	105	April	2005
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Model Engineers' Workshop Computerised Index

As noted in Trade Counter, the computer based index is available from CAHW. It is supplied in DOS format on two floppy discs with a full manual. Facilities are included to VIEW, SEARCH, SORT, EDIT, UPDATE, and PRINT. Cost is just £10.00 and non UK orders should add £2.00 carriage. CAHW are at: 61 Waller Drive, Banbury, Oxon. OX16 9NS

MORE POWER AT YOUR ELBOW 1

David Haythornthwaite adds a powered table feed to the popular Wabeco milling machine.

Background

About 3 years ago I purchased a Wabeco vertical mill model 1210 which I find to be superb. My experience is that the machine is well built and gives a good finish on milled items. However I have always been aware that a powered traverse to the milling machine table would improve the finish that is obtainable.

At the time of purchase, there was (and still is) a CNC version of the machine available, but I felt that for my type of work, I could not justify the extra cost of this. I enquired about the cost of obtaining a power feed for X direction only, but again felt that the cost could not be justified for my amateur activities. Historically, industrial table feeds might have taken a drive from the main motor, or utilised a small fixed speed motor driving through a multi speed gearbox. In more recent years, variable speed permanent magnet motors have become more popular. Now that stepper motors and associated drivers have become more accessible, I felt that this would offer a viable route forwards. Hence I recently set about designing and making a powered feed for the X direction using a stepper motor and controller available from Arc Euro Trade (usual disclaimer).

Design considerations

The first consideration taken into account was that any motor drive should not extend above the level of the top of the milling table so that long materials could still be bolted directly to the table without interfering with the motor drive. I have the long-table version of the Wabeco, model 1210, and it did not matter to me if the motor drive extended below the end of the table as I never screw the table so far to the left as to cause the motor to impact with the base of the machine. I did however design the drive so that it can be rotated about the leadscrew and used in any position, as I believe is the case with the factory supplied drive. To the left of the graduated dial is a machined recess 30mm Dia. and 15mm wide to which Wabeco attach their motor drives and I decided that my fixture would clamp to and swivel about this point.



1. Finished drive before refitting the handwheel and chip guard over the motor.

I wished to retain both the original indexed collar and the hand wheel, but to fit a belt drive to the leadscrew meant that the end of the leadscrew would be 30mm too short and would need extending. I decided not to fit a clutch to the motor drive as this would add complication and require a further extension to the leadscrew. However as stepper motors are "locked" in their stopped position, it is necessary to have a switch to provide power to the "free" terminal on the controller which allows the motor to be turned by hand. You should be aware that this is not entirely free running, but in practice I have found the extra drag to be perfectly acceptable. I did not wish to make drastic changes to the actual Wabeco machine, so in order to extend the leadscrew, I arranged to fix the drive pulley onto the 10mm section of the leadscrew where the manual handle was originally fixed, and to fix a flanged 10mm extension shaft (Part E.) to the side of the drive pulley using four countersunk setscrews. The existing handle is then be fitted to this extension piece.



2. Wabeco leadscrew with hand wheel removed.

First purchases

Stepper Motor AC570764525M from Arc Euro Trade (Usual disclaimer)

Bi Polar Stepper Motor Controller from Arc Euro Trade (Usual disclaimer)

Leadscrew Pulley 30XL 037) from local
Motor Pulley 15XL 037) Bearing
Belt 110XL 037) Factors shop

Construction

The first task is to remove the handwheel from the Wabeco leadscrew by gently tapping out the 3mm roll pin fixing it to the shaft. If it is tight, support the leadscrew to eliminate any tendency to bend the end of the leadscrew shaft. Once the handwheel is removed, it is possible (but not advisable) to slide the graduated collar from the leadscrew. I recommend that you leave it in situ, but if you really must remove it then remove it enclosed in a polythene bag. The graduated collar is friction held onto a central bush by a 4mm ball bearing which bears on a groove on the inside of the graduated collar. The ball bearing is situated in a 4mm hole in the central bush and is spring loaded. When you slide the collar from the bush, the ball bearing and spring are expelled at great speed. If anyone wishes to have a spare, they are welcome to search the far corners of my workshop where lie the original parts! Not one of my best tricks! Even with help from the management section of the



3. Drilling holes to attach the leadscrew extension to the pulley.

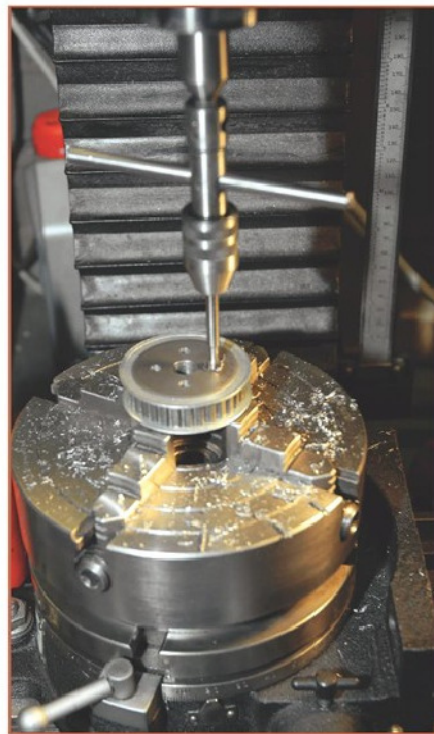
household I couldn't locate them. The leadscrew pulley is a toothed belt pulley bearing the code 30XL037 and this, together with the motor pulley 15XL 037 provides a 2:1 step down ratio between motor and leadscrew. Of course a small v-belt would also be suitable, but I kept to a toothed belt with a recognisable reduction ratio in case I ever decided to go down the full CNC route. Fitting the belt to the pulleys resulted in a linear distance of 80.5 mm between shaft centres and this decided the layout dimensions. I did not allow for any belt adjustment but decided to fit this retrospectively only if necessary. This would take the form of a tensioning ball race running on the outside of the belt. Having used the device with no re-tensioning arrangement, it does not seem to be necessary.

Pulleys

Both pulleys as supplied had a 6mm bore and had two grub screws at 90deg. to fix them to the shaft. Luckily the smaller pulley fitted the 6mm shaft on the stepper motor and so needed no adjustment. However the larger pulley needed boring out to fit the 10mm section on the end of the leadscrew.

The 30 tooth pulley was mounted in the 4 jaw chuck on the lathe and set to run true by the centre hole using a Verdict. The centre hole was then drilled to 9.5mm and finally bored out to 10.1mm. The material was fairly hard but machined well. I held the pulley by the fixing boss (as in **photos 3 & 4**) rather than risk damage to the aluminium belt flanges. You will remember to remove the grub screws before drilling and boring won't you?

Transfer the 4 jaw chuck, complete with pulley to the dividing head or rotary table, if you have one, and set up on the Wabeco table. Centre the hole under the spindle and then move the milling table 12mm in x direction to offset the pulley. Centre drill, and then drill, 4 indexed holes in the face of the pulley at this setting, 4.2mm dia and 15mm deep. This will give you 4 holes at 24mm pitch circle for fixing the leadscrew extender (Part E) to the pulley. Exchange the milling machine drill chuck for a lathe centre and use this to guide a 5mm tap in the holes at the same settings. Photos 3 & 4 show the operation. Pay attention to the position of the grub screws when carrying out this operation. You should drill the new fixing holes so that they do not interfere with the existing grub screw holes. If you



4. Tapping the holes.

don't need your milling machine for other work, leave the rotary table in situ at 12mm offset.

Leadscrew Extension (Part E)

The leadscrew extension (Part E) was made from a piece of 41 mm (1½in.) dia. Free cutting mild steel. A length of 45 mm was sawn off on the bandsaw and chucked in the 3 jaw S.C. chuck using outside jaws. I have a 4in. S.C chuck and I feel that this diameter is too big for the normal jaws as several teeth would not be in contact with the scroll, thus putting too much strain on



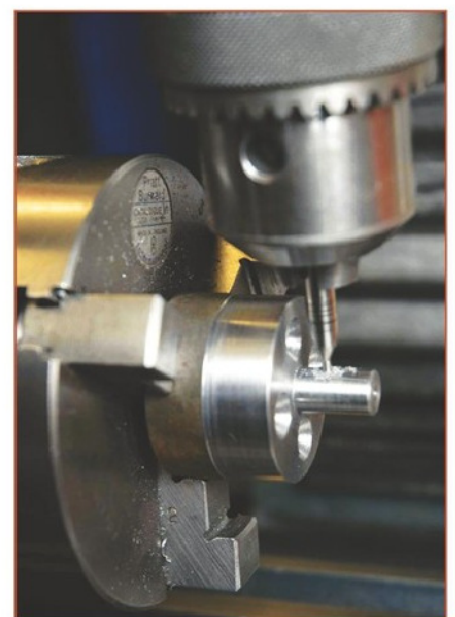
6. Using the edge finder.



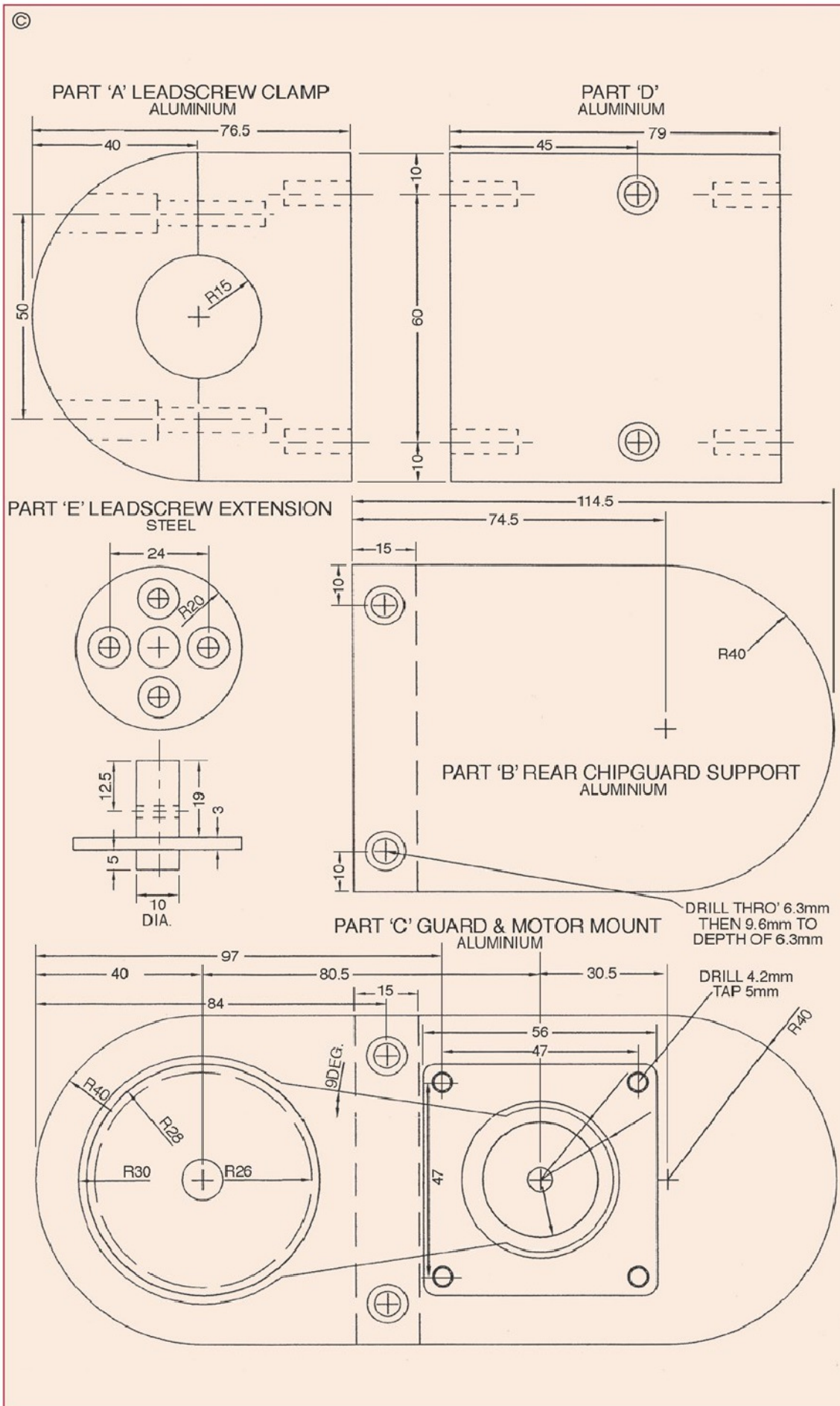
5. Countersinking the holes.

the remaining teeth. I closed the jaws, and being a self taught machinist with lots of bad (but safe) habits, I slightly slackened the grip of the chuck jaws and ran the back of a lathe tool against the side of the extended end whilst running the lathe very slowly (by hand) until the piece ran true on the outside end. Then I tightened the jaws fully. Purists may frown, but it does work extremely well to true up a length of bar on which the chuck end is not guaranteed to be exactly at right angles.

Centre and face the end and bring up the tailstock. Take a light skim over the outside of the bar to tidy up the outside diameter to 40mm, taking this as far as the chuck jaws will allow. Then turn the end of the piece down to 10mm dia. For a length



7. Cross drilling.



of 19mm. Use the Wabeco handle as a guide to your final fit. Whilst the work is still in the chuck, transfer it to the milling machine face up on the rotary table which in my case I had left in situ on the milling table offset at 12mm after tapping the pulley. Centre drill, drill 5mm, and countersink the 4 holes for the 5mm countersunk grub screws. **Photo 5.** illustrates that a fairly small countersink is called for. Mine was $\frac{1}{16}$ in. dia. and worked just fine.

While you have the piece in the chuck and on the rotary table it is a good time to drill the 3mm cross hole for the 3mm roll pin which attaches the handle. The centre of the cross hole should be 6.5mm from the face of the flange. We all have our own way of doing these things, but I set the rotary table vertical and used an edge finder (wiggler) to locate the position of the flange face and to find the centre of the shaft. If you locate the flange face this way, do not forget to move your table by half of the width of the edge finder, before setting your dials or zeroing the DRO. Then move 6.5mm along the shaft, centre drill and ream or drill 3mm.

Photos 6 & 7 illustrate this.

Some time ago I fitted a BW Electronics DRO shared between my Myford Lathe and the Wabeco mill. Using a DRO transforms the way you can work and almost does away with marking out altogether. It certainly helped with locating the 3mm cross hole. Still in the chuck, return part E to the lathe and part off. You need to part off at a position which will give a flange thickness of 3mm plus a spigot length of 5mm after cleaning up. Then reverse the item in the lathe either centering



8. Turning the spigot in the collet chuck.



9. The finished lead screw extension.



10. The finished motor and pulleys.

accurately in the 4 jaw or as I did fitting the 10mm section into a collet chuck ready for turning the spigot and facing the other side of the flange, as in **Photo 8**. The spigot needs to be concentric with the shaft extension on the other side of the flange. The leadscrew does not quite reach through to the end of the pulley and the spigot locates in the recess thus formed in the pulley at the end of the shaft.

Having taken trouble to get my cross hole truly radial, I found that the cross hole in the handwheel supplied with the Wabeco would not line up and it was way off centre. Presumably these are drilled as an assembly, but it was not what I

expected from the otherwise well made Wabeco. I decided to cross drill the handwheel accurately at 90deg. to the original but couldn't drill right through without a long series 3mm drill which wasn't available. I therefore drilled half through with a 3.3mm drill and tapped it for a 4mm grub-screw to bear on my "perfectly aligned" cross hole. A friend of mine used to say that all quick simple jobs are actually slow complicated jobs in disguise. How true.

Stepper motor

Having refitted the handwheel, we now proceed to motorise the shaft. I actually made the power supply, pulse generator (oscillator) and wired the controller first so that I had a control system to try the motor as I progressed. I used a 555 chip for the pulse generator which is substantially similar to that described by Peter Rawlinson in Issue 110 for his tailstock power system. Here I would reiterate Peter's warning about the maximum voltage not going over 40v. My original power supply also had an off load voltage of 44v and I therefore played safe and used an alternative transformer of 26v a.c. which I remember gave me a finished maximum off load d.c. voltage of around 34v. well within the specification of the controller.

As stated previously, the motor comes with a 6mm shaft, front and back and this fitted the motor pulley, which I purchased. However I did not wish to retain the rear drive shaft and so I shortened this (more later). Electrically, the motor has 8 wires coming from it and can be wired in several configurations. However, as supplied it has no terminal box and this must be addressed to ensure that no cutting fluid or swarf enters the motor. I purchased a small cast aluminium box from Maplin which is 48mm sq. and 30mm deep. I drilled a hole in the bottom, clearance size for the grommet on the cable outlet from the motor, and fitted a cable exit sheath on the side of the box. At this stage you should consider in which direction you wish the cable to exit from the terminal box. Mine goes in a downward direction. I then superglued the box to the motor case, not wishing to drill the motor casing. I would suggest that Araldite would probably be stronger and would carry less risk of adhesive entering the motor.

The motor must be configured as series wound. On my motor, this meant that the purple and brown wires should be connected together, as should the yellow and blue wires. This then gives you two coil circuits across the white & green wires and the red & black wires respectively. The information leaflet supplied by Arc. gives details. The two circuits should be soldered to a 4 core flex leading out of the cable exit sheath. All connections should be insulated with tape – or preferably with shrink wrap sleeving and the wires carefully coiled inside the terminal box for closure. I did not shorten my motor wires – you never know when you may need the length. My motor does not seem to interfere with television or radio and the 4 core flex is unscreened. However if you wish to remain in harmony with the neighbours and "the boss indoors" then

screened cable is to be advised. This cable is carrying considerable current which is being chopped into a square waveform at varying frequency depending upon the set motor speed. It is likely to give off radio frequency interference. I simply did not have any screened lead to hand. **Photo 10** shows the finished motor, but please note that the pulley is fitted to the shaft incorrectly in the photo. In reality the pulley is fitted with the flange against the motor and the fixing boss towards the shaft end.

Motor mount and guard

The main motor mount and guard chassis is constructed from rectangular aluminium bar and as drawn it uses 80mm x 15mm bar. This would clamp nicely into the 30mm diameter clamping slot in the Wabeco leadscrew housing which is 15mm wide. Unfortunately the nearest that I could find was 3in. x 1/4in. so I purchased a length of 20in. (or 500mm) from Mallard Metals, (www.mallardmetals.co.uk) to make the 4 main pieces A,B,C & D. Sorry for the mixture of metric and imperial measures but imperial was all I could obtain. I shall try to describe construction from 80mm x 15mm even though I adjusted mine for the imperial bar.

A clamping piece (A) clamps onto the machined clamping recess on the leadscrew housing and onto the end of this clamping piece is fixed another aluminium bar (D) which lies parallel to and behind the leadscrew. On the outer end (right hand end) of piece D is fixed a 192mm long aluminium bar rounded off at both ends (C) which supports the motor and encloses both pulleys and drive belt.

Thus this piece acts as motor support and is an integral part of the guarding arrangement. On the left end of part D is fastened a shaped aluminium bar (B), which is situated behind the motor (to the left) and acts to support the rear of the motor chip guard. I decided to fully enclose the motor in this way as stepper motor casings are magnetic and therefore attract steel swarf. I dislike holding aluminium together by tapped setscrews, but I used 1/4in. Whitworth for those setscrews holding the frame together as the coarser Whitworth thread is better in aluminium than the finer metric threads.

Marking out and machining part C

Out of the four aluminium bar parts I made part "C" first as I like to do the difficult bits first and once this is made and the motor mounted on it, you can prove that the dimensions in the drawing are suitable for your machine, pulleys and belt. Start by sawing off 192mm from the aluminium bar and milling one end truly square as a reference end. Mark out a centre line down the length 40mm from the edge – or 38.1mm if you are using 3in. wide bar. Then mark points 40mm 120.5mm and 151mm from the reference end for the leadscrew centre, the motor shaft centre



11. Boring the pulley cut outs.



12. Cutting the 9degree belt slots.

and the centre of the rear curve respectively. Whilst doing this you may also mark out for the four 5mm fixing holes for attaching the motor, 97 and 144mm from end, (later to be blind drilled 4.2mm and tapped 5mm x 0.8).

The specification sheet from Arc Euro Trade shows these holes to be spaced at 47.14mm centres, which must make sense to some designer somewhere, but I drilled them at 47mm centres with no problems. I also drew the curved ends with dividers (40mm radius for 80mm bar or 38.1mm for 3in. bar) and marked out r17.5mm and r30mm circles for the two pulley cut-outs. You may also mark out the position of the two holes for fixing to part D. These are at points 84mm from the end, but I waited until parts C, A and D were completed before drilling in order to prove the layout dimensions.

Remember that the marking out side is the INSIDE side of the finished piece and therefore DO NOT countersink these fixing holes, which are countersunk on the OUTSIDE edge. Finally mark out the two lines shown at 9deg. to horizontal from pulley to pulley representing the outside of the belt. Note that these are not tangential to the pulley cut-outs as the belt runs at a smaller diameter than the pulley flanges. If you are using 3in. bar and put the setscrew holes 10mm from the edge BEWARE. The countersink holes are very close to these 9deg. lines and the motor fixing screws are also very close. Careful marking out and checking pays off.

The method for forming the end curve depends upon your equipment, but I proceeded as follows :- Make, or find an existing, mandrel to fit into the centre of your rotary table. I have a box of these so I selected a 1/2in. mandrel. Drill through part C at the point 40mm from the reference edge at the diameter of your mandrel (1/2in.) for centring on the rotary table and drill partially through from the inside at the 151mm mark for the centre point of the rear curve. You could drill right through if you wish but it would leave you with a hole of no apparent use on the outside of the finished product.

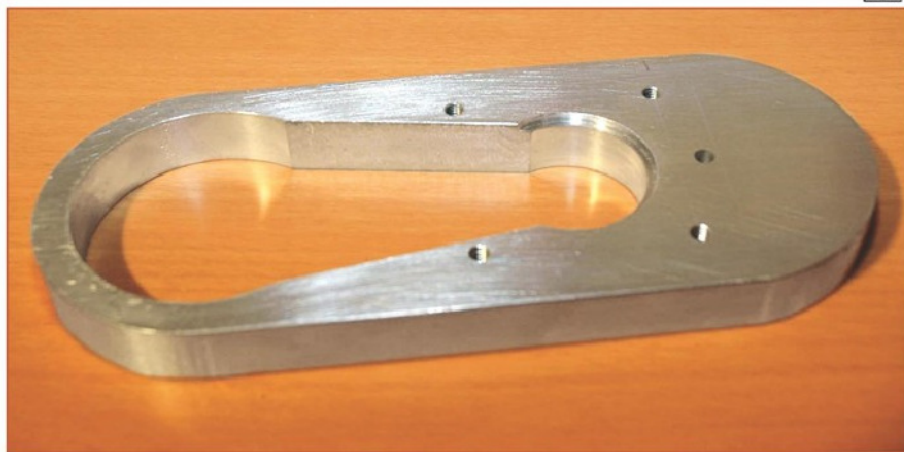
Insert your mandrel into your rotary table and mount the bar for part C on the table with one of the centre holes (those at 40mm or 151mm) located onto the mandrel spigot. i.e. at the centre of the

table. Pack the aluminium bar up from the rotary table surface by clamping onto some 1/2in. strips or by clamping onto some MDF. Pack so that the bar can be rotated through the full 180deg. without the packing or clamps interfering with the cutter path. A 6in. table is perfectly capable of this. Round off the end of the bar by rotating the bar against a 1/2in. endmill set for the full depth of the bar and taking shallow cuts making sure that you rotate the rotary table in the direction that does not cause "climb milling" i.e. cutter resisting the rotation of the rotary table. Gradually move the rotary table nearer to the cutter until a 180deg. rotation of the table results in a smooth arc from one side of the bar to the opposite side as shown in photos 11-13. Once both ends have been rounded off, set up part C on parallels in the machine vice with the leadscrew centre point (40mm from the end) directly under the milling head and take out the majority of the 60 mm diameter hole with a hole saw. Then finish the hole with a boring head bringing it up to 60mm diameter. This I found to be about the limit for the Wabeco spindle but it coped quite well using light cuts. Move the table 85mm left in the x axis and cut the 35mm hole for the motor pulley in the same way. The motor has a 38mm dia. locating ring on the fixing flange so while you have the boring head all lined up over the hole, bore a recessed circle of 38mm dia and 2mm deep making

this a nice locating fit on your motor. If you haven't already drilled and tapped your motor fixing holes (12 mm deep for 5mm setscrews) now is a good time to do this.

Now to take out the centre piece where the belt runs. Mount the part at 9deg. to the X direction using the swivel vice if you have one. Using a 1/2in. slot drill take out the first line of the belt, rotate by 18deg. and remove the second line as shown in photo 12. Check your belt and pulleys on the bench but in my set-up the centre line of these cuts were tangents between a 26mm radius at the leadscrew end and a 14mm radius at the motor pulley end. If you get it right first time, then your belt will miss all the bolt holes and you will have a nice triangular centre piece to insert later as part of the belt guard. Keep this seemingly waste part for refitting later. Part C should now look like photo 13. Attach the motor and hold the part in position over the leadscrew pulley with the belt held tight to ensure that all angles and dimensions are correct. Saw off the shaft from the rear of the motor with a hack saw (unless you wish to retain it and have it poking through part B).

The next part of this article will cover the remaining mechanical components, then conclude with the details for the control electronics. Meantime, I am available by telephone to help any would be constructors on 01282 435843 (Burnley Lancs).



13. Part C after machining.

MYFORD VM-E CNC RETROFIT 1



1. The starting Point. Myford VM-E

Background

This conversion had its beginnings in various articles by Dick Stephen. I make clocks in a rather less skilled manner than he does and appreciated the idea of making some of the chores easier. I also have long had an interest in modifying tools and enjoy attempting something new and as I am retired I can afford the time to learn by experience. Hmm!

The milling machine in question is a Myford VM-E which shares a lot of external similarity with a range of imported vertical milling machines. **Photo 1.** The detail will be different in each case but I suspect that several of the lessons I learned would be relevant to these other products. I have become very appreciative of the qualities of my Myford mill over the five years or so during which I have been its owner. It is accurate and rigid and the variable speed is very handy too; so it was with some trepidation that I began to plan a CNC retrofit. In view of this I set a design criterion that any change should be fully reversible.

Apart from anything else, I want the machine to have the best resale value possible when I am no longer able to enjoy it.

I planned from the beginning to use the electronic control and software, which Dick has clearly described and so I shall confine this article to the mechanical modifications which would enable the Myford to benefit from CNC operation. The VM-E is a different beast from the X-3 and I began by listing some design considerations:

- there is limited clearance under the table and y-axis carriage for the 25mm acme leadscrews to be replaced by ballscrews,
- the x and y leadscrew bearing arrangements would need rethinking,
- the rise and fall knee together with the separate worm driven quill require a different approach to fitting a ballscrew downfeed for the x-axis,
- the size of the machine (the table weighs in at 110lbs) might require more substantial stepper motors than the X-3,
- the ballscrews and nuts should be removable for servicing without dismantling the slides,
- the lever operated down feed for the quill should still be available for drilling.

On the plus side, all the Myford's slides had been scraped from new and I was confident that smooth movement throughout the range of travel could be achieved.

Ballscrew selection

Some careful measurements showed that the largest outside diameter of ballnut would be around 28mm in order to leave enough space for a housing in which it could be mounted for the x and y axes. **Photo 2.** Immediately this showed that there would be no way that a 25mm screw could be fitted to match the diameter of the original. In fact 16mm shaft diameter seemed the maximum feasible. I am quite happy that this will cope with all my clock making work, especially as the ballscrew is significantly more efficient than an acme of a similar diameter but I do make other demands on the machine. I live in rural North Devon and jobs appearing at the door have ranged from the mouthpiece for

a French horn through to emergency repairs to a silage harvester. So I needed to know some load figures for any ballscrew I might fit. After some frustratingly expensive quotes from the big names I eventually lit on a supplier via the internet. Prices were competitive and rather surprisingly Marchant Dice turned out to be just down the road in Torrington. This company provides a range of ballscrews and nuts which are suited to the retrofit market. Questions to Kevin Marchant were promptly answered and my query about the maximum axial load produced **Table 1** which makes interesting reading.

I have done no physics since leaving school but even so I was reassured that 16mm diameter screws with 2.5mm balls

In this first of two articles, Peter Edwards describes the addition of ballscrews to the X and Y axes of this popular machine.

would be more than adequate for the work I do and there would be no percentage in trying to squeeze in the 4.00mm pitch screw. Other data indicated that I could expect a working life of 89,000 hours under average conditions!

Further enquiry discovered that the ballnuts had a facility for adjusting backlash as well as simple optional swarf seals. Delivery time was quoted as three days and precisely that time after ordering I collected the kit from Torrington. **Photo 3.** Among the data provided on the Marchant Dice website was the recommendation that ballscrews should be supported at one end by a pair of angular contact bearings and at the other by a single ballrace within which the shaft is able to make a small amount of axial movement, presumably to allow for adjustment of the angular contact bearings and/or temperature effects. Inspection of the Myford showed that the Y axis was fitted with a pair of ball bearings at the front and nothing at the rear of the shaft. The X axis had a single ball bearing at the left hand end and a needle roller on the right where the powerfeed was mounted. Like Dick Stephen, I intended to make turned extensions for the ends of each ballscrew and so could choose bearing sizes to fit the cast housings and then turn the extensions to fit the internal bearing diameter. The Marchant Dice eBay site came up with two pairs of angular contact bearings to fit these housings at a fraction of the price quoted by my local bearing supplier so I was in business. I realised that I would have to make up housings for the single bearings at the opposite end of each shaft.

Fitting the Y axis screw

There are three main components in the table assembly on the Myford. Firstly the knee, which is raised and lowered by a vertical screw. The top of the knee is a dovetail slide on which a carriage moves to give the y travel. The Y axis screw is held in bearings in a casting bolted to the top front of the knee and turns in a nut attached to the underside of the carriage. **Photo 4.** The top of the carriage is another set of dovetails at right angles to the y axis. Between these a second nut is located within which the X axis screw

Table 1**Ballscrew Assembly Loading Specifications**

Pitch (mm)	Screw Diameter	Axial Load (N) Dynamic	Axial Load (N) Static
2.5	16	3500	5500
4.0	16	2600	4200
5.0	16	4600	7200
5.0	25	5100	12600

turns. The table rests on this upper dovetail and the x axis screw is supported by bearings located in cast housings secured to each end of the table. Replacing the bearings in the y axis front casting was straightforward. The original bronze acme nut was located by a turned spigot fitting a hole bored in the carriage casting. Careful measurement enabled a steel housing to take the ballnut to be bored in the 4-jaw and an accurate spigot to be turned on one face. **Photos 5 and 6.** There are several critical right angles here which need checking and rechecking during setup and machining.

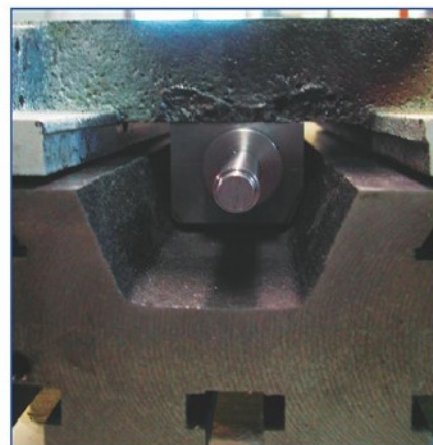
The ballnut is held in the housing by an M6 grub screw. The end of the grub screw is turned down with a slight taper to be a tight fit in the hole provided in the nut. A second grub screw needs to be fitted in the housing to locate over the backlash adjustment point on the nut. A third hole is needed to allow lubrication of the nut. Careful thought is needed to locate these where they will be accessible once the components are reassembled. In my case there was reasonably easy access from under the knee for the first two screws but I had to drill an access hole in the side of the knee casting so that an oil can could reach the lubrication point. **Photo 7.**

It would be possible to do most of this work by removing just the table and carriage but the fitting of a rear bearing for the Y axis is impossible without the removal of the knee. The Myford has some very substantial castings and a bit of planning is advisable before beginning dismantling. The table is best removed by sliding it on to a substantial support (a Workmate is ideal) placed beside the machine. If the leadscrew and gibs are

removed first then no undue force is applied where it should not be. The knee has to be lifted off the top of the dovetail slide on the pillar after moving the head round to one side. This is straightforward once the table and carriage have been removed as the knee raising screw and its bearings are then revealed. Knee lifting is definitely a "three Weetabix job".

Once the knee was on the bench the awkwardness of fitting a rear bearing for the y axis became apparent. The inside of the casting is rough and does not lend itself to a precise location for the bearing. Eventually, after cleaning up the worst of the flash, I was able to make up a 6mm steel plate which was fixed to the inside of the back of the knee with capscrews, the plate being fitted with M5 grub screws at each corner to act as adjustment jacks so that it could be set truly perpendicular to the y axis. **Photo 8.** This was most easily achieved with the machined back of the knee resting on a flat surface and a DTI mounted in a stand resting on the same surface. By sliding the DTI and stand around on the surface and adjusting the M5 screws accordingly the plate was made parallel to the back surface of the knee and therefore at right angles to the Y axis. This was just one of the times I had cause to be grateful to Myford for the accuracy with which machined surfaces on the various castings are set out in relation to each other. A simple housing was turned for the bearing which would eventually be bolted to this plate. **Photo 9.**

It was time for a trial assembly with sleeves fitted to the ballnut housing and to the front bearings. In each sleeve a concentric $\frac{1}{8}$ inch hole had been reamed. A length of $\frac{1}{2}$ inch silver steel then allowed

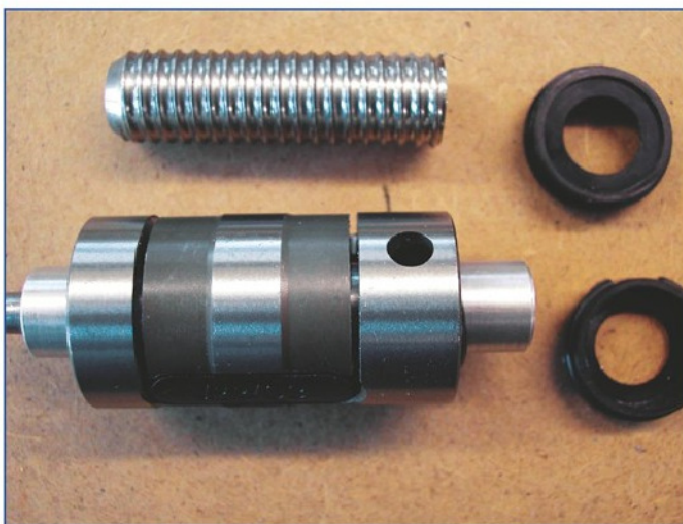


2. Not a lot of room. An upside down shot of the table and carriage (it was on the bench during fitting). The replacement ballnut housing is shown with a steel plug carrying a $\frac{1}{2}$ inch silver steel rod which was used for alignment. The critical dimension is that between the top of the bore and the surface of the housing where it faces on to the carriage.

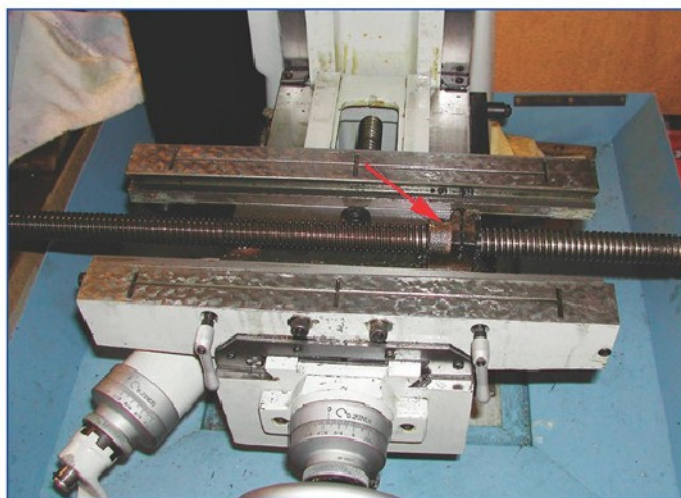
the various components to be lined up and checked for free sliding movement. At the same time the rear bearing housing was located on the back plate and the securing screw holes marked, drilled and tapped. There are quite a few places where screws have to be located with some precision and I made a set of silver steel stubs with conical points to be a close fit in the 5, 6 and 8mm holes of the various components. A tap on the end of the appropriate stub then left a fine mark, which could be picked up with a punch or centre drill before drilling tapping size.

I had decided that the removal and replacement of the screws and nuts should be made possible without major dismantling and it seemed a good idea therefore to make intermediate register plates to fit between the castings, which held the main bearings for each axis and the castings to which they were secured.

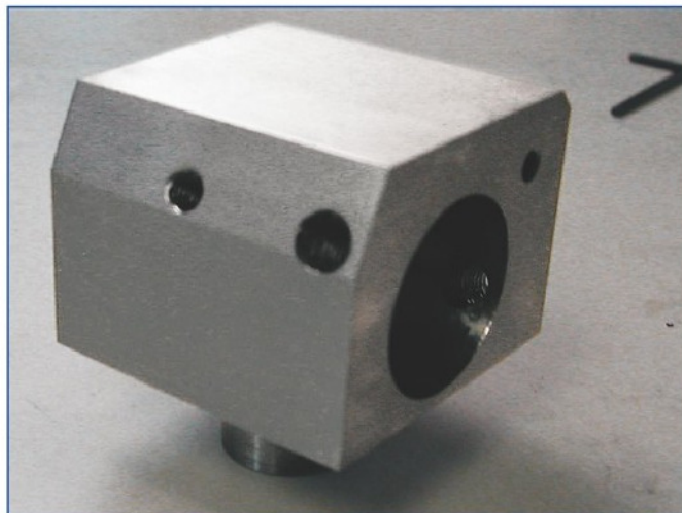
Photo 10. Each of these plates took the form of a 6mm steel plate cut to the appropriate outline, but larger than the



3. A small stub of 16mm x 2.5mm ballscrew, ballnut on its keeper and two swarf seals.



4. The carriage with the table removed to show the 25mm Acme screw and the bronze nut, arrowed. Myford's scraping is well shown here too.



(Above left) 5. Boring the ballnut housing in the four-jaw.

(Above right) 6. X axis ballnut housing showing the corner chamfer needed to fit under the table. The two holes on the chamfer are for the ballnut locating screw and the backlash adjustment screw. The small hole in the end face is for lubrication and lines up with a cross-drilled hole connecting to the bore.



7. Oval lubrication access in the knee

bearing castings. In this extra area of the y axis plate two 6mm holes were drilled for screws to locate the plate on the knee, while 6mm dowels were fitted to the front of the plate to locate the bearing casting precisely. The set up sequence was as follows. The bearing casting was located on the dowels of the register plate and then both were fitted over the axis while the two 8mm fixing screws for the bearing casting were fitted. The whole assembly was then centred to give free sliding movement to the carriage while the 8mm screws were nipped up. 5mm diameter holes were then drilled using a power drill into the knee casting located by the

"extra" holes previously drilled in the register plate. Once tapped, 6mm cap screws could be fitted into these holes, which then held the register plate securely. Subsequent dismantling left the register plate in place so that on reassembly the bearing casting could be relocated on the dowels thus aligning the bearing correctly. This has turned out to be well worth the extra work. Photo 11

Fitting the X-axis

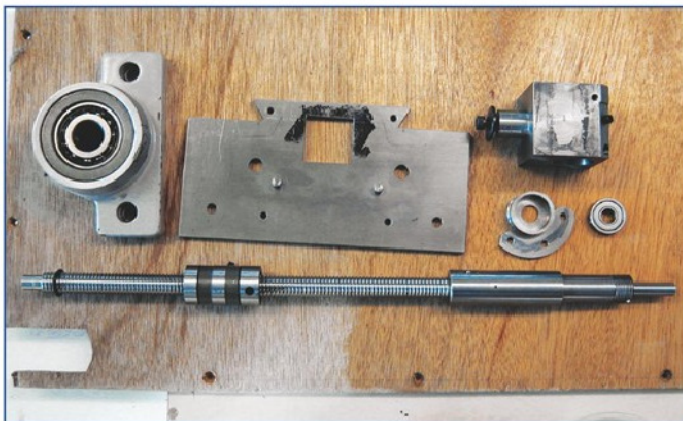
The set-up of the bearings and nut housing for the x-axis was very similar and



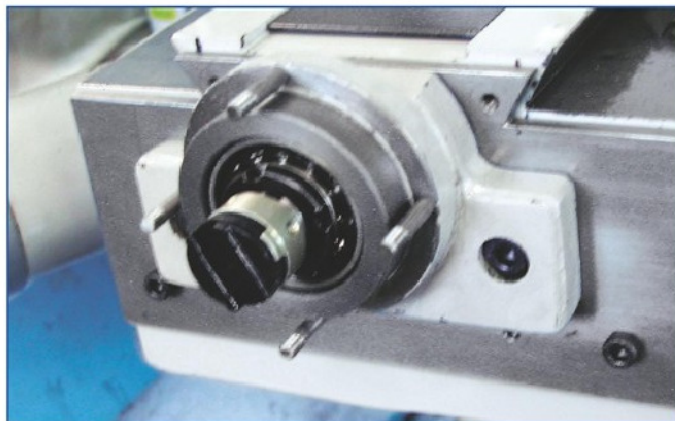
8. Knee tapping! My pillar drill is at its limit here to drill and tap the four fixing holes for the levelling plate which locates on the inside of the knee and takes the rear bearing housing for the y axis.



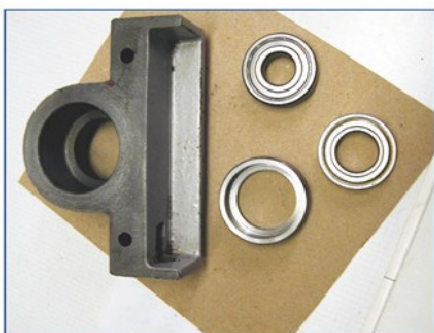
9. The knee casting showing the rear bearing housing for the Y axis mounted on the levelling plate. Two levelling grub screws and two fixing cap screws for the plate can just be seen above the bearing housing.



10. Y axis components, before cleaning up. The mounting plate for the rear bearing housing is not here. It was already set up in the knee casting.



11. Y axis, showing the bearing housing, studs to locate the stepper motor tube and half of the Oldham coupling.



12. X axis left hand end bearing housing, inner sleeve and two ballraces. (At this stage I did not have the angular contact bearings).

made easier by placing the table upside down on the bench and then assembling the various components to it with the carriage removed from the knee for this purpose. There is very little space for the nut housing here and careful thought had to be given to the location of the nut locking screw and backlash adjustment so that they could be accessible.

The left hand bearing casting originally had just one ballrace. Fortunately, the

inner face of the casting had been bored concentrically although for no apparent purpose. While muttering another prayer of gratitude to the splendid people at Beeston, it was no great task to turn up a sleeve for this inner bore to make it the same diameter as the outer one and fit the pair of angular contact bearings.

Photo 12.

Once again, I fitted a register plate between the casting and the table. This time, however, I did not use dowels. Instead, I Loctited a collar into the bored hole for the axis in the register plate. The outside diameter of this collar was then turned to be a good fit in the bore of the casting in which the bearings had been fitted. **Photo 13.** This provides a neat and positive location. The right hand end of the axis is supported in a needle bearing courtesy of Arc Euro Trade. This bearing is pressed into an aluminium housing made to locate on Myford's end casting. **Photo 14.** Provision has been made in the fittings at each end of the X axis for a neoprene washer to be fitted within the casting to act as a swarf seal.

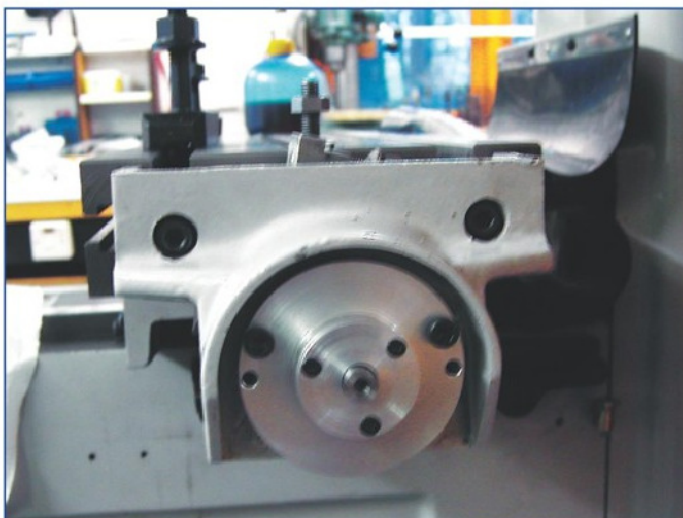
Photo 15 shows the work on X and Y axes completed.

Work on the Z axis will be covered in a follow up article, but meantime, if anyone

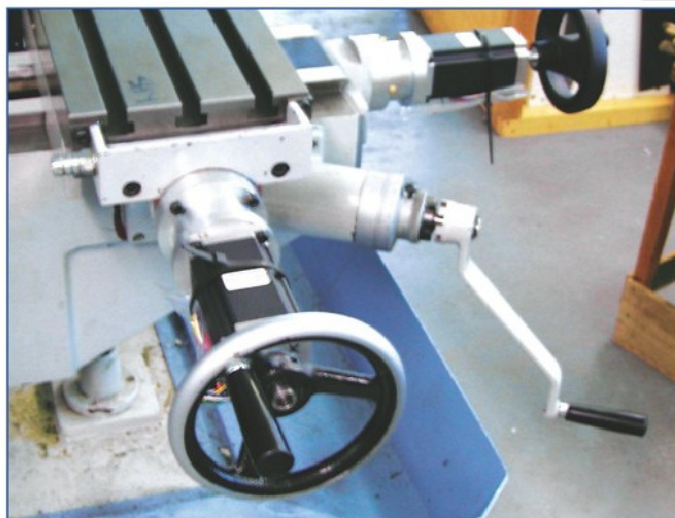


13. X axis register plate, boring the ring on which the bearing housing will locate.

wishes to discuss my approach they are welcome to contact me via e-mail at edwards@fullacott.plus.com



14. X axis, right hand bearing housing. The two blank holes locate on register pins in the grey casting behind.



15. X and Y axes complete.

TRADE COUNTER

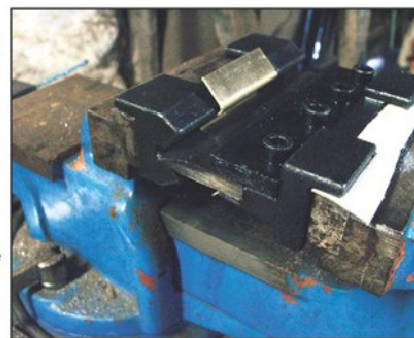
Please note that, unless otherwise stated, Trade Counter items have not necessarily been tested. We give news of products and services which have been brought to our attention and which we consider may be of interest to our readers.

Warco New products

Three new items have been announced for forming sheet metal, a Mini Bender, Mini Slip Rolls and a Vice Brake. Both the Mini Bender and the Slip Rolls have a nominal width capacity of 12in. or 300mm and are intended for light sheet material of up to 20g (1mm) and up to the width capacity, although in each case, narrower material of greater thickness may also be handled. Cost of each of these is £89.00. My guess is that these will find favour amongst enthusiasts working in smaller scales probably below one inch to the foot, particularly in model rail circles.

The third item is a Vice Brake, a punch and vee tool for use with a bench vice, and available to suit vices having 4in. 5in. or 6in. jaws. The punch blade is segmented so that the four inch device, which I have been able to try out, can be configured as 1in. 2in. 3in. and 4in. as supplied. In addition, if needed, the blade might be cut to give a specific length. Setting up is a very quick procedure – open the vice, locate the punch and vee, then get on with the bending. The first clever bit is that the parts of the tool are held in place on the vice by powerful magnets, so no fiddling about trying to hold parts of the tool and the work with one hand while winding in the vice with the other. The second is in the form of the Vee, which has a base slot a little wider than expected. The result is that thicker material can be bent up to 90degrees in the main Vee but thinner may be formed to more acute angles in the base slot. The accuracy of work produced will no doubt depend on the condition of the vice, and here I found that the addition of a thin piece of card packing gave more precise tool alignment. It was then easy to produce nice crisp bends in a bit of scrap sheet brass. Accurate positioning of bends demands accurate location of the work. In standard form working to scribed lines will give good results. For those demanding tighter tolerances, it should be straightforward to drill and tap the vee to accommodate a couple of

bars to carry a position stop. This would bring a basic budget tool up to the realms of quality fly press work. Prices for the Vice Brake variants are 4in. - £15.00, 5in. - £16.50, and 6in. - £18.00. For more details on these and other Warco products phone 01428 682 929 or visit www.warco.co.uk



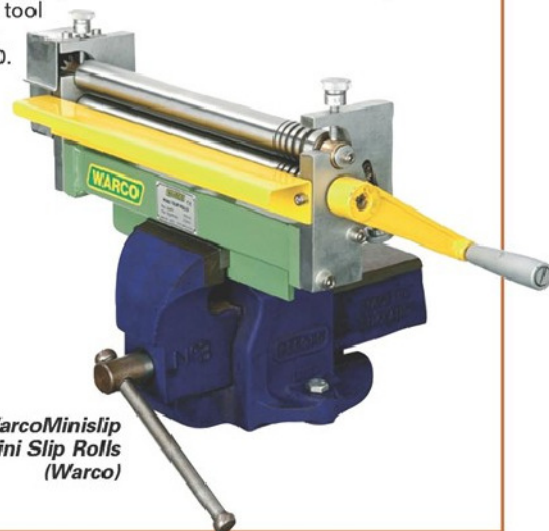
WarcoVB1 Vice Brake installed and bending sheet brass



The Mini Bender from Warco



**Warco VB2
With thin material,
bends beyond
90deg. are possible**



**WarcoMinislip
Mini Slip Rolls
(Warco)**

MEW Index

The index for MEW was traditionally maintained by Harold Hall and a year or so ago, the baton was taken up by Barry Chamberlain. **The Index is currently available in DOS format from Barry at CAHW, 43, Waller Drive, Banbury, Oxon, OX16 9NS Telephone 01295 255 744. Price is £6.00 for within the UK and £8.00 for non UK orders. Both prices include post and packing.**

Southern Springs & Pressings

Literature was recently received from this company outlining their capabilities in high quality springs, circlips, R clips etc. Whilst they do not have a standard range, they do welcome enquiries for small quantities as might be typical of the home enthusiast. A look at their website may be of interest to readers as not only are details of products available, but also their booklet "*Springs and Pressings*" which gives design guidance, may be downloaded free of charge. www.southernsprings.co.uk

L. S. Caine Electronic Services



The following announcement was received from Lester Caine:-

Expanding Range

"L.S.Caine Electronic Services is please to announce a major addition to the The Model Engineers Digital Workshop range. From the 1st of July, Shumatech, DivisionMaster and YADRO will be joined by the MicroMill CNC range. Jeremy at Quantum CNC is joining fellow users in having fun attempting to complete all those projects he has been saving for his retirement, and we will take over the sales and support of the Quantum CNC product range. We have no doubt, however, that Jeremy will continue to make his expertise available if required.

There is method in our madness, in that the increasing range of kits requires a number of new machined boxes and other components for which a CNC mill will be most useful, so in addition to selling the MicroMill we will be using it ourselves in our own production.

MicroMill

It is actually an interesting time to take over the MicroMill, since Microproto Systems who manufacture the Taig based MicroMill Desktop CNC Machining Systems have just announced an optional closed loop version of this machine, using a Mach3 interface in place of the earlier DOS based MPSPRO machine interface. We plan to upgrade the fully enclosed Industria version of the MicroMill to the closed loop machine since it will provide higher cutting feeds and potentially greater accuracy. We will retain the uncased 2000LE open loop machine for those of you on a budget, and are looking at the possibility of providing an upgrade to existing customers to the closed loop controller.

In order to provide a fully stand alone machine we will be adding an option of an ITX based small profile computer and LCD screen already configured with the relevant software. In the Industria version this will be fully integrated, so that when we deliver a machine it is just a case of plug in and switch on.

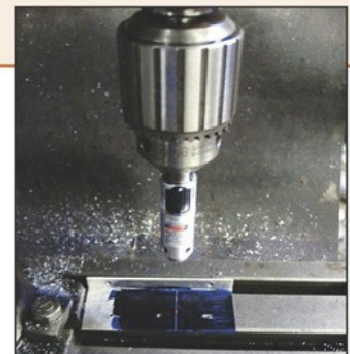
The MicroMill versions of DolphinCAD and VCarve will continue to be supported, and we plan to add a CNC Router table in the future, which will form part of the CNC kit packages which are currently in the pipeline. The switch to Mach3 for the MicroMill Industria fits nicely in our plans to provide a low cost 'DIY' system, using the same front end software as the fully enclosed and safety compliant Industria package.

Tacho Range

We have a new range of kits based on the designs from Tony Jeffree has just had published in Model Engineers Workshop. We will be offering complete kits with a machined case for the two different display options in the near future. Or just buy the bare boards and do it yourself. **Contact: Lester Caine - eMail: lester@lscs.co.uk Tel: 01386-852122 L.S.Caine Electronic Services 25 Smallbrook Road, Broadway, Worcestershire, WR12 7EP"**

Chronos Laser Centre

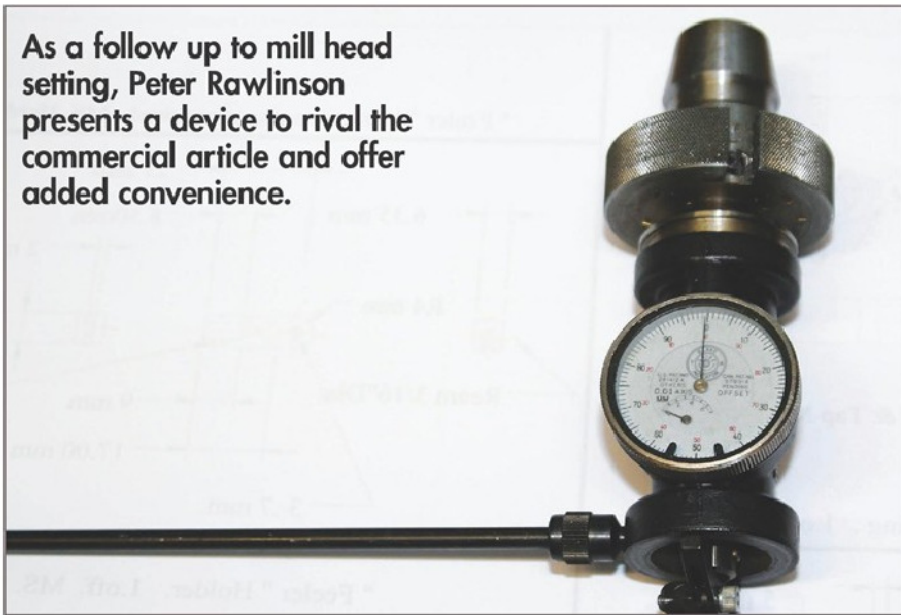
I mentioned this briefly in the last issue but at that point had not had the opportunity to give it a try. The leaflet suggests coating work with making blue, which will absorb some of the laser output making the dot appear smaller. To try out repeatability of positioning, I blued a piece of aluminium, scribed a single line, placed it on the mill table, then moved the table away and back in both directions, checking the position with the DRO. After a bit of practice, I was able to get within a couple of thou either way, probably more than sufficiently accurate for most work, and certainly better than scribing then centre popping then drilling. As it mentions in the leaflet, unlike "wobbler" type centre or edge finders this device is "direct" in that you do not have to the opportunity for error when allowing for half the diameter of the wobbler. One point to note, to ensure concentricity, the body and arbor are machined from one piece of aluminium. So, to preserve the accuracy, when mounting in a chuck, tighten the jaws only enough to grip. Price for this is £56.95 and UK mainland carriage. **Contact Chronos on 01582 471 900 or at Unit 14 Dukeminster Estate, Church St. Dunstable, Beds, LU5 4HU see the on line catalogue at www.chronos.ltd.uk**



Laser centre in mill directed at blued plate

CO-AXIAL CENTERING GAUGE

As a follow up to mill head setting, Peter Rawlinson presents a device to rival the commercial article and offer added convenience.



1. Commercially available "Blakes" gauge.

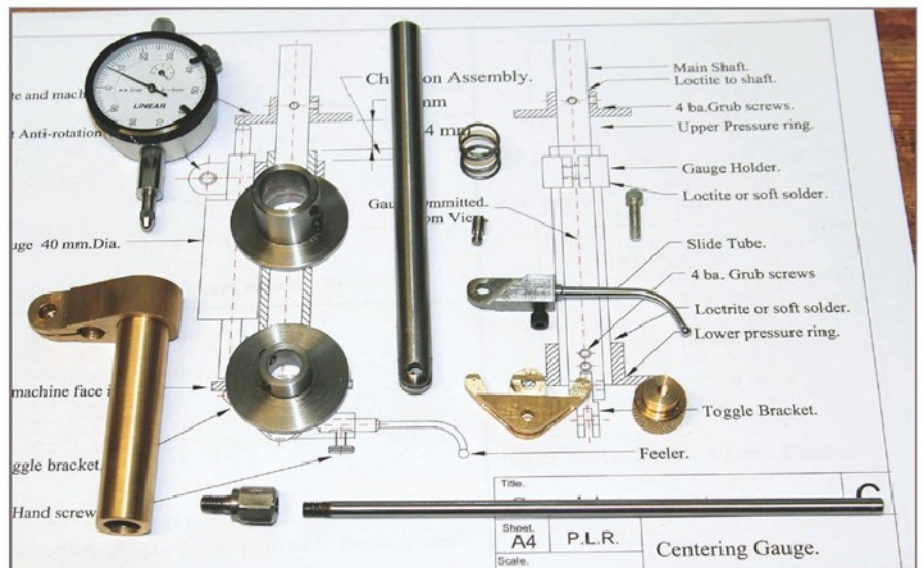
The grey cells are stirred

During that evening I wondered how difficult it would be to make a similar gauge in the amateur's workshop, and

decided that it was in fact very simple and excluding the value of the time would cost some £15.00 including a 1½in. dial gauge. (These are frequently on offer at under £10.00.) So I rang him back and said that I would design one and let him have a drawing, but the exercise then escalated so that I built the one in the photograph to



2. Home built unit complete.



3. Various component parts.

Background

Readers who have read my earlier article on adjusting the vertical setting of a mill head, (Issue 116) will have no doubt noticed that I use a device which was purchased many years ago called "A Co - Axial Centring Gauge" manufactured by Blakes. This is a professional gauge and the price nowadays reflects this; they are now in the order of £180-00 including the dreaded VAT. Typically when setting a mill head, or centering up a workpiece, a DTI is fixed in the spindle and rotated whilst in contact with either a surface parallel to the table, or the work. In order to watch the clock all the way round, you need to be able to look around from the rear or use a mirror. This unit saves the very awkward use of a mirror or the gymnastic contortions, as the gauge can be kept facing forwards whilst rotating the spindle.

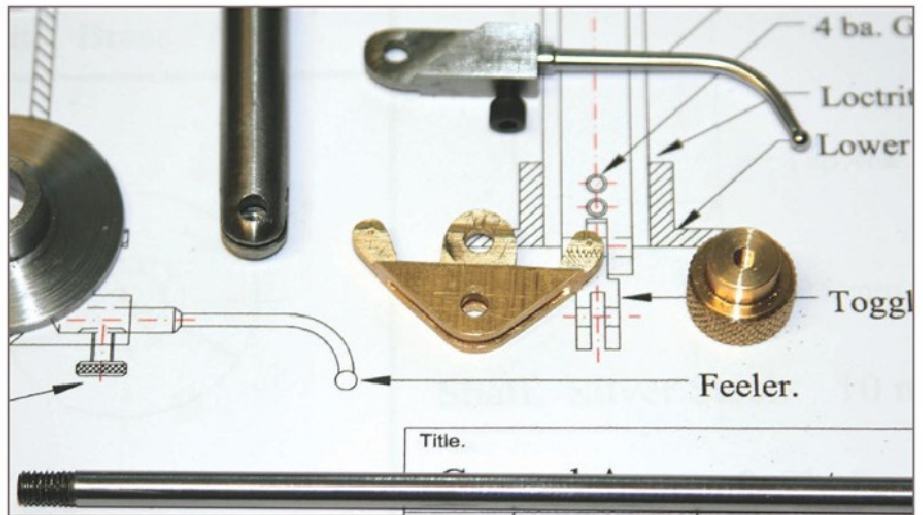
Soon after this previous article was published I had a phone call from Tony Skinner who lives near Glasgow asking about this gauge as at the time a well known tool supplier was offering the gauge at about £120-00, which is of course a substantial saving. He was wondering if this was the same article and I assured him that indeed it was.

prove the design and eventually wrote it up as this article.

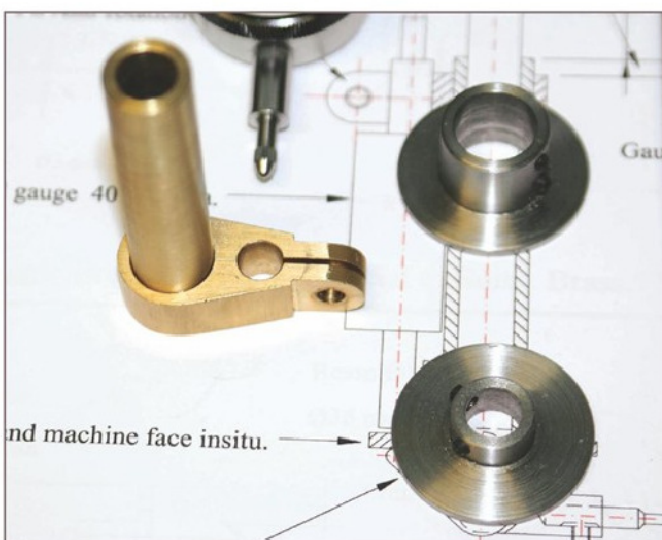
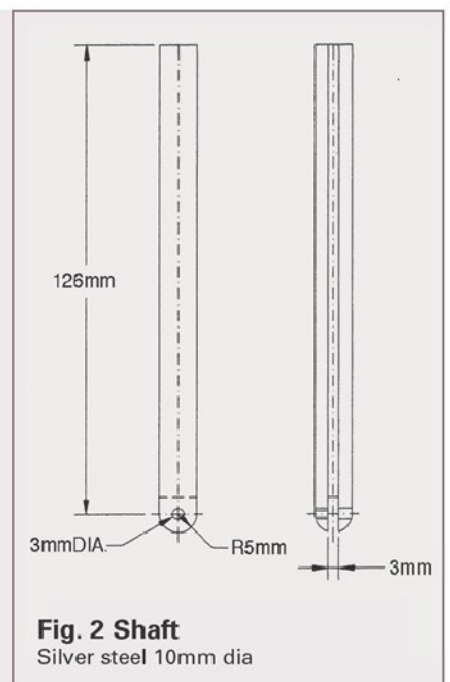
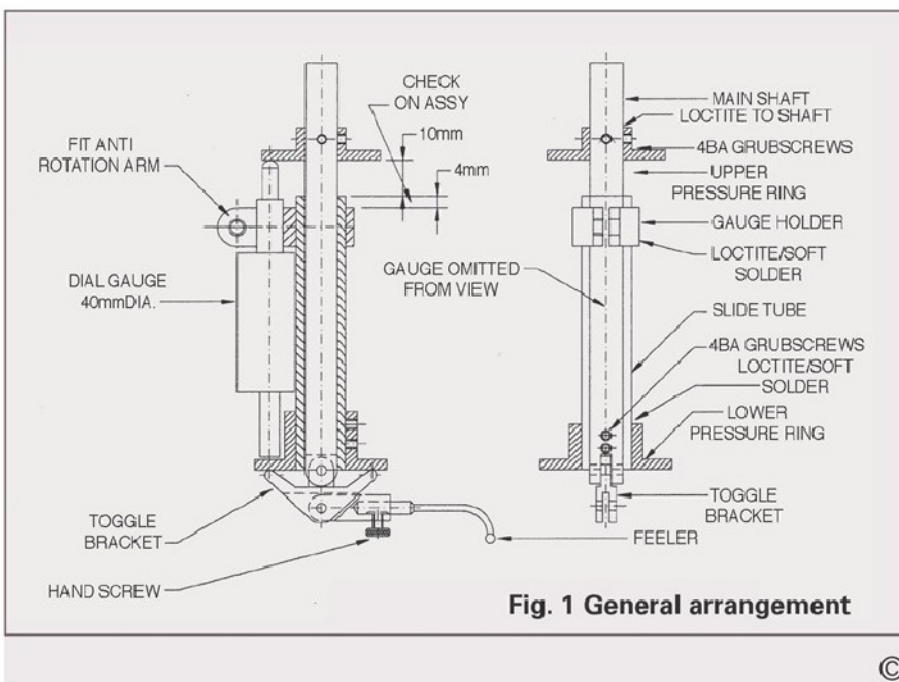
Of course some precision is required as would be imagined in a measuring instrument, but even this is less than I first thought. The shaft must be a good sliding and rotating fit in the tube (without play). This can be accomplished by either reaming the hole right through the tube or by fitting bushes at each end. The professional unit seems to have either ball bearings or needle rollers, and inside these a sliding bronze bush. (You gets what you pay for!) The other precision requirement is that the two rubbing pressure surfaces (for the gauge and the toggle bracket) must be parallel to each other and located



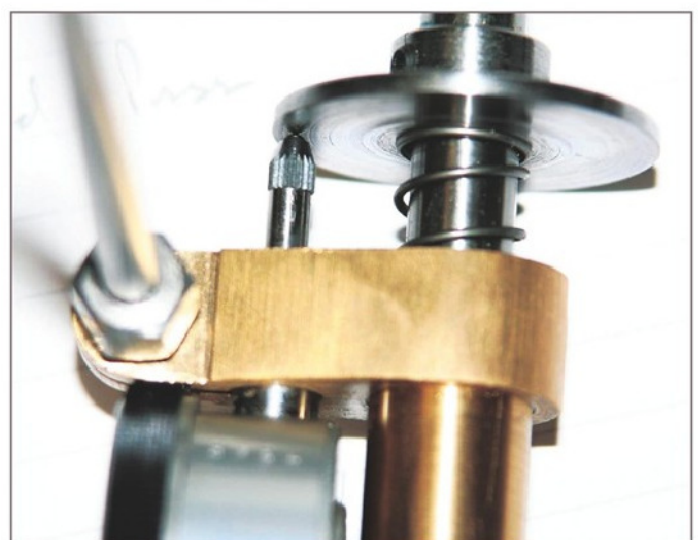
4. Detail of toggle and feeler holder (commercial item).



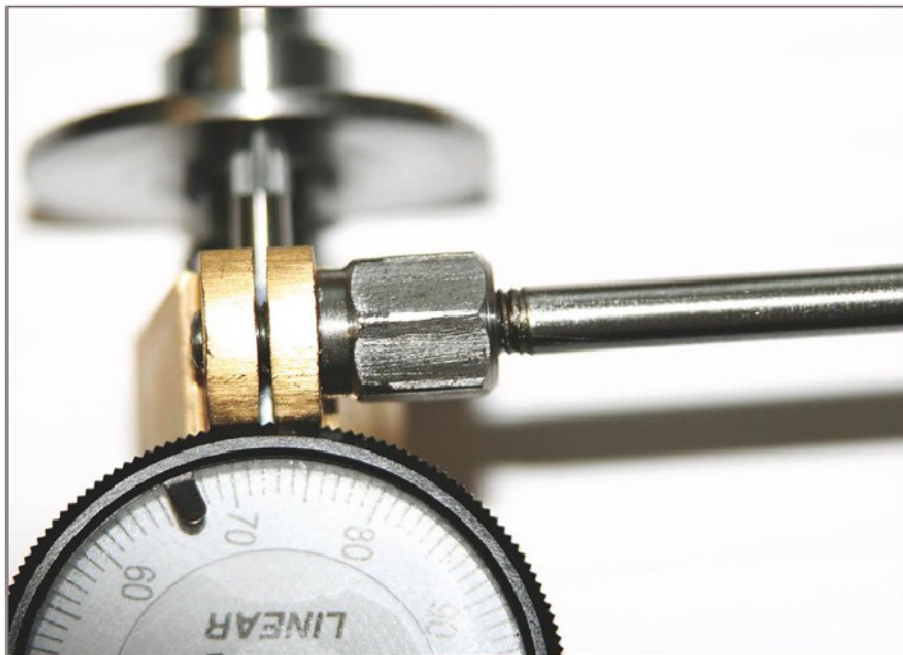
5. Close up of toggle bracket and associated parts.



6. Gauge holder detail.



7. Detail of return spring.



8. Anti-rotation bracket.

at 90degrees to the shaft and the outer tube axes.

Ensuring accuracy

This can be accomplished by mounting the pressure discs on the respective parts, (shaft and tube) and finish machining in

situ. This is best done by Loctiting the pressure disc in place, mounting the shaft between centres and then finish machining the pressure face. The final job is to cut the slot for the toggle. In the case of the tube, the bore should be completed first then mounted between centres and the outside diameter turned to finished size. This is then followed by fitting the lower pressure

disc, Loctiting into place and again finish machining the pressure face.

The gauge holder is held in place by a grub screw and there is nothing critical in the machining. The clamp screw has also doubled as the anti-rotation mounting. The gauges usually have either an 8 mm or similar imperial mount size but check before machining.

The only other parts are the toggle bracket and the "Feeler" holder and these are fiddly, rather than complex. For the first of these, I started with a piece of brass about 50mm wide by 1/4in. thick and long enough (about 100 to 150mm) to hold in the vice, then machined across the end of the material to give a datum. This was followed by machining the long slot in the toggle bracket using a 2mm slitting saw on the end. I then moved on to drilling and reaming the two holes. The material was positioned in the vice using an end stop and the top rebated machined. The part was then turned over (remembering to locate the datum end against the end stop) and the second rebate completed. This part was then cut off and the remainder completed by hand using a 1in. wide band sander. The "ends" of the toggle arm require polishing, as do the pressure faces on the discs.

Assembly and test

The whole gauge was then assembled and tested by simply revolving the feeler holder against the gauge. This test showed that the reading was a total of 0.02mm out, (0.01mm or 0.0004in. on the radius) I

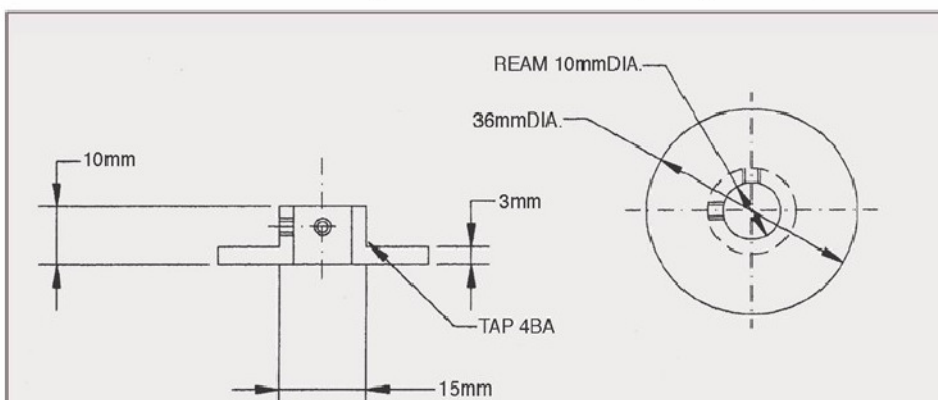


Fig. 3 Upper pressure ring
10ff. Material to suit. Brass or steel.

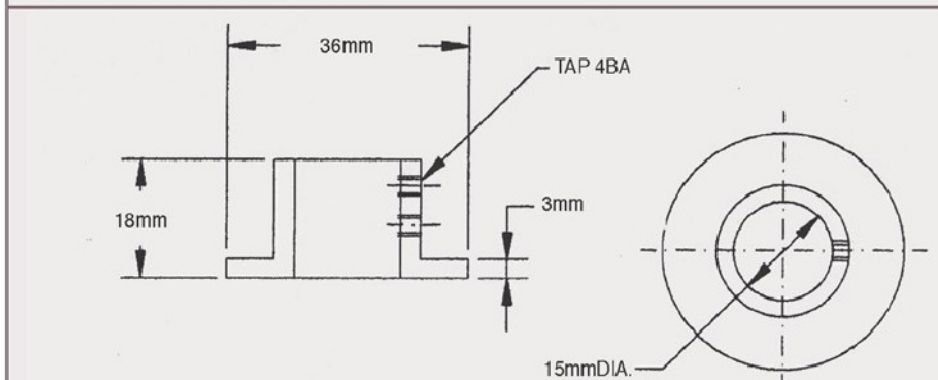


Fig. 5 Lower pressure ring

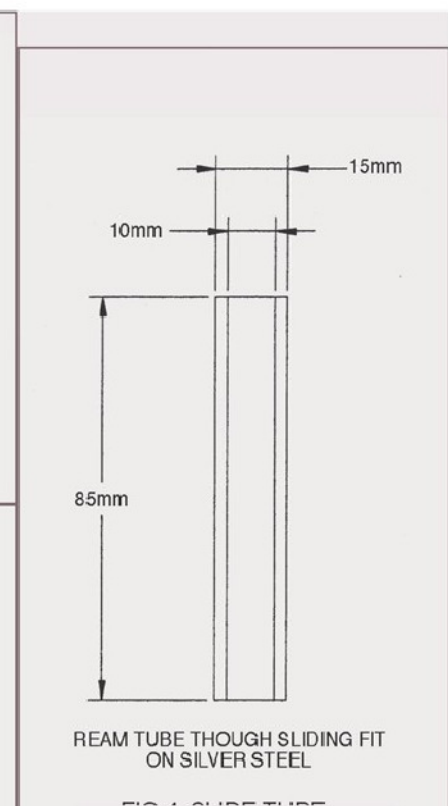


Fig. 4 Slide tube
1 Off. Brass or PH. Bronze.

would deem this to be very satisfactory as the tool is only used as a comparator and the adjustments are only used to reach the smallest variation. However I did wonder where this discrepancy came from and found that the silver steel shaft had a minute curve in it. I decided that the magnitude of the error did not justify the manufacture of a replacement.

This would of course be easily rectified if grinding equipment were available as the shaft and pressure ring could be accurately ground at one setting.

Operation

To use this gauge is simple. For an example let us assume we wish to cut a slot across a 20mm diameter bar and this is held vertically in the vice on the mill. We therefore wish to start by ensuring that the mill spindle is accurately centred on the work. First fit the gauge into the mill spindle and mount a stop for the anti-rotation arm. Then using the X & Y axis handwheels, adjust the material so that it lies approximately under the centre of the gauge.

Swing the feeler so it touches the outside of the material. Rotate the mill spindle and watch the gauge. By adjustment of the X & Y axes the "Variation" in the reading will diminish till no further correction is possible. Your bar is now central.

If dealing with unmachined material, it should be noted that (unless precision ground) most bars are finished by a rolling process and may not be perfectly round. Hence there will always be some slight variation.

If you have variable speed control going down very slow, then it is easier to carry this out under power (approximately 15 RPM.), but the first revolution should be done by hand to make sure nothing fouls or is under excess pressure.

Legitimacy

Of course the old adage of patents will arise again and this has been discussed at length in previous issues of the magazine. However, to reiterate: - As long as the individual is making only one for himself then this is perfectly legal.

I hope readers will look into the making as it does make mill centering and alignment very easy, especially if the mill backs onto a wall and there is no room at each end. One disadvantage, which does arise, is that the dial gauge cannot be readily removed for other uses. However, if "multi use" of the gauge is required, then a simple modification can be incorporated, and a supplementary sketch is included for those who wish to enjoy this added versatility.

As before I am happy to help if I can but phone only please and I will not ring back for obvious reasons. You can send an Email prior to calling (please give two days notice as emails are not checked on a daily basis). Email:-

www.piprawli61@tiscali.co.uk

Peter Rawlinson, Charing, Kent. 01233 712158.



9. Device in use on mill to set head vertical.

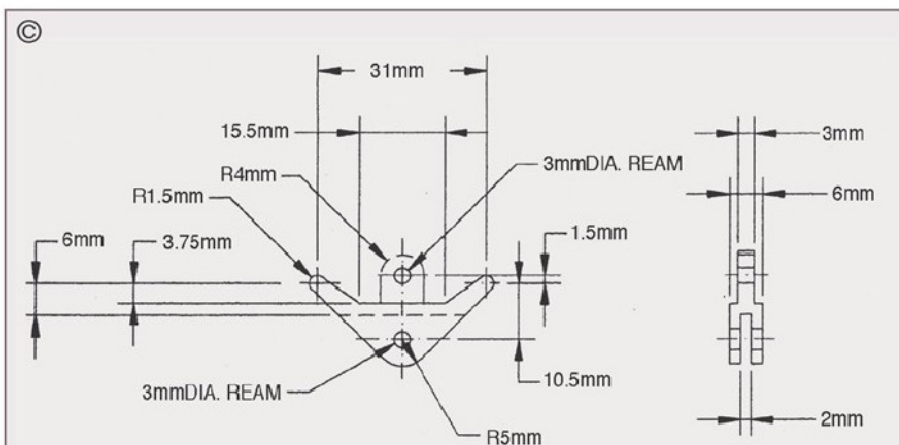


Fig. 6 Toggle bracket

1 Off. Material to suit.

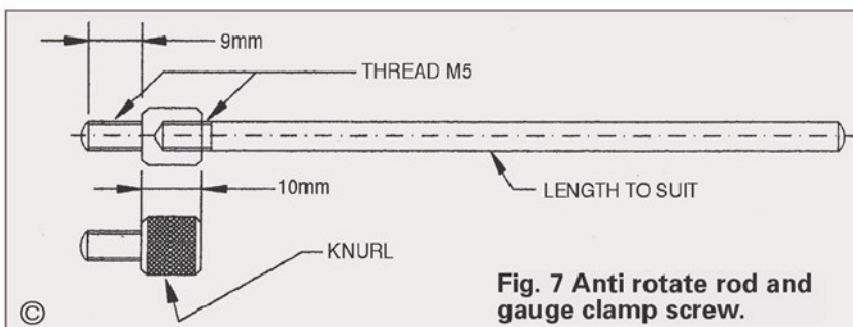


Fig. 7 Anti rotate rod and gauge clamp screw.

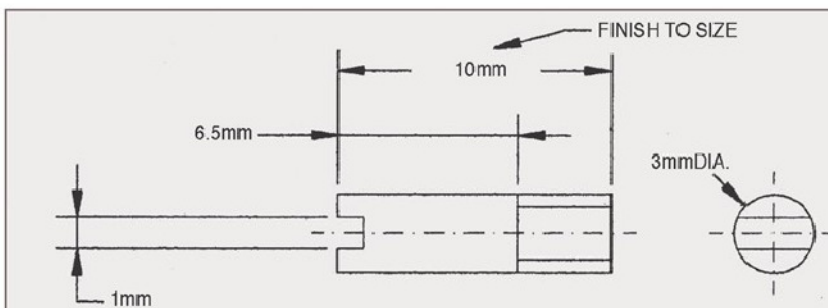
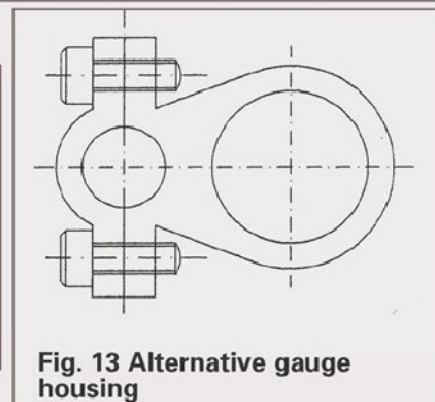
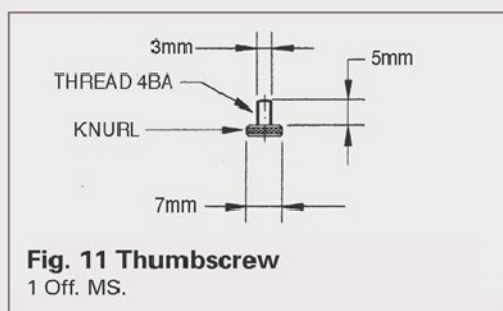
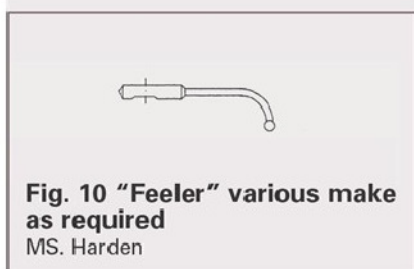
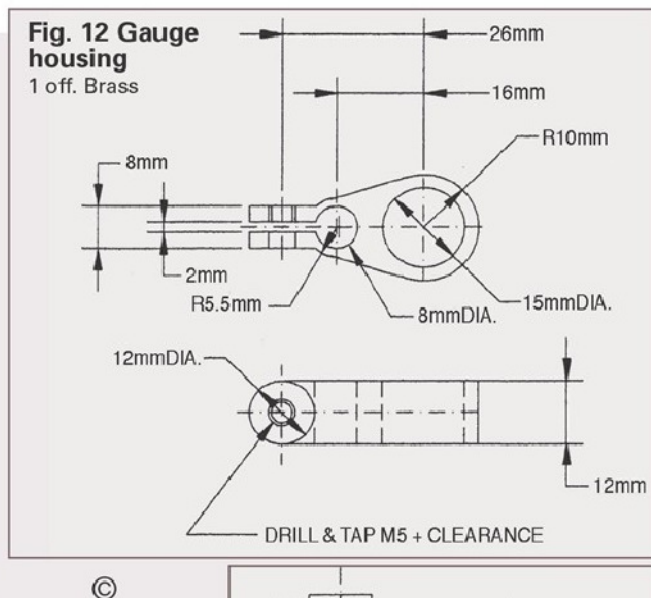
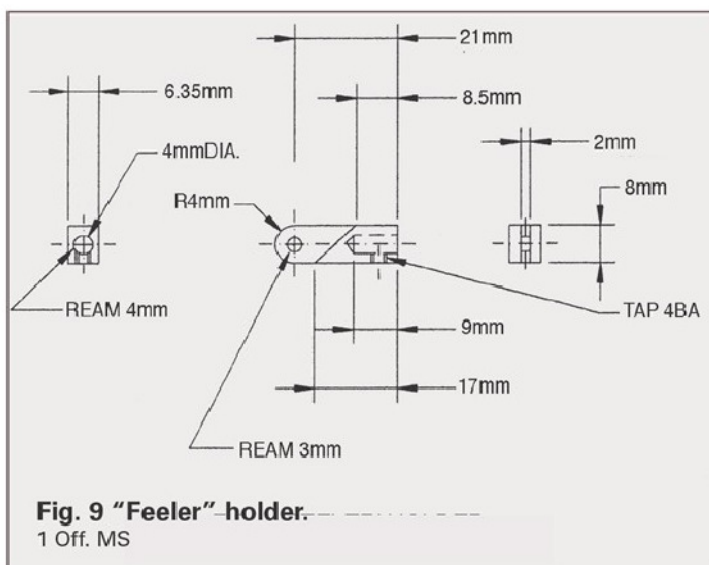


Fig. 8 Pivot screw

1 Off. Silver steel, Thread 4 ba.

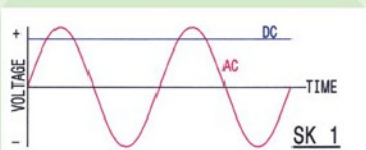


IN OUR NEXT ISSUE

Coming up in Issue No. 119 will be

Lever Locking Topslide

Alan Jackson describes his device seen at Sandown Park which allows radial and angular movement and also incorporates a withdrawal mechanism for screwcutting.



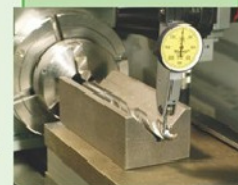
BASIC ELECTRICAL THEORY

Basic Electrical Theory

Harold Hall starts a short series giving guidance on electrical topics.

Chester 626

Mike Haughton reports after a year or so, of experience with the machine.



Drill Grinding With The Quorn

Joerg Hugel reports on further work to achieve high performance regrinds

Issue on sale 6th October 2006

(Contents may be subject to change)

Scribe a Line

Dick Gays writes:

Ken Thornton's article "Making Chuck Jaws" in MEW issue 116 is very interesting and certainly made me think. How many times have I changed my jaws, carefully cleaning them each time, and utterly failing to notice that the teeth are off set to one side as Ken points out. A quick check on my own jaws confirmed that this is indeed the case. Ken mentions that it had been suggested to him that this offset assists the tightening qualities when using the chuck. Depending on your interpretation of what that means, it is probably right, though I think a little more can be added.

If a line is drawn perpendicular to any tangent at the point it touches the circumference of a circle, that line will pass exactly through the centre of the circle. If two such lines are drawn in different places for the same circle, then they meet exactly in the centre of the circle. It might be thought that if the same thing was done with a scroll instead of a circle, the results would be the same but this is not so.

I have drawn a scroll as near as I can to the dimensions of Ken Thornton's chuck scroll, (in black, Fig 1) and added concentric circles (shown red) increasing in size by 3mm to represent the pitch of the scroll. From a point where the scroll curve crosses one of the circles a short arc is drawn and then two straight lines are added from the centre of this arc, to where it crosses the scroll curve and to where it crosses the true circle. On my drawing these lines are 3.9 degrees to each other. (see enlargement Fig 2). Drawing a line from the cross over point 3.9 degrees away from a line going from the same point to the centre of the circle shows a gap of 3.11mm from the centre of the circle. Note that repeating this process from at least two other places will prove that the scroll does not have a fixed centre in the way that a circle does, it all depends on which bit of the scroll you mean.

Could it be that the 1mm offset found by Ken Thornton is the average offset between the inner and outer part of the entire scroll? If my drawing is accurate which I doubt, it would indicate that if instead of using a square to find the offset of the jaw teeth, a protractor set at 93.9 degrees would find the centre?

No doubt someone who really knows will give a better explanation, but until they tell me I'll accept this one.

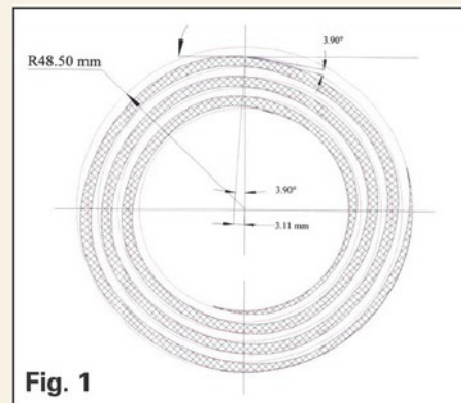


Fig. 1

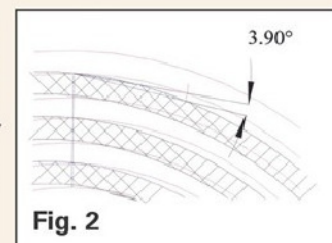


Fig. 2

Dyson Watkins writes

I was recently given an incomplete device which I guess has probably been a tool and cutter grinder. I have since attempted to find further details of it on the internet but to no avail. There is no maker's plate or other identification of any kind. Hopefully there may be someone amongst the readership of MEW who could cast some light on its origin.

The drive shaft carrying the grinding wheel is spring loaded. The spring is fitted between the



R.H. end of the bracket and the wheel mounting. I assume that the pulley was driven from a separate motor, that there was no provision for adjusting the cut incrementally but simply allowing the material to be removed by the spring action. The wheel has a very fine structure and so it could simply be a lapping device.

I would be interested to find any details of the missing parts or possibly obtain a copy of its user handbook; costs reimbursed of course.

Alan J Munday writes:

In Ken Thornton's article on "Making Chuck Jaws", he queries the reason for the offset. The answer lies in the mathematics. The scroll is an Archimedean spiral. The radius of curvature at any point on the spiral curve is equal to the radius at that point. This shows that the measurement of 27.5mm chuck jaw radius makes sense in fitting the curvature of the scroll at the inner radius.

The centre of curvature lies on a line at right angles to the tangent at the point on the spiral curve. This is not on the radial line to the point on the curve but is offset from it. The offset of the centre of curvature from the radial line is equal to pitch/2pi which in this case is $6/6.283 = 0.955\text{mm}$ which shows how good the measurement was.

So the offset is not to do with the tightening qualities but to make the radius on the jaw fit the curvature of the scroll. I see no mathematical reason for the other radius of the jaw being 48.5mm

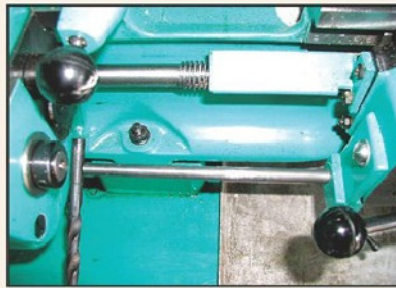
Dave Fenner comments;

Regarding Alan's final point, the 48.5mm radius allows clearance as the teeth move at the outer part of the scroll. He also tells

Mike Edwards writes:

The accompanying photographs illustrate the modifications I have carried out to my new Myford lathe.

I had fitted a door on my previous Super Seven to keep the storage area clean, on the inside of which, racks were fitted for the collet set and centres. However on the Industrial Stand, the opening is really too wide for fitting a door, so as you can see from the photographs I have fitted drawers. The right hand side of the cabinet was jig sawn out to allow me to make use of the area to the right of the central drawers, this is where my large drills and machine reamers are stored. All of the drawers are mounted on industrial runners and work very well, with little effort required to move them. The lower section of the cabinet has a "drop down flap" with storage behind for face plates etc. Also shown in the photos are my saddle stop arrangement, and saddle lock screw both as fitted to my previous machine.



me that he has been working on additions to his CNC Utilities software, and that a package will be available soon for cutting scrolls and chuck jaws by CNC methods. Note, that as with the earlier program, the software generates step and direction signals at the parallel port, for direct connection to stepper drivers. As with the earlier work, the package will be available for free download from Colin Usher's website.

In addition, I must thank Wolfgang Vogelbien who emailed from South Africa also to point out the reason for the offset.

Steve Scanlon writes:

Please find below a brief resume of the model engineering course we offer at Guildford College and which may be of interest to readers in our locality.

Time: Wednesday 13.30 to 16.30 or 18.00 to 21.00

Contact: Steve Scanlon, School of Technology, Guildford College, Stoke Park, Guildford, Surrey, GU1 1EZ

Telephone: 01483 448500 or College advice and information centre 01483 448585

Course name: Machine Shop Appreciation / Projects in Engineering

It is a course aimed at both beginners and more experienced metalworkers who

wish to use the extensive machine shop facilities at Guildford College. You need NO formal entry qualifications or previous experience as there is a large number of exercises that can be chosen from that take you through a series of simple steps allowing you to use lathes, mills and other machines proficiently. If at any time you wish to further your skills on a project of your own choice the necessary help and guidance will be given. More experienced students can work on their own projects at their own rate.

A broad sample of the work undertaken includes students working on model steam locomotives, traction engines and stationary engines, restoring classic cars and motorcycles and making and repairing machine tools.

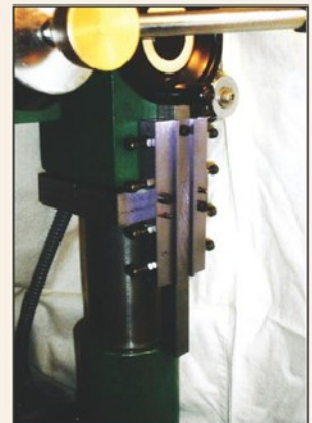
I will be delighted to hear from any MEW readers interested in joining our course.

Peter G Shaw writes:

Because of the limitations of my current lathe milling setup, I have been looking into the purchase of a small milling machine such as the Sieg X1 or X2, and their clones from Warco, Chester, Axminster etc. or the Warco ZX15/Chester Champion. I would be interested in receiving any comments, good or bad, about these machines. My email address is latheman@btinternet.com.

Mr. J. A. Lewis writes:

Taming a Chester champion mill or repeatability repeatability. No it's got nothing to do with politics or lasers just plain engineering by putting a slide on the round column to keep the head from moving when raised or lowered. The mark one job works spot on. Although the slide may be more robust if it was 2in x 1/2in. instead of 1 1/2in x 1/2in. that was all I had in stock at the time. The fixed slides with the gib strips, which are held by loose pegs could do with strapping together to stop any spring when the gib strips are adjusted. Mark two coming soon. Have fun.



Ted Wale of Nova Scotia writes:

In issue #114 Jim Whetren detailed a modification to his lathe tail stock whereby the usual spanner and nut locking in the front is replaced by a lever at the back. The sometime interference of the compound slide with the fixing is removed and the spanner consigned to the tool box. Excellent! I had seen several tail stock locks intended to achieve this but none really turned me on until I saw Jim's design. I made a kit for my 10in. Southbend and it worked like a charm as soon as I had overcome a slight problem due to the 1942 Southbend castings (60 years ago wartime standard) being rougher than present day items and the resultant interference with the under-way shoe eliminated. The tail stock is seen in photo #1 which looks and is very similar to his Prazimat. Well done Jim.

I also have a 6in. Craftsman lathe and, in view of the success with the Southbend, I immediately started to fix up this with the same modification. However I ran into some problems which took time and effort to overcome. The purpose of this letter is A) to recommend strongly the mod. to all modelers who are owners of "spanner lock machines" and B) to warn such owners of the possibility of problems and some of the things to check before starting on the smaller lathes that many, like myself, own. The problems are easily overcome when identified in advance.

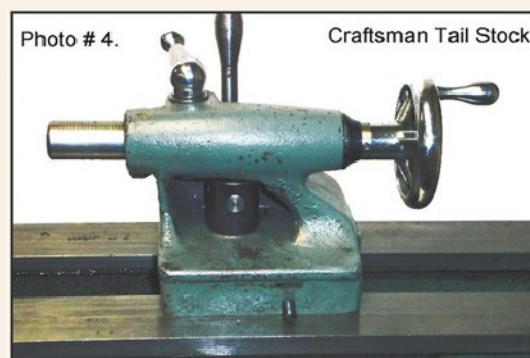
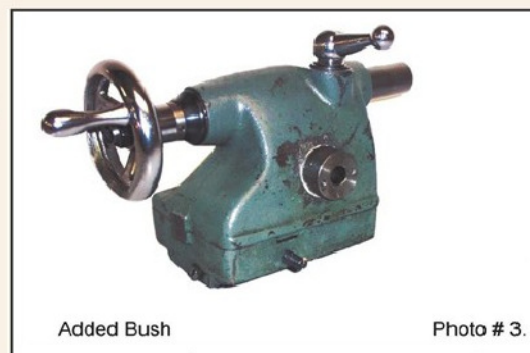
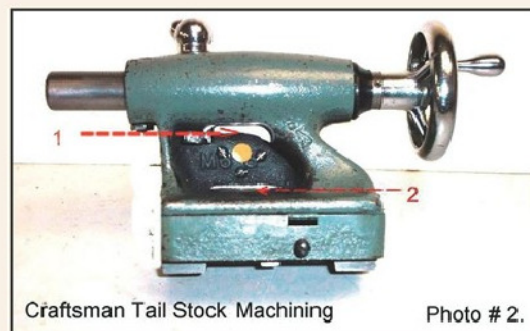
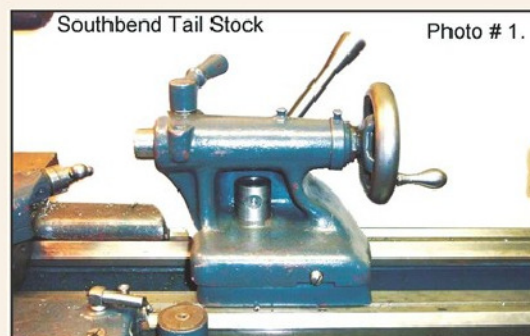
We have to realize that the spanner/nut fixing is a relatively simple fixing not requiring much from the parts involved while the Whetren fixing is a fairly tight design requiring reasonable accuracy of the few parts used. This is not a criticism of the spanner/nut designers- rather their system is a good production design which works well with the least machining of the parts which helps keep production costs down.

As this is a smaller machine, I reduced the height of the Bearing Block/Lock Plunger to 1.125in. but kept the diameter of the Cam Spindle at 0.500in. as designed by Jim, as any reduction here could prejudice the clamping action. In photo #2 is seen the same view this time of the Craftsman tail stock. Firstly, there was not sufficient room top to bottom of the cavity where the new fixing had to go. Even when I had machined away all that I thought was safe under the T.S. shaft housing it was tight-(note 1). Hence the reduced height of 1.125in. Secondly, there was not sufficient meat in the vertical back wall of the housing to safely carry the cam spindle hole. This hole is really a bearing that supports the spindle during the quite firm force needed to lock the T.S. I had to mount a bearing bush as seen in photo #3 and this also had a little problem. The casting was not even thick enough to allow for full spot facing of the seat for the bush. I could only make this spot face over about 225 degrees before the casting wall was getting dangerously thin. So I mounted the bush with three bolts as seen in photo #2 all below the half diameter and carefully packed it into the spot face cavity and under the top half with slow curing epoxy(wonderfully useful stuff for a job like this) after carefully adjusting the bolts so that the bush hole was horizontal and true. Thirdly, the face on which the nut sits in the original was not level. It was just as cast and fettled (again no criticism) so it had the casting draw angle. I had to machine it flat as seen in **Photo 2**. The resultant step in the metal (*note 2*) - at the back shows how much had to come off. I missed this first time and nothing would line up nor operate.

A new fixing bolt of 0.375 x 24 was made and this finer thread made the final adjustment much easier (I found this out on the Southbend). Also the manufacturing method needs to be changed. Because the new bush has to be drilled before mounting. The system becomes:- 1) Make the parts without drilling the cam spindle holes and without reducing the height of the Lock Plunger by the 3mm for working clearance. 2) Mount the Bearing Block/Lock Plunger assembly in place (with a grub screw to hold them firmly together) and lock tightly by the new bolt. 3) Drill, from the rear, the 0.500in. dia. cam spindle hole in the Block/Plunger using the bush hole to set and guide the drill. 4) Disassemble and complete all the parts as given by Jim. This is no more work but just a different order of the steps to accommodate the bearing bush addition.

The completed Craftsman Tail Stock is seen in **photo 4** and it operates as well as that on the Southbend. Both are a joy to use. Please don't let any reader be put off this little job by anything I write here. This letter is meant to encourage and help with the few differences that arise on different smaller machines.

NOTE. To avoid confusion. The machined surfaces labeled 1 & 2 in Photo #2 do not go through the casting. This can be seen in **Photo 3**. In **Photo 2** the bright machined surfaces show up as the same colour as the white backdrop

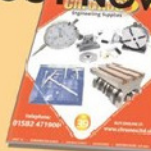


Bob Stageman writes:

On the subject of the motorcycle lift, mentioned in a recent *"On The Editor's Bench"*, I actually have two, but one was

made by a friend many years ago. I came across his number the other day and called him to say that the lift (the old original design) is still working well, and has he got any more. Apparently his assistant has now taken over and my old mate Norman has retired. There are still a

couple of the most recent design available at about £185 unpainted and requiring the supplied wooden top to be fitted. The design can be seen on his website www.dragonflyforge.co.uk but these will probably go soon after which an updated version will be produced.



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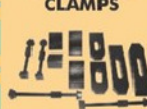
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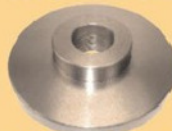
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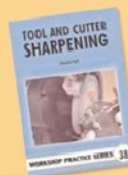
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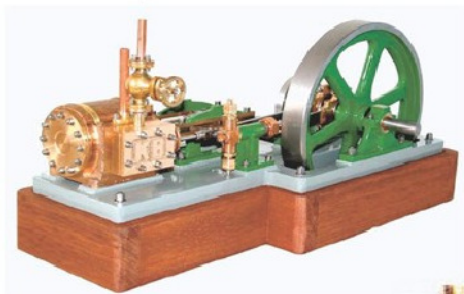


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0"G	Hertford Hall	4-6-0
0"G	Royal Scot	4-6-0
0"G	Josie	4-6-4
0"G	Bat	4-4-0



RAINHILL

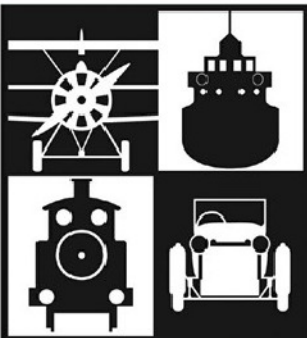
2.1/2"G	Southern Maid	0-6-0
2.1/2"G	Austere Ada	2-8-0
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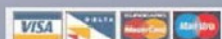
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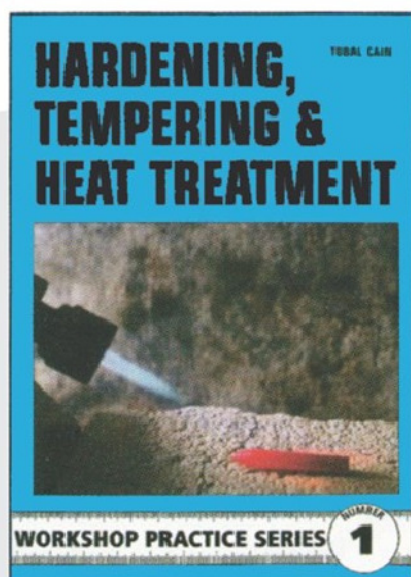


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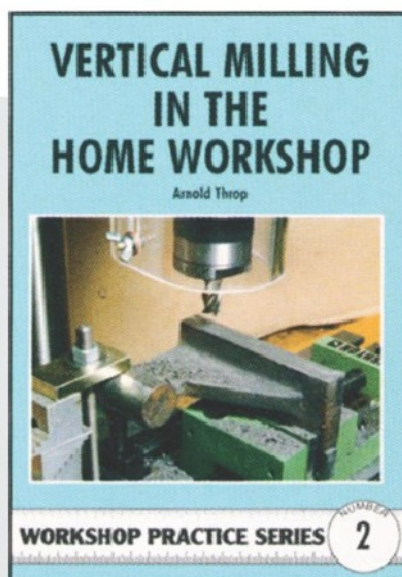
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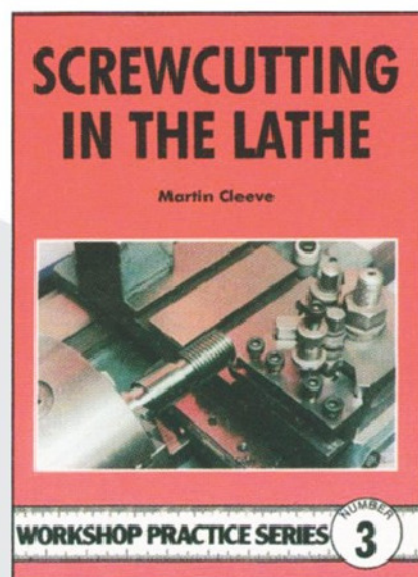
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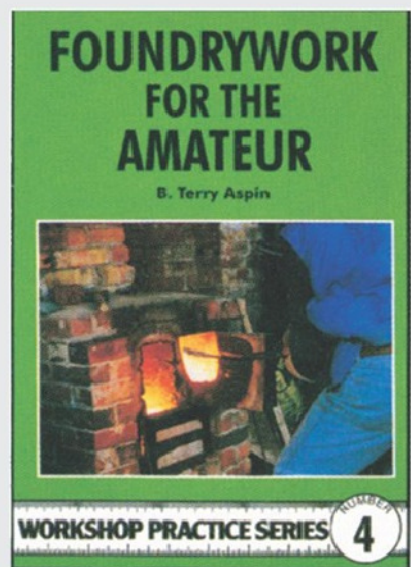
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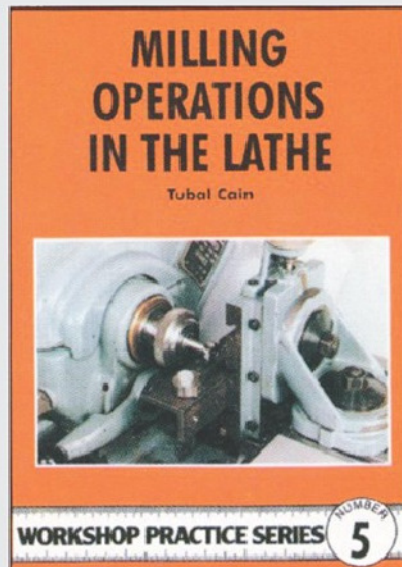
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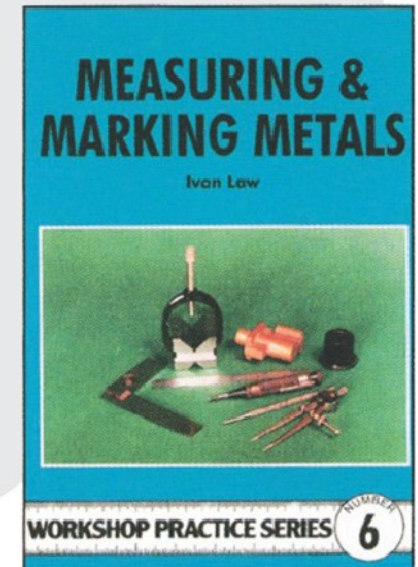
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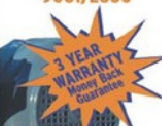
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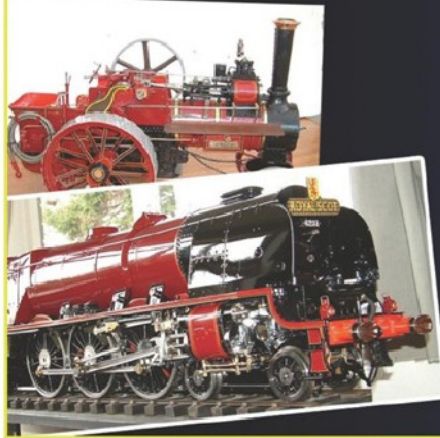
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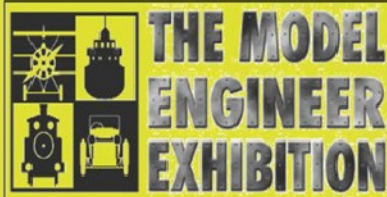
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Boxford taper turning attachment	£150
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Colchester student capstan hardly used	£300

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Myford Super 7 lathe



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Boxford VM30 milling machine, 30 INT head + 3 way DIGITAL READ OUT



Gabro AC450 knotcher



Viceroy disc sander + extractor



Boxford 1130, 5 1/2" x 30"



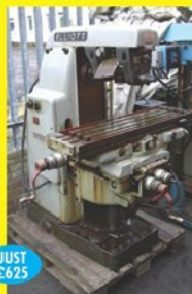
Milling/Drilling grinding X-Y table



Boxford high speed 8" shaper



Boxford pedestal 1/2" / 2MT drill



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Henry Milnes vertical milling machine



Boxford 260VMC 3 axis vertical milling machine



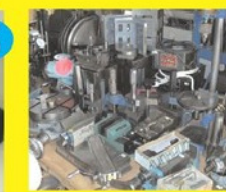
Harrison Graduate wood lathe



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Features

Cast Iron Construction, Easily Portable, Metric or Imperial Thread Cutting, Can be installed and cutting with 5 minutes.

Specifications

Centre Height	90mm	Spindle Bore	19mm
Swing Over Bed	180mm	Spindle Taper	MT3
Swing Over Cross Slide	100mm	Speed Range (High)	100-2500rpm
Distance Between Centres	325mm	Speed Range (Low)	0-1100rpm
Motor	400W	Weight	38Kg

Special Offers

Contact us for details.



Conquest Lathe £365

Standard Accessories

3-Jaw Chuck 100mm, 4-Jaw Chuck 125mm, 4-Way Toolpost, Lathe Tools, Fixed & Travelling Steadies, Face Plate.

Features

Vee Bedway, Wide Speed Range, Adjustable Slideways, Cast Iron Construction, Hardened & Ground.

Specifications

Centre Height	105mm	Spindle Bore	20mm
Max. Swing	210mm	Spindle Taper	MT3
Swing Over Cross Slide	75mm	Spindle Speeds	130-2100rpm
Distance Between Centres	400mm	Tailstock Taper	MT2
Motor	0.55Kw	Weight	150Kg



DB8 Lathe £725

Standard Accessories

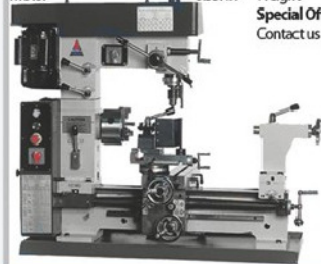
3-Jaw Chuck 125mm, 1-13mm Drill Chuck & Arbor, Lathe Tools, 4-Way Toolpost Combined Vice / Compound Slide.

Features

Powered Crossfeed, Separate Motor for Lathe & Mill, Large Milling Table, Leadscrew Guard, Heavy Duty Cast Iron Construction.

Specifications

Centre Height	210mm	Spindle Bore	28mm
Max. Swing	420mm	Spindle Taper	MT3
Swing Over Cross Slide	60mm	Speed Range (Lathe)	160-1360rpm
Distance Between Centres	520mm	Speed Range (Mill)	117-1300rpm
Motor	0.55Kw	Weight	155Kg



Centurion 3-in-1 £1250

Standard Accessories

3-Jaw Self Centering Chuck 160mm, 4-Jaw Chuck, Machine Stand, Fixed & Travelling Steadies, Thread Chasing Dial, Face Plate.

Features

Engineered from High Grade Castings, Gap Bed, Independent Feed & Leadscrew, Cuts Left & Right Hand Threads, Metric & Imperial Graduations.

Specifications

Centre Height	150mm	Spindle Bore	38mm
Swing Over Bed	300mm	Spindle Taper	MT5
Swing Over Cross Slide	200mm	Range of Speeds	75-1400rpm
Distance Between Centres	570mm	Tailstock Taper	MT3
Motor	1.1Kw	Weight	450Kg



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Features

Dovetail Column, Adjustable Depth Stop, Fine Feed Head Control, Geared Drive, Slideway Covers, Zero Setting Dials.

Specifications

Drilling Capacity	12mm
End Mill Capacity	12mm
Face Mill Capacity	16mm
Table Surface Size	90x404mm
Longitudinal Travel	240mm
Cross Travel	110mm
Max. Distance Spindle to Table	270mm
Spindle Taper	MT3
Spindle Speed Low Range	0-1100rpm
Spindle Speed High Range	0-2500rpm
Motor	350W
Weight	55Kg



Conquest Mill £450

Standard Accessories

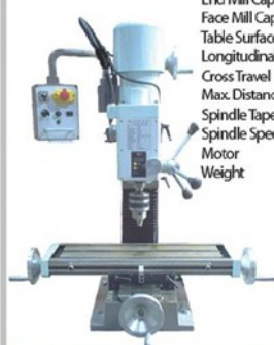
1-13mm Drill Chuck & Arbor, Variable Speed, Milling Drawbar

Features

Dovetail Column, Adjustable Depth Stop, Fine Feed Head Control, Geared Drive, Slideway Covers, Zero Setting Dials.

Specifications

Drilling Capacity	20mm
End Mill Capacity	16mm
Face Mill Capacity	63mm
Table Surface Size	180x600mm
Longitudinal Travel	350mm
Cross Travel	200mm
Max. Distance Spindle to Table	300mm
Spindle Taper	MT3
Spindle Speed	50-3000rpm
Motor	1000W
Weight	135Kg



Century Mill £895

Standard Accessories

Machine Work Light, Central Lubrication System, Machine Stand, Table Guard.

Features

Head Swivels 90 degrees, Head Tilts 45 degrees, One Shot Lubrication System, Interlocked Spindle Guard.

Specifications

Drilling Capacity	32mm
End Mill Capacity	25mm
Face Mill Capacity	75mm
Table Surface Size	156x745mm
Longitudinal Travel	365mm
Cross Travel	135mm
Max. Distance Spindle to Table	330mm
Spindle Taper	MT3 or R8
Spindle Speed	190-2100rpm
Motor	1.1Kw
Weight	410Kg



Shown with optional Powerfeed

626 Mill £1395

Features

Cut, Fold & Roll in one Machine, Slip Rolls Ground, Folder has Removable Fingers, Three Wire Grooves, Rigid Cast Iron Frame, Back Gauge.

Specifications

Shearing Thickness (Steel)	0.6mm
Bending Thickness	1mm
Bending Angle	90 deg
Rolling Thickness	1mm
Min. Rolling Diameter	39mm
Weight	45Kg



12" Multiformer £145

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