

No.95

DECEMBER 2003/JANUARY 2004

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MODEL ENGINEERS' WORKSHOP

THE PRACTICAL HOBBY MAGAZINE

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in the lathe

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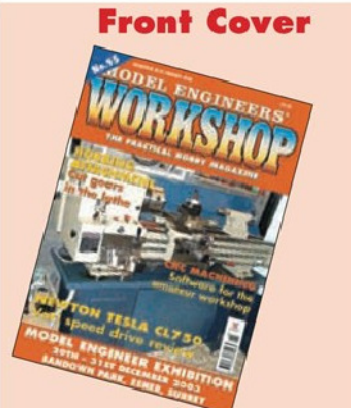
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Turn to pages 56-57 for a Christmas
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A Chester Craftsman similar
to that discussed on page 42.
This one has long bed and
inverter drive.

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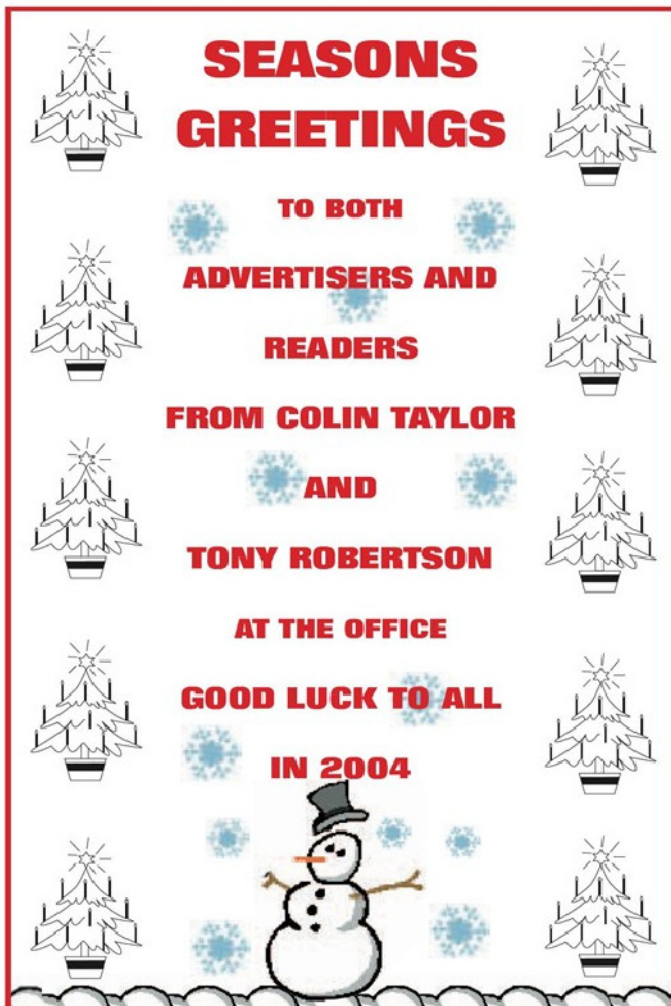
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Good Winter Reading (and information) just for you!



Machine Shop Methods • 1950 • Milne • £ 18.05

Dave Gingery, whose many books we have stocked for years, reckons this is the best beginner's machine work book he has seen, and it certainly is good. The majority of the chapters are concerned with using the lathe, but others cover the drilling machine, the shaper, the milling machine and the grinder. And there are other chapters on holding the workpiece, useful tools and fixtures - full drawings for a large number of items, gears and gear cutting, cutting speed and finish, accuracy and materials. The illustrations (all drawings) are very clear and the text is concise and to the point - Lorus J. Milne really knew his onions. 376 very heavily illustrated pages. Paperback.



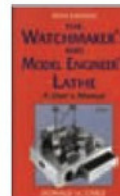
Soldering, Brazing & Welding - a Manual of Techniques • Pritchard • £16.94

Very good book on all ways of joining bits of metal together. Covered are all ways of soldering and brazing, albeit slightly briefly and then, in much greater detail, Oxy-Acetylene, MMA, MIG and TIG welding. Most of the instructions refer to welding steel, but welding other materials and distortion control are covered in separate chapters, as is quality in welding. Recommended for those taking up welding, or as a reference book if you have some experience. 160 pages full of drawings, diagrams and photographs. Larger format paperback.



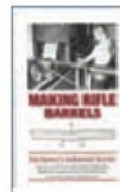
How to Run a Lathe • 1942 • South Bend • £ 7.75

For years Lindsay and ourselves sold 1000s of copies of the 1966 edition of this great book - then "South Bend" put the price through the roof.... Now Tom Lindsay has reprinted the 1942 edition, and it costs less! There are differences between the two editions, but the main text is identical - most of the changes are in the photos, with different hairstyles, and sometimes lathes. As a book to keep by your lathe for everyday use, this has no equal - buy a copy. 128 page illustrated paperback.



The Watchmaker's and Model Engineer's Lathe - a Users Manual (Fifth edition - updated) • de Carle • £ 18.39

This covers the small and very precise lathes used for watchmaking. It deals with most makes of these in detail, with useful hints and tips on setting them up, and using them. The virtual demise of this type of lathe has resulted in this edition being extended to cover larger lathes, such as Myford's, Unimats and the like, which can also be used for watchmaking. Interesting and useful. 220 pages. Over 280 illustrations. Hardbound.



Making Rifle Barrels • c. 1916-1918 • £ 7.95

Fascinating series of articles extracted from *Machinery Magazine* showing exactly how rifle barrels were made during the First World War. There are 26 pages on Machining the Lee-Enfield Barrel, 27 pages on Drilling, Reaming and Straightening Rifle Barrels, with the final 10 pages covering Machining Rifling Bars on the Bench Lathe and on Drilling a Long Blind Hole. Detailed and interesting information of interest today, even if the processes described, other than in the final section, are essentially industrial. Softcover.



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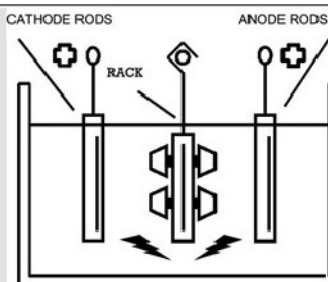
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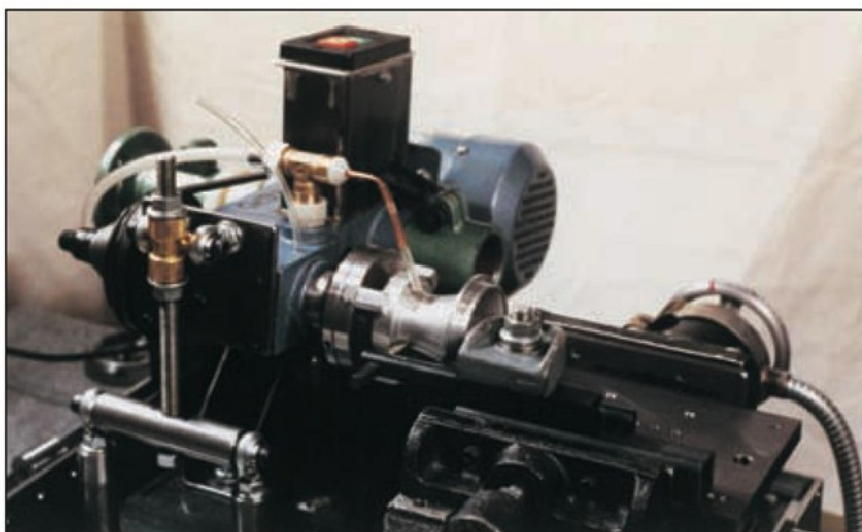
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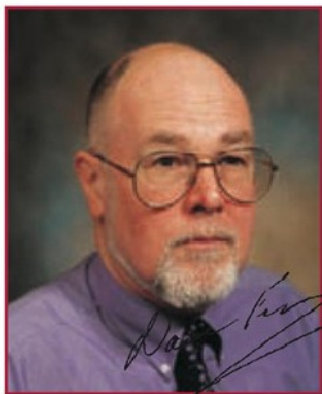
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ON THE EDITOR'S BENCH

A local commendation

It was a particular pleasure to receive the most recent newsletter from Remap, which gave details of their latest round of prize-winning projects. Within these appeared the name of Jim Brown, a member of the Perth and Kinross panel, and also one of our model engineering club members, who gained the Inman Award for his design of "Pill Popper". This device had been created to assist a client who had difficulty in removing pills from the modern style plastic packaging. In essence it works on a punch principle, pushing a single pill down through one of several different sized apertures, avoiding the need for deft finger work.

The photo shows an earlier version which proved the concept.

Although developed for one particular client, the device would be of assistance to anyone with reduced manual dexterity, and it is understood that there may be interest in commercial production.



The Pill Popper devised by Jim Brown

MEW index

In this issue the centre pages will be found to contain the latest index details for MEW, either to pull out or copy. It will also be noted from both Trade Counter and Scribe a Line, that Harold Hall who has been the conscientious archivist and creator of the published index wishes to recruit a successor, to take up the dual opportunities of first providing a service to the hobby, and in a second sense, of taking over a small business. Long term readers will recall that Harold took over as editor of MEW in 1991, and passed the baton to Geoff Sheppard in 1995, and since then has contributed numerous articles aimed at encouraging the novice. A book will be available soon based on the series "Turning Projects for Beginners", and judging by the number of queries concerning back numbers for these, will be well received by many.

Other Reading

As editor of MEW, I am privileged to receive newsletters from a number of organisations. Two recent items of note are that from the Bournemouth and District with a most amusing "and finally" story, and the Bulletin from the Society of Ornamental Turners. The latter contained an interesting description of "Bryan Donkin's Pantograph Engraving Machine and Rose Engine". Having often seen the modern Taylor Hobson machines, it was interesting to see that the Donkin machine operated by moving the workpiece and pattern under a fixed (after adjustment) spindle and fixed pointer, rather than moving the spindle.

Sad news from Australia

Many readers will share my sense of loss at hearing of the sudden death of Philip Amos, who has been a regular contributor to MEW since 1993.

Roger Stuart Philip Amos was born 18 July 1927 in Sydney. He was educated at the Sydney Church of England Grammar School and the University of Sydney - Bachelor of Science 1948 (Physics & Maths) and Bachelor of Engineering 1950 (Mechanical & Electrical with First Class Honours in Electrical Engineering).

In 1950 he joined Email Limited as an assistant engineer. This company was a diversified manufacturer whose products ranged from domestic appliances to high voltage switchgear to automotive components with around 9500 employees.

With the passage of the years Philip moved up through the technical side of the high voltage switchgear business, gradually moving into management and finally as Group General Manager in charge of all products other than domestic appliances - about half the company - and was a director on the company's main board, retiring in 1987.

He was a Fellow of the Institution of Engineers (Australia), a Fellow of the Institution of Electrical Engineers (London) and a Senior Member of the Institute of Electrical and Electronic Engineers (USA).

In parallel with this career Philip joined the Australian Army Reserve in 1948 as a private in the infantry, later transferring to the Royal Australian Electrical and Mechanical Engineers where after service as an NCO he was in due course commissioned as a Lieutenant. He then passed through all ranks to Brigadier in regimental, command and staff postings. He was awarded the Reserve Forces Decoration, and the Efficiency Decoration, and was appointed an Honorary Aide-de-Camp to Her Majesty the Queen. He retired from the army in 1982. He since served as Honorary Colonel of the University of NSW Regiment for 6 years, and as Honorary Colonel Commandant of RAEME in NSW for 6 years. In the last two years of the latter he was also the Representative Colonel Commandant RAEME for Australia.

His hobbies, in addition to his home workshop, had included dinghy sailing and a small farm. Philip is survived by his wife Kathy and their two adult children - Jane and Ian, to whom we extend our sincere condolences and sympathy.

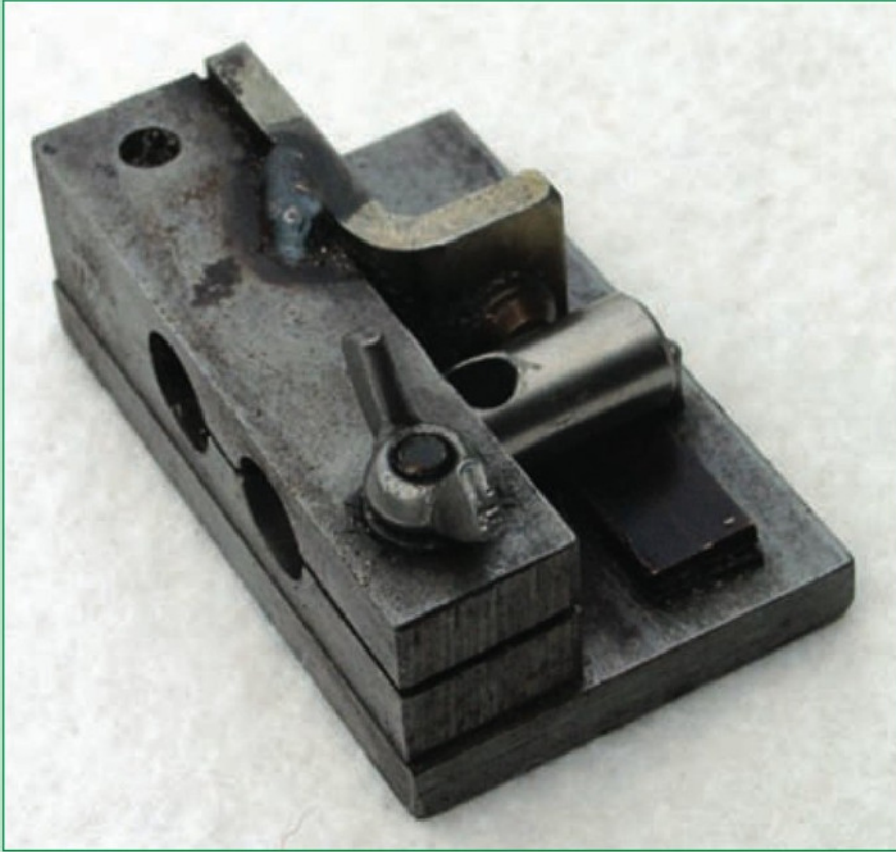
The Model Engineer Exhibition

Celebrating its 73rd show, the original Model Engineer Exhibition returns to Sandown Park Exhibition Centre this year, 29-31 December 2003, with a packed schedule of events. The world famous model engineering competition will once again be prominent at the show with a high calibre of entries expected and a competition display area not to be missed. Top traders from around the UK will also be present for those who wish to stock up on otherwise difficult to find tools and equipment whilst representatives from the UK's clubs and societies will be on hand to offer demonstrations and advice to visitors. Again this year will be featured the FREE daily lectures from the Society of Model and Experimental Engineers (SMEE). Last year's lectures included the well attended and extremely illuminating talk on Stirling engines by Roy Darlington. Members of SMEE will be on hand to provide information and advice on Model Engineering and related matters to all those attending the show.

Other attractions include an outdoor miniature railway, robot wars display, 18 x 40ft indoor railway track and live miniature gas turbine displays. To see all of the above attractions at a special reduced rate call our advance ticket hotline on 01353 654422 or order online at www.meex.co.uk. Tickets are also available on the door.

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Tues 30 Dec 10am - 5pm
Wed 31 Dec 10am - 4pm

JUDGING THE WORKSHOP

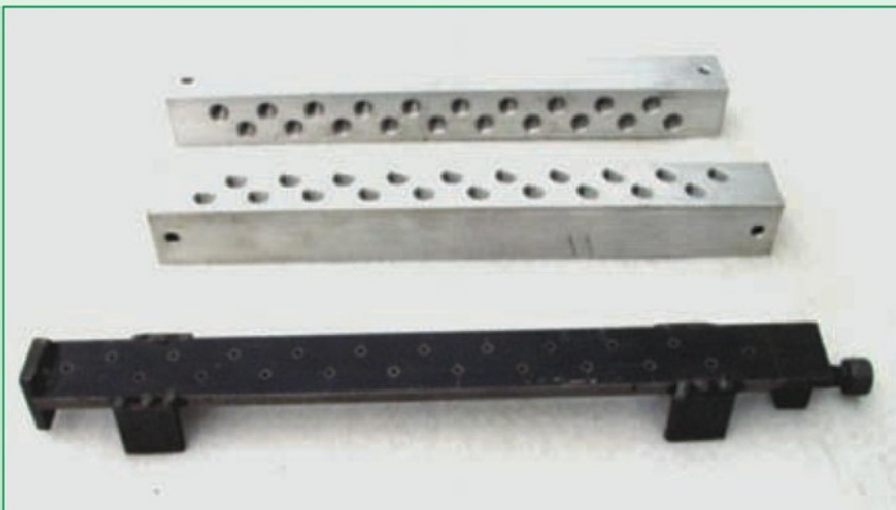


Jig for cross drilling and tapping $\frac{1}{8}$ in dia. stainless pins, is first placed against stops on the mill table for drilling, then transferred to second machine for tapping.

Why so few

As I sit writing these notes, it is a fine late summer afternoon, the weather is perfect, and thoughts are of tea and scones in the garden. By the time you read them it will

probably be winter, the workshop season will be in full swing, and the Model Engineer Exhibition at Sandown park will almost be with us. I have long since lost count of the number of times I have



This jig gives positions for starter holes $\frac{1}{8}$ in. dia in first one face (two positions) then second face for 20 pipe connections.

Exhibition chief judge Ivan Law discusses the question of finish.

attended this annual event, but it must be in the region of fifty. Looking back over the years, one aspect has always seemed to me to be an enigma. Why in the Tools and Workshop Appliance section are there so few entries of small items such as jigs and fixtures? There are usually some wonderful examples of major items, such as tool and cutter grinders, milling attachments and, on occasions, even small lathes, but examples of quickly made fixtures are rare! The Exhibition Hall will contain many models covering a large number of prototypes in all sizes. In the construction of these models, it is almost certain that the builder will have encountered some problem which was solved by producing a simple – or maybe not so simple – fixture. That fixture or drilling jig may have been quickly and crudely made, but if it does the job it was made for, it has served its purpose. It may contain some ingenious aspect or it may not, but the model making fraternity will still find it interesting. It could well suggest the answer to, or give inspiration to others in solving similar problems.

Doing it your way

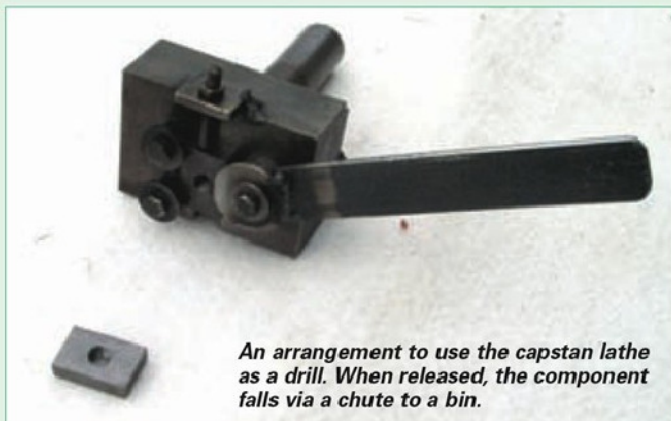
The tool section of the exhibition is one where the model engineer can show, and exercise his design ability. A tool is not a model or a miniature representation of a larger artefact. It is not a case of reproducing in a smaller scale, someone else's design work, but starting with a



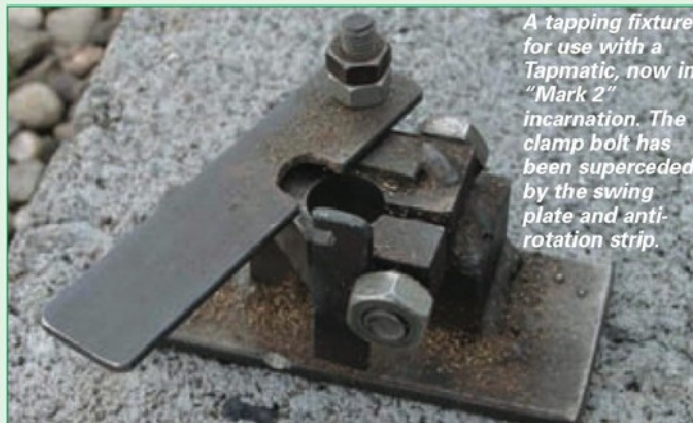
The toggle clamp holds a $\frac{1}{8}$ n. bar vertically for drilling and tapping.

clean sheet of paper with an idea, and designing a piece of equipment, complicated or not as the case may be, to assist in the production of components for some other project. A fixture

TOOLS AND APPLIANCES



An arrangement to use the capstan lathe as a drill. When released, the component falls via a chute to a bin.



A tapping fixture for use with a Tapmatic, now in "Mark 2" incarnation. The clamp bolt has been superseded by the swing plate and anti-rotation strip.

or jig does not have to be highly finished, that would be pointless. The finish expected on items of tooling is a thorny problem and the judges are often subjected to criticism for expecting a high degree of finish on all items on display, and are accused of down marking exhibits if the finish is not exemplary. This type of criticism is often both inaccurate and misguided, the finish on tools such as jigs and fixtures should be suitable for the task the tool has to perform, and no more, a high degree of finish is not necessary or desirable. However I and the other judges do like to hear criticism and comments as it shows interest is being taken in both the exhibits and the assessment of them.

Appropriate finish

If the exhibit is a machine tool, then a good standard of finish is expected. The castings should be neatly dressed and painted, the slideways should be flat, and it is nice to see a witness of scraper marks. The general finish of the steel should be smooth and free from deep tool marks, but not highly polished. After all, when purchasing a new lathe, the general finish will be a factor in making the final decision; if the machine looks rough, then in all probability its performance may not be up to expectations.

When judging fixtures, drilling jigs, or similar types of work, the criteria are different to those used with machine tools. Some of the questions asked are:- Will it do the job which prompted the design? How is the fixture to be clamped to the machine table? How is the workpiece located from its datum and how is it clamped? Is it unnecessarily complicated? The best fixtures are the simple ones. The general finish is way down the list, and is usually answered by the question "Will it be pleasing and comfortable to use? Or will the user cut his fingers on some rough edge or sharp corner? A few minutes with a file may be all the finish that is needed. The photos illustrate a few jigs and fixtures from the editors collection. These were quickly knocked up for small scale

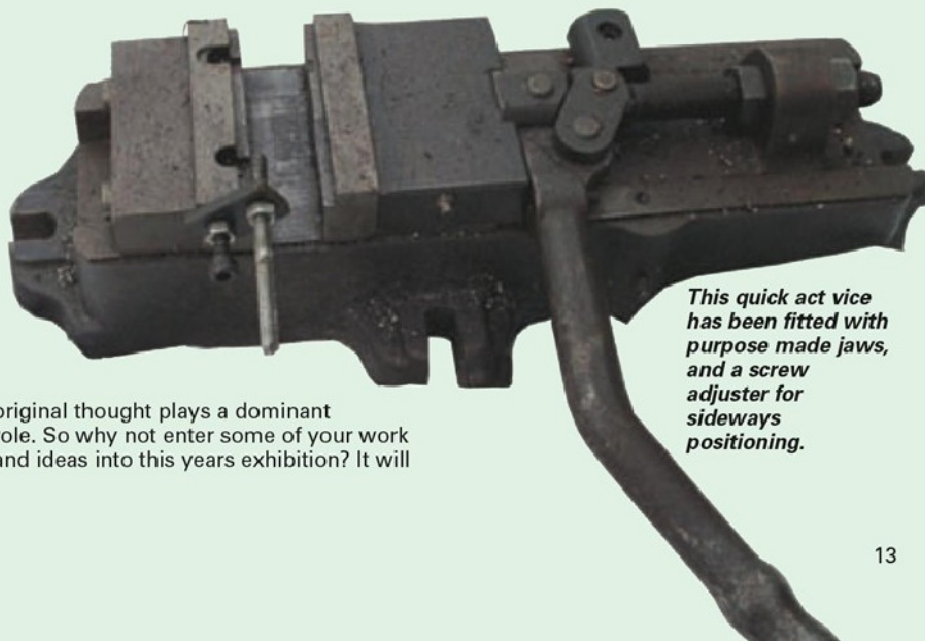


Rudimentary fly press tooling which produces accurately positioned bends in 6mm x 25mm flat steel bar

production rather than model making purposes, but each has fulfilled its initial objective, sometimes with modification in the light of experience.

When assessing the tool section, the judges cannot follow the method used for general engineering models. Tools differ from models in many ways, the main one being it is the only category in which

not only give you satisfaction in seeing it on display, it will also inspire others, some of whom will be heard saying "What a good idea, why didn't I think of that". Who knows it might even lead to a regular jig and fixture column in MEW.



This quick act vice has been fitted with purpose made jaws, and a screw adjuster for sideways positioning.

original thought plays a dominant role. So why not enter some of your work and ideas into this years exhibition? It will

DESKCNC - A WINDOWS CONTROL



Fig 1A Machine velocity and acceleration set up.

Previously

In two recent articles in Model Engineers' Workshop I described the software I have installed on my Wabeco CNC mill. The software was DeskKAM 200 to generate G-code files from .dxf drawing files and the Dos controller CNCPro to output step and direction commands to the stepper motor drives. I have been very pleased with both pieces of software particularly CNCPro which I have found particularly user friendly. Readers who are up in the latest versions of Windows may have observed that it is not now possible to run Dos programmes. A further complication is that the parallel port will also not be fitted to forthcoming computers. To overcome these problems, DeskKAM have brought out a Windows based CNC controller, which does not use Dos, and with it, a new software package DeskCNC. This package is in essence a compendium of DeskKAM 200, DeskEngrave and DeskArt as well as having several new features. DeskEngrave enables the user to engrave using a wide range of the fonts available on a PC. DeskArt allows digital images to be imported and manipulated and then engraved. I have tried this programme and can confirm that it is a very fascinating piece of software with a lot of potential.

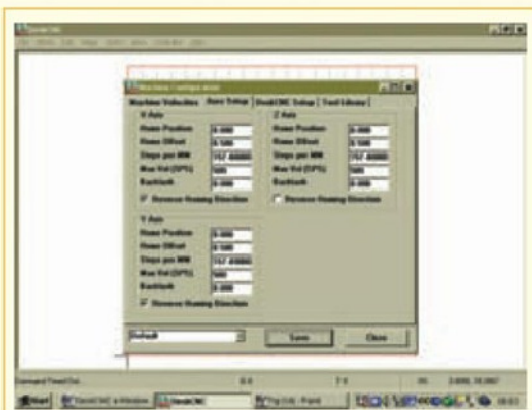


Fig 1B Axis calibration screen

Dick Stephen samples a software and board update.

The new control board

DeskKAM kindly sent me their control board to try in conjunction with their new software. The layout of the connections required to connect the board to the stepper motor drivers is clearly printed on the board, so those readers who are contemplating making the drive unit described in the second part of my recent article will have no difficulty installing this board. It needs to be mounted on four pillars to keep it clear of the bottom of the enclosure. These are attached to the board by 3 mm screws through the holes provided at the corners of the board, which requires a 5 volt DC regulated supply or an unregulated 10 volt DC supply. To accommodate the unregulated supply voltage the board has an inbuilt 5 volt regulator. As my drive unit already had a 5 volt regulated line to supply the opto-isolators on the Gecko drives I used this to power the board. The 5 volt supply recommended for the drive unit will supply 200mA, adequate current for both the Gecko drives and the board. The only other modifications that were required were to fit a separate mains switch for the 5 volt supply and a 2 pole switch for the emergency stop. Having separate mains switches for the control board and for the Gecko drives allows the board to be configured without power being applied to the stepper motors. The emergency stop switch grounds the ESTOP terminal on the board. When this is not grounded, the programme is halted and the computer ceases all operation. The programme can only proceed once the ESTOP switch is released. Also, no information is lost when the ESTOP is used, making this a really excellent and useful safety feature.

I did have one problem when installing the board and that was with the cable to connect the board to the serial port of the lap top I use in my workshop. The male serial cable socket on the board is fitted with two nuts to secure the female plug on the cable. I was not able to purchase a serial cable with the female plug fitted with screws. All I could get was an extension serial port cable, which comes with nuts on the female plug. I had to remove these nuts and drill holes for screws to secure the cable. DeskKAM are aware of this problem and are able to provide boards, which

can be used with serial port extension cables. If you are using a modern laptop, which only has a USB port you should use a USB to serial converter cable.

The DeskCNC software

With the board successfully installed the time had come to test out the software and to configure it for my machine. This article is not intended as a guide to configuring the software. It is never the less worth going through some of the setting up procedure to highlight some of the useful new features included in the programme. When the programme is loaded it detects whether the control board is connected and powered up. If not a message is displayed informing you of the fact. The first task before any cutting can take place is to configure the software and the controller to suit the machine. Clicking on Setup in the menu bar brings a menu list. The first two Options and Post-processor set-up are essentially the same as in the earlier version DeskKAM 2000. The third option, Machine set-up is new, and contains some interesting features. Opening this option produces a multi tab display. The first tab, Machine velocities, shown in Fig. 1A sets the acceleration, velocity and the jog velocities for the machine. These parameters are expressed in steps per second. To set the table of the mill in motion at a constant speed the stepper motors have to initially accelerate the table until the desired speed is attained. The appropriate magnitude of the acceleration required will depend on of mass of the table and friction at the slides as well as the power that the stepper motors are able to deliver. For

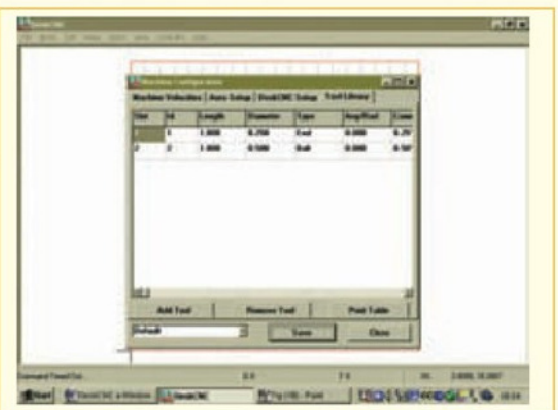


Fig 1C Tool library screen

WINDOWS BASED ER FOR CNC

the smoothest cutting it is essential that the appropriate acceleration is used. The graph on the left of Fig. 1A, a really useful feature, makes setting the correct value of the acceleration very straight forward. As I mostly use cutters 3 mm or less in diameter, the maximum velocity has been set at 6000 steps per second (this equates to a maximum cutting speed of 5 mm per second). The acceleration setting is then adjusted to produce the graph shown. The correct acceleration for the machine is now set over the full range of speeds selected. Profiling on my mill is now the smoothest it has ever been. Opening the second tab brings up the display Fig. 1B for calibrating the three axes. Like the previous display the values entered are in numbers of steps. Apart from the velocity, which must be the same as entered on the previous display; the number of steps per mm and the backlash can only be entered after the axes of the machine are calibrated. The fourth tab Tool library shown in Fig. 1C enables the user to create his own library of tools that are frequently used. This saves time when generating the tool paths for .dxf drawings.

Fig. 2 shows the display that comes up after a .dxf drawing file of a clock wheel is loaded. When the wheel was drawn using Turbocad the co-ordinates of the centre were made (X=0 Y=0). The lower left corner of the grid shown in Fig. 2, which coincides with the centre of the wheel (X=0,Y=0), is the tool start position for all machining operations. When doing the drawing of the part to be machined make an identifiable place on the part the origin (X=0,Y=0). This feature greatly simplifies setting up the work piece when it comes to machining it. Fig. 2 shows the drawing of a weight pulley for crossing out. Clicking on Select brings down a menu and entering

Select single allows the parts of the drawing to be machined to be selected. When these are selected they become highlighted in blue as shown in Fig. 2. To edit the toolpaths click on Toolpath and enter Contour on the fly down menu. Editing the toolpath follows the same procedure as in DeskAM 200. Having created the toolpaths click Toolpath again and enter Run Machine. This will automatically save the toolpath as a .Dnc file as well as loading the g-code file you have just generated and displaying the toolpath for the wheel crossing, ready for machining. If the toolpath had been saved earlier, the saved g-code file can be opened using Open NC. This brings up the display shown in Fig. 3. Only the tool paths of the parts of the wheel that are being profiled are now shown. If for any reason the g-code needs to be modified this can be done using the Edit facility. When you are satisfied that the machining can commence. If the ESTOP switch is open the programme will not run until the switch is closed. The message at the bottom left corner tells you the condition of the controller. The programme can either be run in auto mode or in single step mode using the green GO key or the blue Next key.

Occasions do arise when it is convenient to write your own g-code programmes. This is easily done again using the Edit facility. I used this facility when I was calibrating the machine. I wrote and saved the following two sections of code: -

```
N1 F40 (feedrate 40 mm/min)
N2 X5 (move to X =5)
N3 X0 (move to X=0)
N4 M02 (End)
```

```
N1 F40
N2 X50
N3 X0
N4 M02
```

The first piece of code was used to measure the X-axis backlash. Before commencing the approximate number of steps per mm along the axes were entered in the Axes set-up table (1250 for X and Y and 2500 for Z on my machine). The piece of code moves the table along the X-axis for 5 mm at a speed of 40 mm/min and returns the table back to it's start position. The programme is run in single step mode. Before running the programme, the X axis digital readout was set to zero. After the table has moved the reading on the readout is noted and the readout again zeroed. Line N3 is executed and the reading on the readout again

noted. If the two values are the same and different from 5.00 mm convert the difference to a number of steps. Suppose the readings were 0.10 mm less than 5 mm. For my machine this represents 125 steps. This value can now be entered for the X-axis backlash.

The second piece of code can now be executed in single step. Begin by setting the digital readout to zero and execute line 2 of the programme. This moves the table along the X-axis through 50 mm. After the table has moved note the reading zero the readout and execute line N3. Again note the reading on the readout. The two values should be the same and may well be slightly different from 50 mm. Take the difference convert to a number of steps and divide by 50. This will give you the error in the number of steps/mm along the X-axis. Add or subtract this number from the number originally entered (1250 in my case).

It is worth re-measuring the backlash as this will have altered slightly since the backlash and the X-axis calibration are linked. The value of the number of steps entered does not need to be a whole number. This facility allows for very accurate calibration of the machine. To calibrate the Y and Z-axes the fragments of code are written with X being replaced by Y or Z.

DeskCNC is a very comprehensive programme with a lot of features only some of which I have touched on here. I have not used all the features to date but will doubtless get round to doing so before too long. I have tried the imaging facility with interesting results, but still need to experiment a lot more before I would show anyone my efforts. At an introductory offer of \$300 for the software and the Windows control board, this must represent about the best value CNC package around.

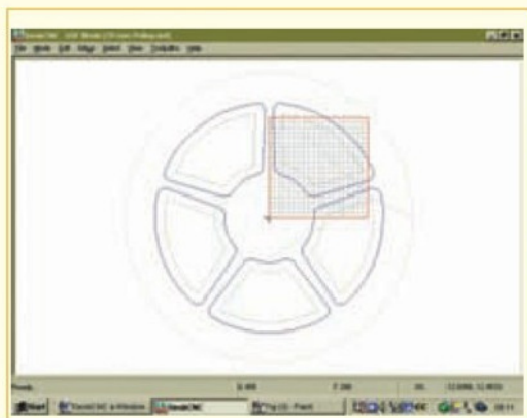


Fig 2 Drawing of weight pulley with features highlighted in blue for machining.

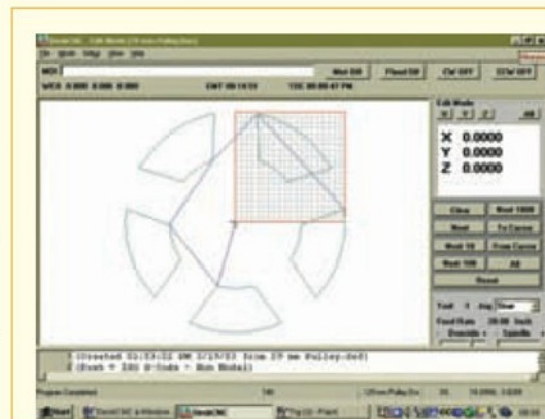
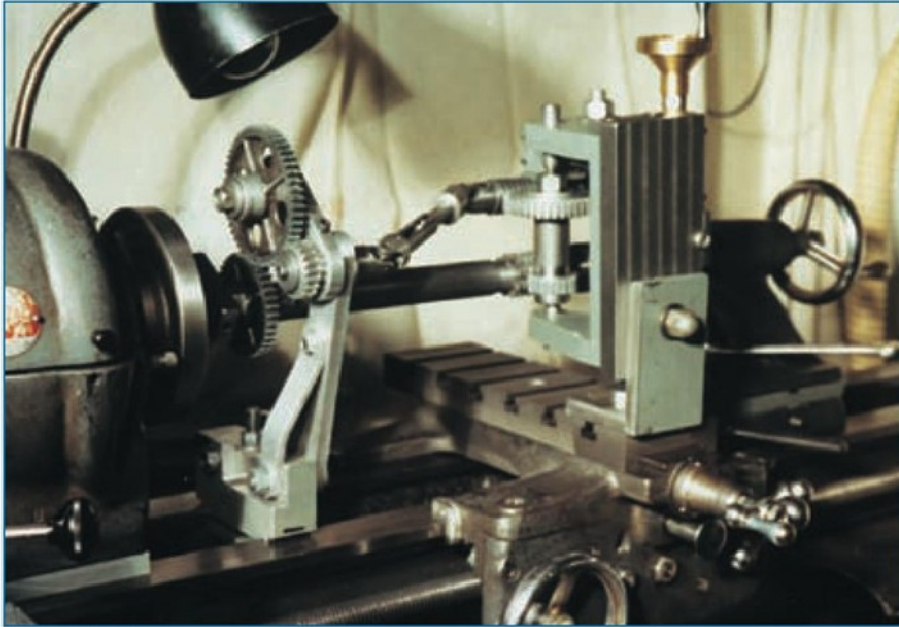


Fig 3 Tool path displayed on screen

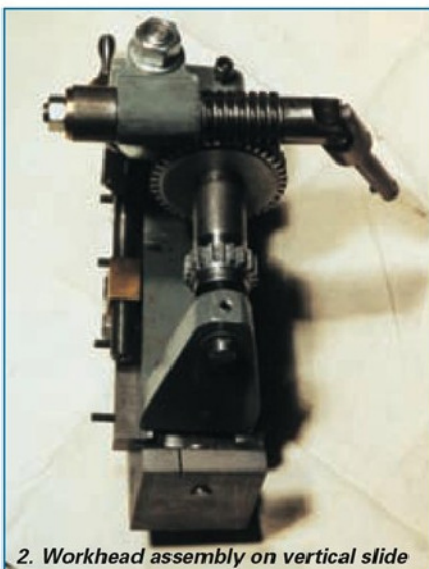
A HOBGING FOR TH



1. Hobbing device set up on lathe.

Protracted evolution

I made a start at gear hobbing around 1967 when I purchased a copy of an American publication "*Complete Metal working Manual*" by R. H. Cooley, which included a gear hobbing attachment that was supposed to generate worm, spur and helical gears. Although lacking a complete understanding of what was necessary at the time, I decided nevertheless to have a go and build the device. I made the casting and all the parts, including the hob, which was to be hand relieved. The hob was a lot of work and could only be sharpened once or twice before the relief was lost and it had to be renewed.



2. Workhead assembly on vertical slide

Dr. Giles Parkes excellent attachment described in MEW Iss. 57 pg. 37 solved the hob-forming problem. The gear hobbing attachment made use of the topslide as the vertical feed, and providing that you had a gear of the same number of teeth as was needed, would make usable spur gears. The expanding gear train did not allow worm gears, and helicals were not possible either. In addition, the overall rigidity was far from perfect.

Back in 2001 I wrote to 'Scribe a Line' in MEW Iss. 74 with a brief mention of a hobbing attachment that worked rather well. This device, shown in **Photo 1** is the final evolution of the above.

It is very easy to build and use, takes no space, can be set up in less than five minutes, does not require a worm gear, and costs next to nothing to make. The change gears of the lathe can be used initially until replacements are made. It cuts worm gears, spurs, and when I master the maths, will make helicals too. I have cut countless gears in tufnol, brass, cast iron and aluminium. They have been used in all sorts of applications and have worked very well. For those who question the wisdom of using a spur gear instead of a worm gear for the index gear. I will say that my aluminium index gear has worked for six years, cut over fifty gears and yet shows no wear that I can see. However if it ever does wear the device will readily produce a worm for those who want to go that route. The drawings have not been completely detailed, (for example the simple bolt and bush pivot for the idler gear), but in conjunction with the photographs, should convey sufficient

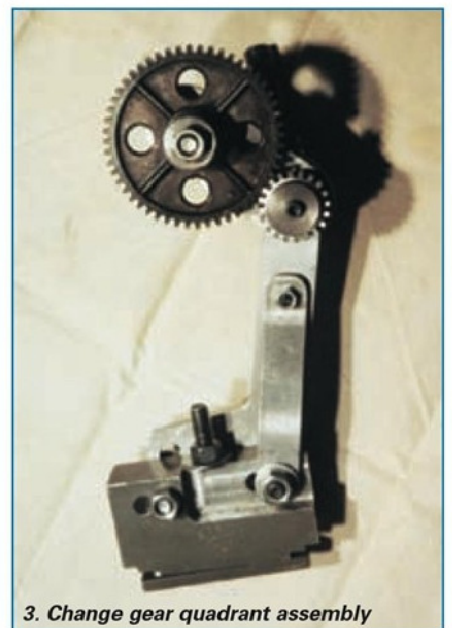
John Whalley describes an easily made but versatile attachment

information for most would be constructors. The slide shown, with the outboard leadscrew reduces the overhang by about 1.125in. from that provided by my topslide and goes a long way to reducing the rigidity problem if an angle bracket that is at least 7/8in. thick is used. Gears of about 5/8in. dia. can be made. I might add that when very small worm gears are required that use a hob that is too small to fit on the mandrel in the usual manner. I mount the hob in a chuck and drive the attachment from the tailstock end with a chain and small sprockets driven from the leadscrew to a long universal shaft that connects to the boss on the tail stock side of the worm that drives the index gear. The necessary gearing is mounted on the headstock quadrant, and sometimes gears are needed to clear the tailstock handwheel. I mention this only as an insight to what can be accomplished with a little perseverance.

The work head casting

In the original publication this was made from cast iron. I changed several dimensions to serve my needs and moved the mounting boss for the brackets to the opposite side of the casting. Since I have a small foundry it was no problem to cast in aluminium and has proved to be up to the job.

The casting needs to be milled flat on the top and bottom of the mounting boss, and the left rear side where the vertical



3. Change gear quadrant assembly

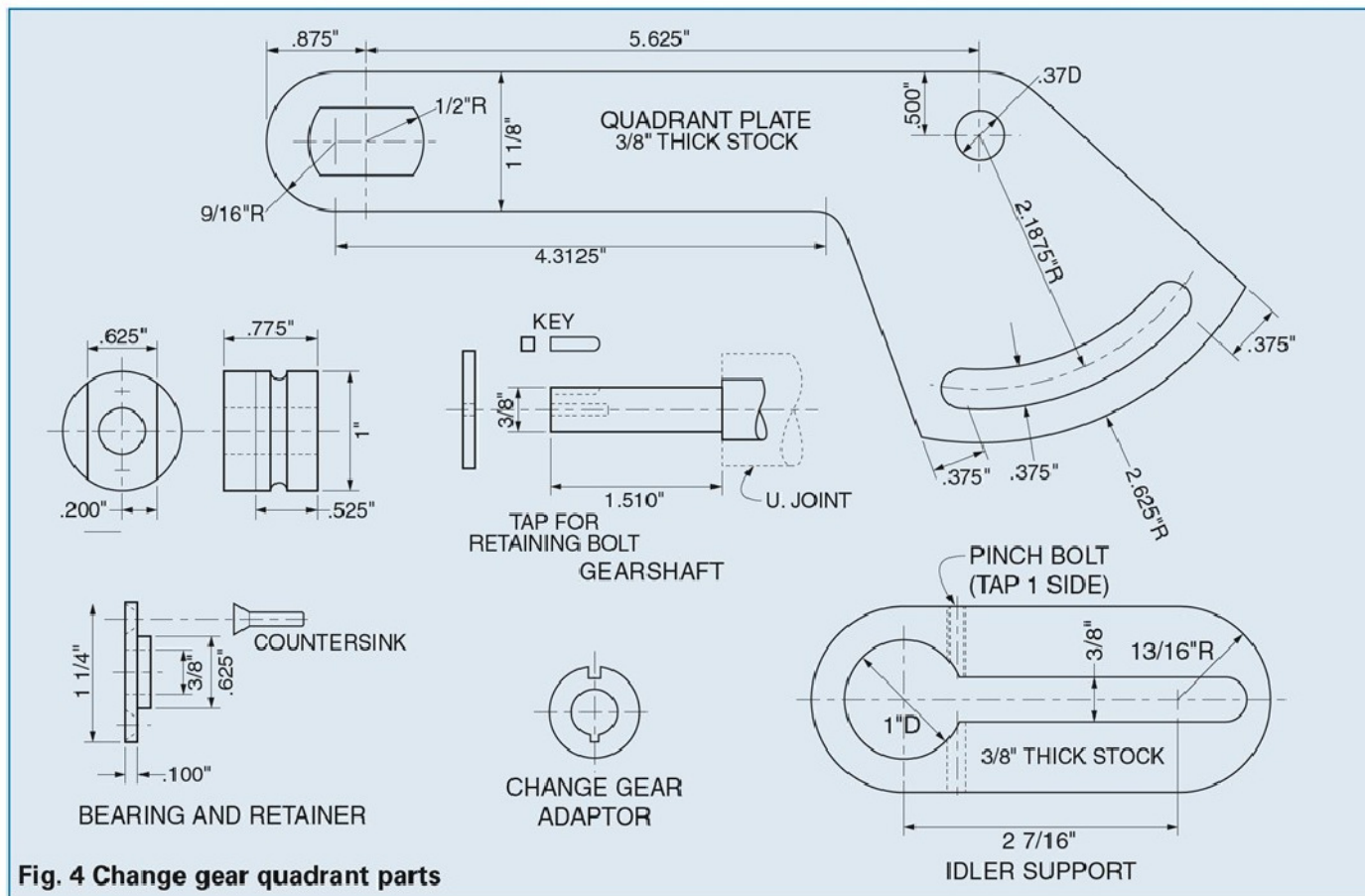


Fig. 4 Change gear quadrant parts

used, and many of you will find a way that no doubt suits you better. My arrangement of the vertical slide appears in **photo 5**. All running surfaces are in bronze bushings, which are not shown. The rather protracted arrangement of the change gear quadrant and various parts is to allow it to be assembled either in front of or behind the mandrel as may be required to produce very small wormwheels along the lines previously mentioned.

with a very rigid angle bracket (at least 3/4in. thick, 1/2in. is better) vertically on the cross slide so that the blank will be at the helix angle of the hob and able to be fed up and down parallel with it. It is worth mentioning that while the topline can be used as a vertical slide, a purpose built one with much less overhang will work much better particularly when larger dia. gears are being hobbled.

The gear blank to be cut must revolve

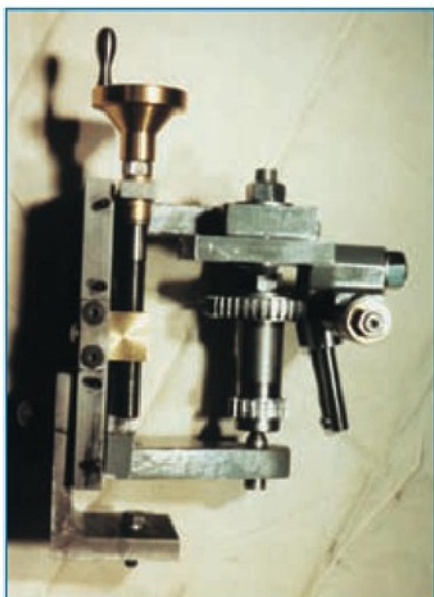
counter clockwise as seen from above with a right hand threaded worm. (Hence the idler gear in the photos).

The blank works best 0.010in. undersize from normal dimensions usually used in gear cutting calculations. (feed in 0.005 in. less than root dia.)

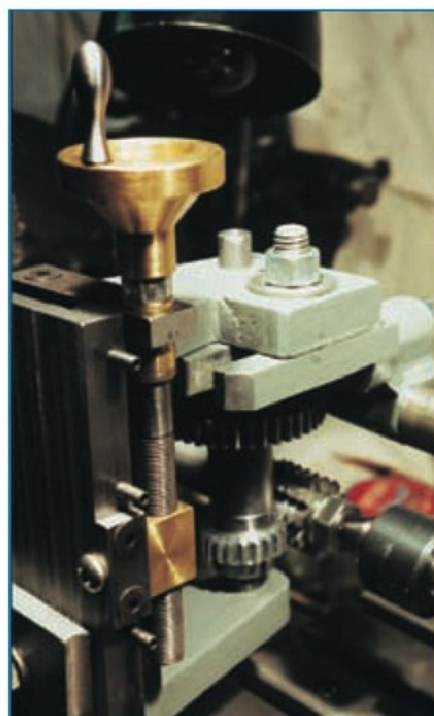
Verify the helix angle of your hob with both a maths calculation and by placing a

Operation and set-up

With reference to the photos assemble the work head casting on the vertical slide



5. Workhead assembly showing vertical feed screw.



6. Detail of set up also showing tailstock support.

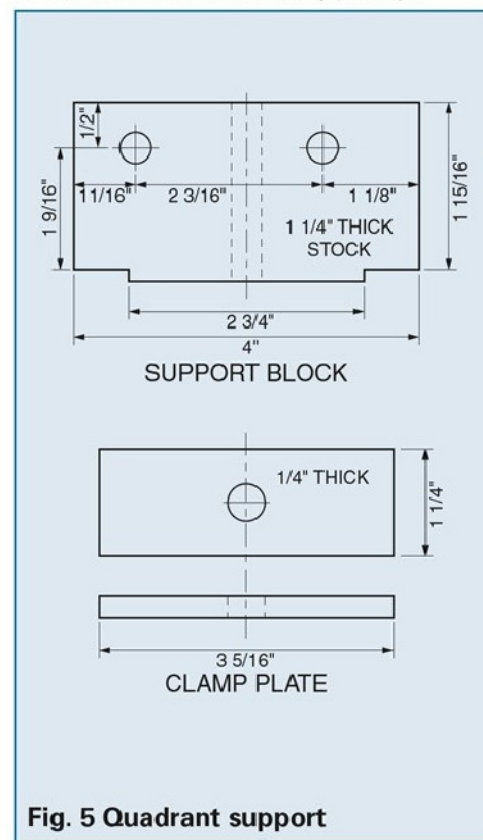


Fig. 5 Quadrant support

slender rod in the hob thread to check that you are set up correctly. (The vertical slide and the casting must be at the helix angle of the hob and travel parallel with it).

Before cutting a gear (say a 20T spur gear) start the machine in motion and verify the following:

- That you have 20 turns of the hob to one of the blank.
- Turn in the cross slide until the centre of the blank just touches the revolving hob (set the cross slide at zero) and make sure that you have 20 notches cut on the blank. (if you don't you have either got your gear ratio wrong, or if the notches are not clearly defined, the blank is not revolving in the correct direction and will not generate a gear).
- Wind the vertical slide up past the hob giving it time to cut all around and verify that the marks are at 90 deg. to the blank. (if not, correct this situation by adjusting the helix angle as required).
- Wind back down, feed in the cross slide the root dia. minus 0.015in. (Lock the cross slide and I might mention the saddle must be locked also). Mark the gear blank with a felt pen, to give a visual indication of completed revolutions. Running the lathe just a bit slower than the usual milling speed advance the vertical feed about 0.050in. every turn of the blank, or whatever feed works best, allowing time for the hob to cut all around until you feed out of contact with the hob. Wind back down to the starting point (out of contact with the hob). Remove the gear arbor, marking it's position with a felt pen so that it can be replaced in exactly the same place as it was before. Measure the root dia. and replace. Feed in the necessary amount to finish the gear. Start the machine and check that everything lines up, then proceed to finish cutting the gear.

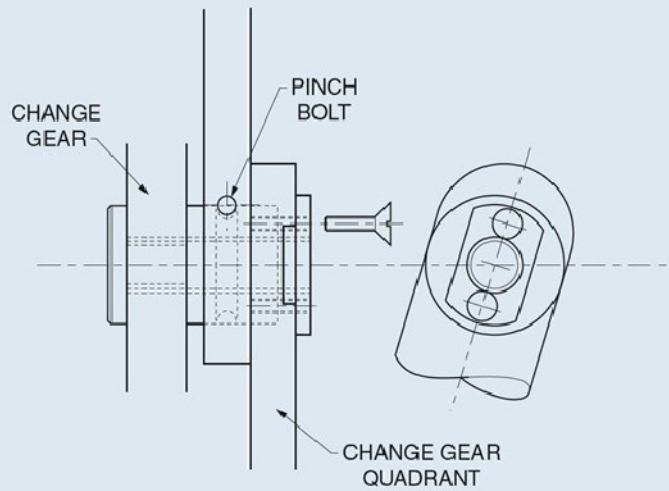


Fig. 6 Quadrant assembly

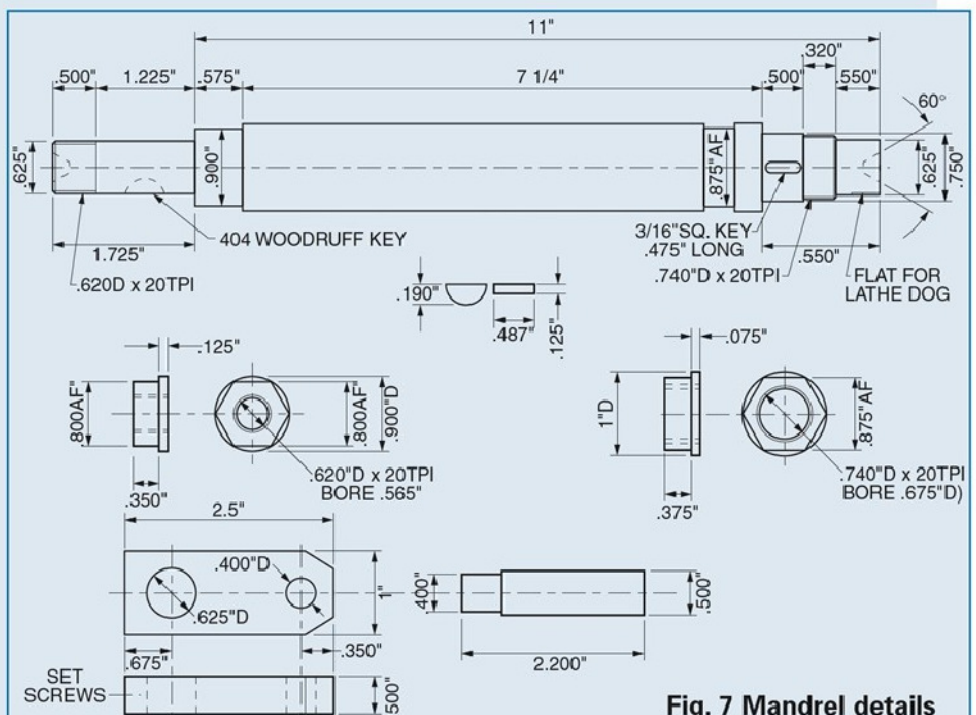


Fig. 7 Mandrel details

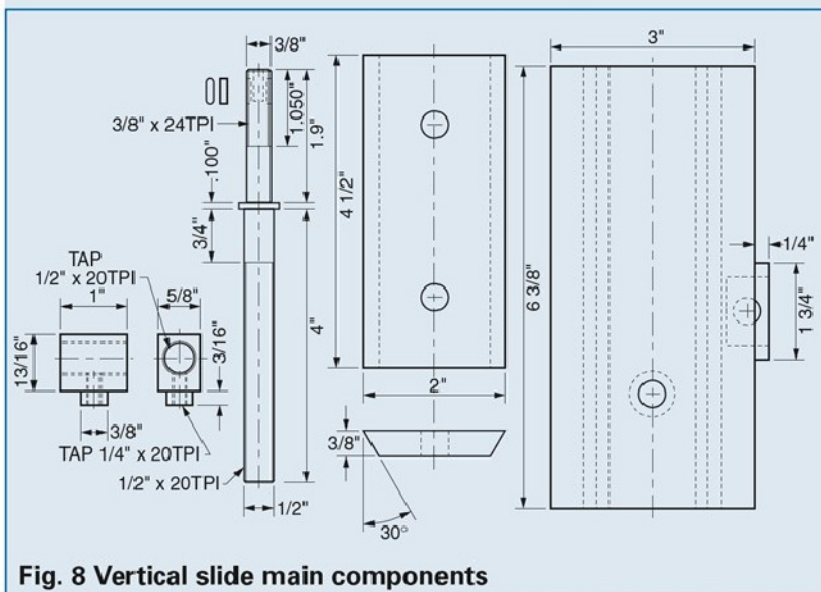


Fig. 8 Vertical slide main components

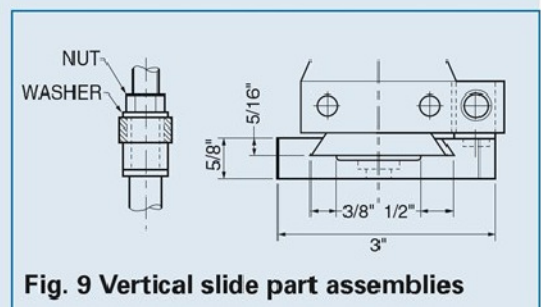
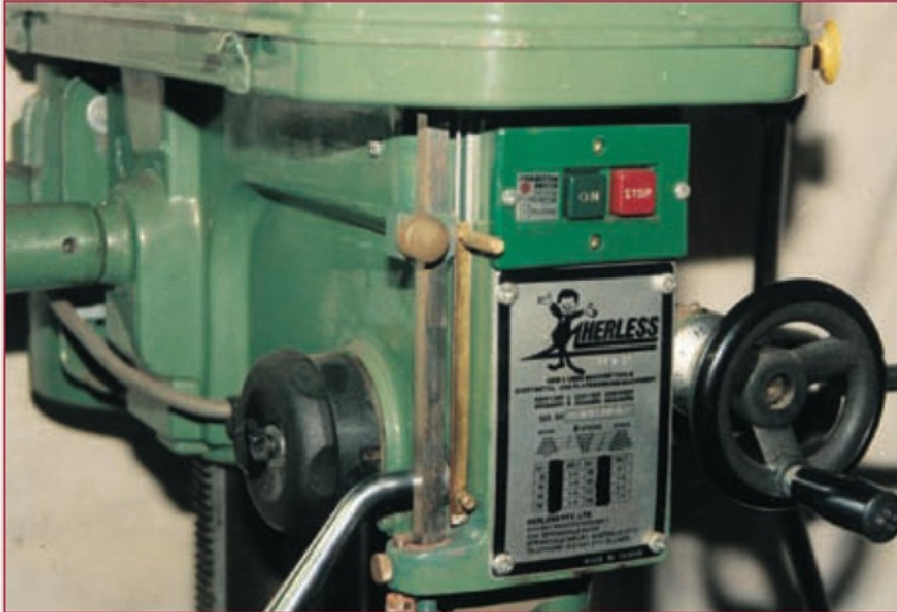


Fig. 9 Vertical slide part assemblies

TRAVEL STOPS FOR A DRILL/MILL



1. New depth stop with former knurled brass clamp screw.

When I bought my Taiwanese drill/mill nearly 20 years ago I selected a model entitled RF-15 which was the smallest and least expensive one then available, as it was all I could afford at the time.

It was fitted with a conventional drilling depth stop - a threaded rod having attached a scale calibrated in mm and with two thin nuts. This rod was mounted on a lug projecting from the side of the quill, and passed through a hole in the main casting at the top of the machine as shown in drawing 1. The nuts can be set to stop the quill vertical movement at any point less than its maximum travel.

This form of stop is very positive in action, but it is also inconvenient to use because of the time needed to screw the nuts up and down the rod to achieve the required setting. So it was noted for future replacement by something less tedious to use.

The larger sizes of drill/mills also feature a longitudinal stop on the machine table. It comprises a dovetail or tee slot (along the front face of the table), in which moveable stops can be positioned and locked. In some designs, each carries a thick washer, which encounters a fixed block attached to the table support thus limiting the table travel in either direction - see **drawing 2(a)**. My machine does not have this facility and the table does not have sufficient "meat" to allow such a slot to be safely machined in its front face, so some different arrangement is required if longitudinal stops are to be provided.

New depth stop

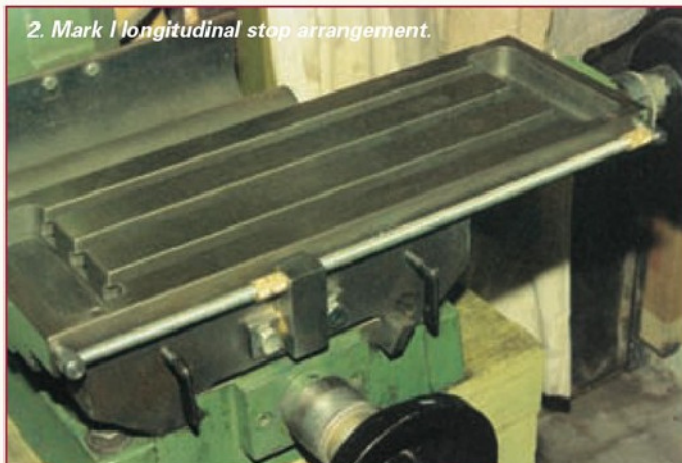
There is not much available space to fit in a replacement for the original depth stop. The design replaces the threaded rod with a square rod on which a block can be

Philip Amos describes some easy modifications to achieve enhanced accuracy and repeatability on a budget machine.

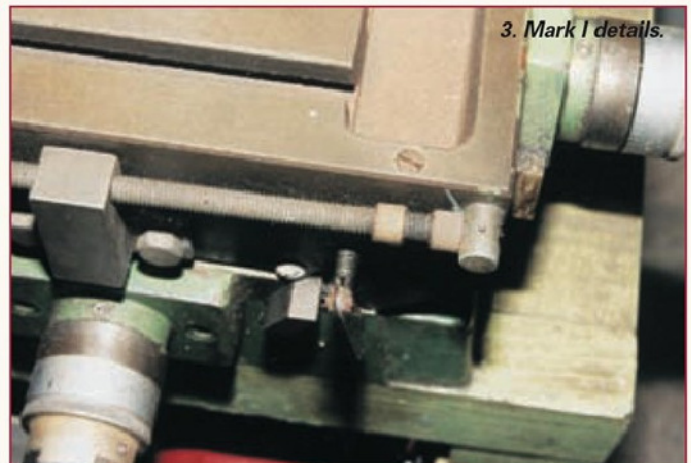
clamped as shown in drawing 3a and **photo 1**. The original mm scale item 4 was removed from the threaded rod; as it was fairly fragile it was attached with epoxy adhesive to a piece of 1.5 mm thick aluminium alloy strip item 5 to stiffen it. This was then mounted by means of two brass screws (D headed to prevent rotation) items 6 & 7 with knurled brass nuts items 8 & 9 to a piece of aluminium alloy angle item 3, in turn fastened to the side of the drill/mill head casting with two fillister head steel screws item 10. The brass mounting screws pass through slots to allow some vertical adjustment of the scale position. The brass screws/nuts are of different lengths to allow finger clearance to the top casting etc.

Originally the stop nuts (the top one is merely for locking) impacted on the "as cast" surface of the lug on the main head casting. As that surface sloped there was a slight difference in vertical position depending on whether the corner or side of the nut hex met the casting, so a vertical steel screw item 12 was inserted in the casting to form an anvil for the stop block. This screw was locked by a brass screw item 11 from the side (**drawing 3(b)**). With a rush of enthusiasm the steel stop screw was engraved with 10 divisions, to permit fine adjustment of its position - of course a needless and foolish conceit. If any control is needed finer than 1 mm then the vertical movement handwheel calibrated to 0.025 mm is available for use.

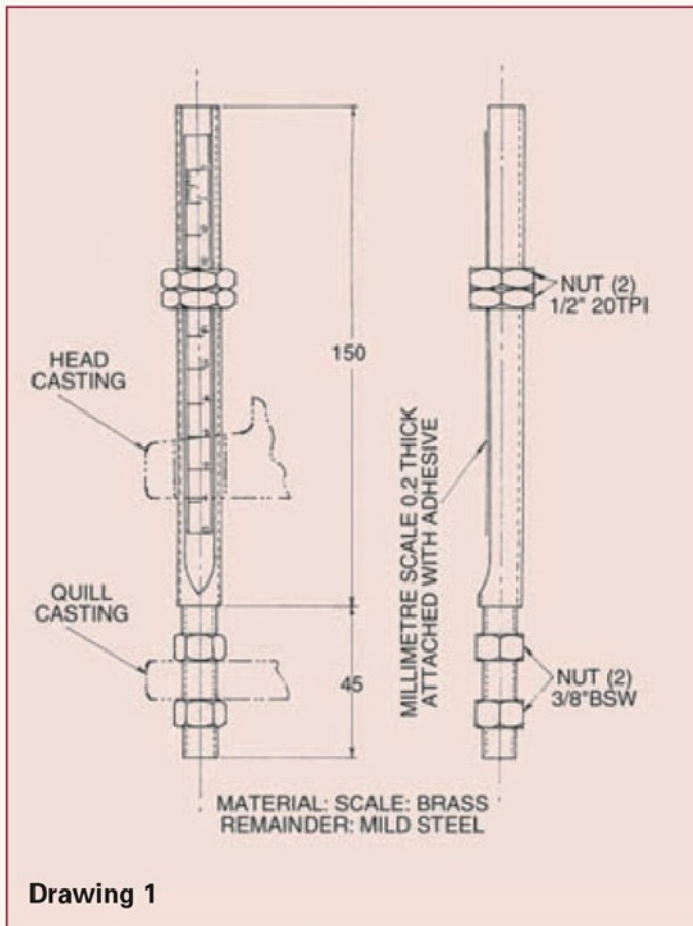
The stop block item 15 has a square groove through it, closed by a clamping plate item 14 actuated by a hex headed brass screw item 13. There is a "heel" on



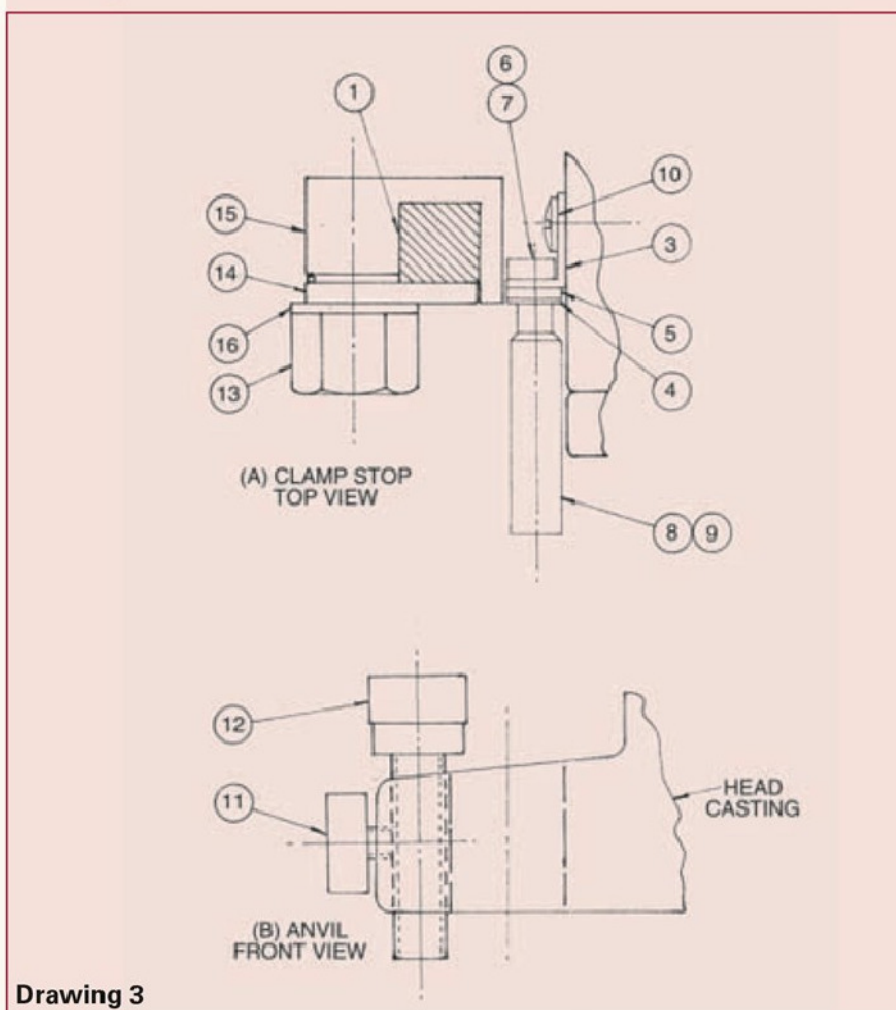
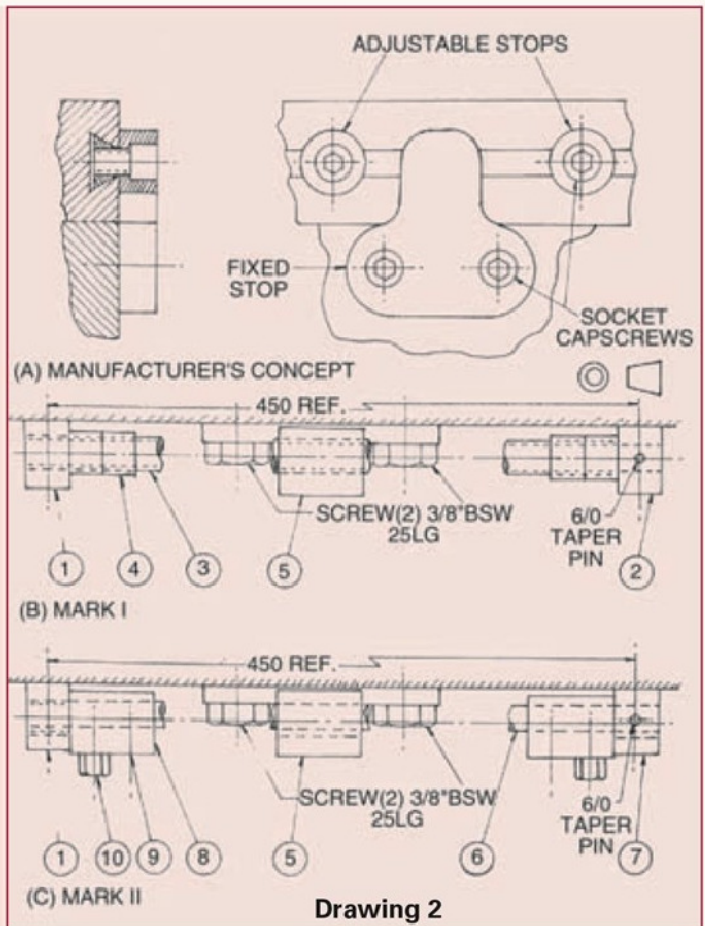
2. Mark I longitudinal stop arrangement.



3. Mark I details.



©



the clamping plate to improve positive clamping. All steel components were blackened with a proprietary solution after photographing, and the fiducial line groove filled with white paint for greater visibility.

Originally a knurled head brass clamping screw was tried but when finger tight this did not seem to adequately positive clamp the stop block to the square rod. **Photo 1** shows this knurled head screw in place.

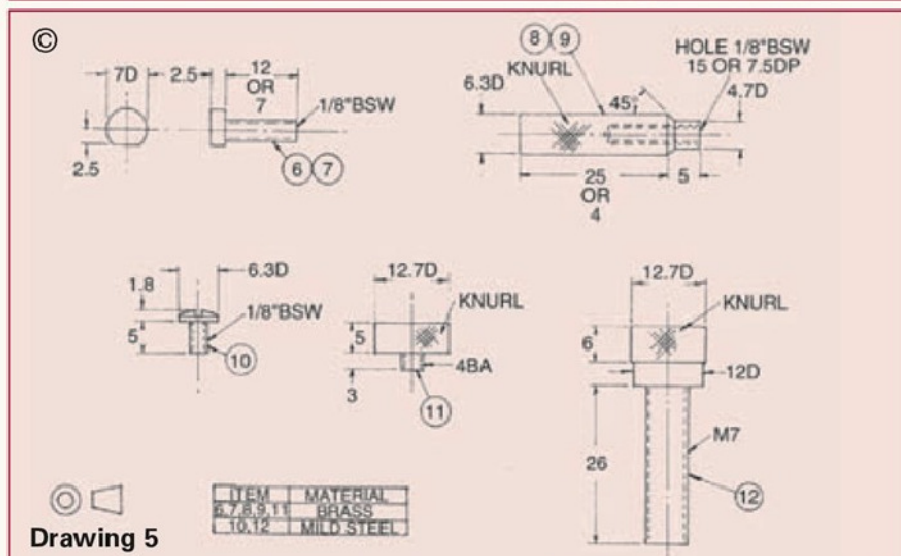
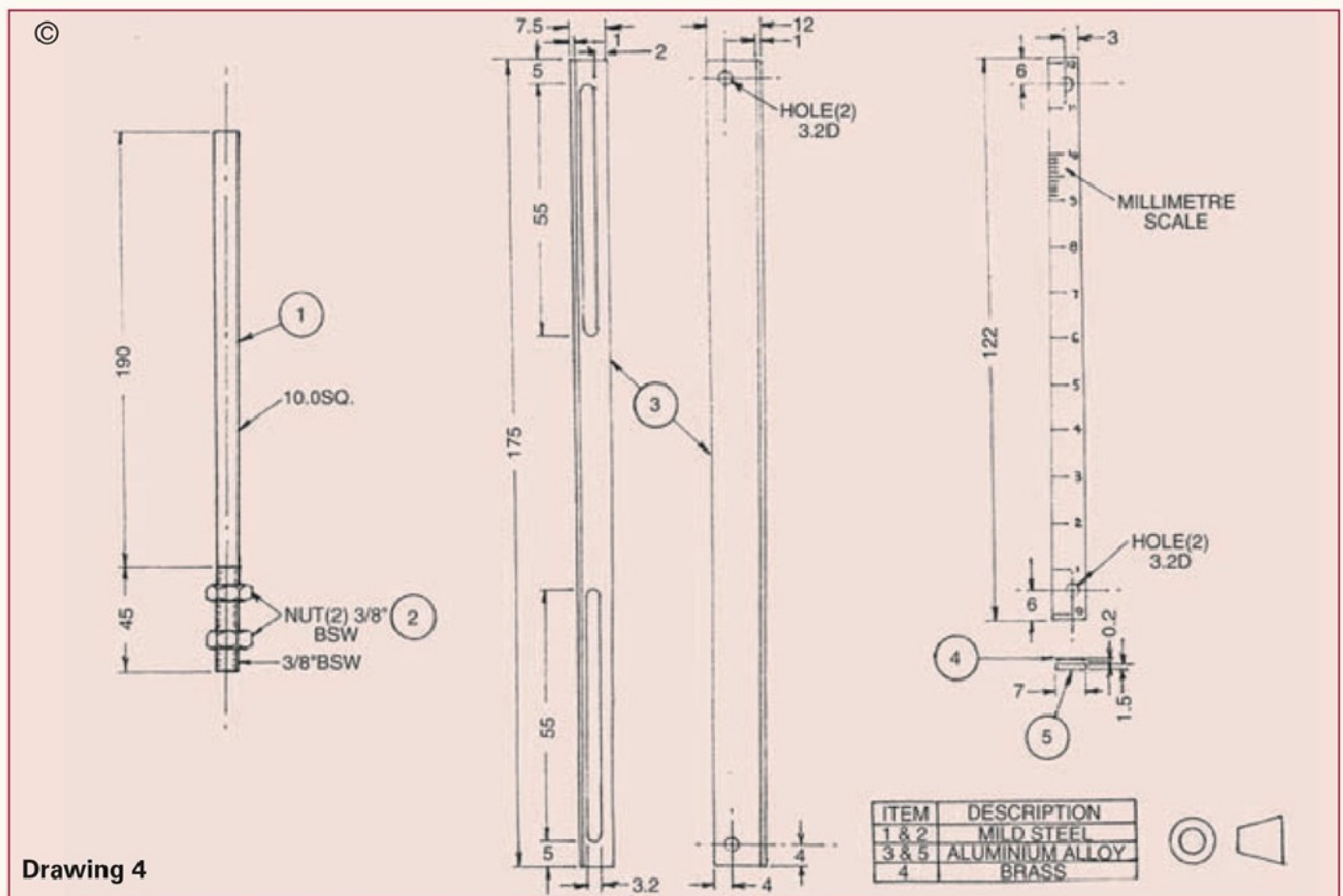
Longitudinal stop

The initial design shown in drawing 2(b) comprised a length of 3/8 inch BSW threaded rod item 3 attached to the front of the table by two mild steel posts. That on the left, item 1 had a hole threaded 3/8 inch BSW while that on the right, item 2, had a plain hole 7.1 mm diameter and the rod was turned down to 7.0 mm diameter for 13 mm of its length to fit. A transverse 6/0 taper pin through the right hand post held the rod in place. The left hand end of the rod has a screw driver slot for ease of manipulation.

At each end there were two knurled brass 3/8 inch BSW nuts, item 4, having an outside diameter of 12.7 mm. These would encounter a mild steel block, item 5, attached to the centre of the table support saddle; the threaded rod passes through a hole in this block.

The nuts can be set to provide a desired stopping point at each end of the longitudinal travel; the second nut in each case providing locking action - see **photos 2 & 3**.

This arrangement provides a very



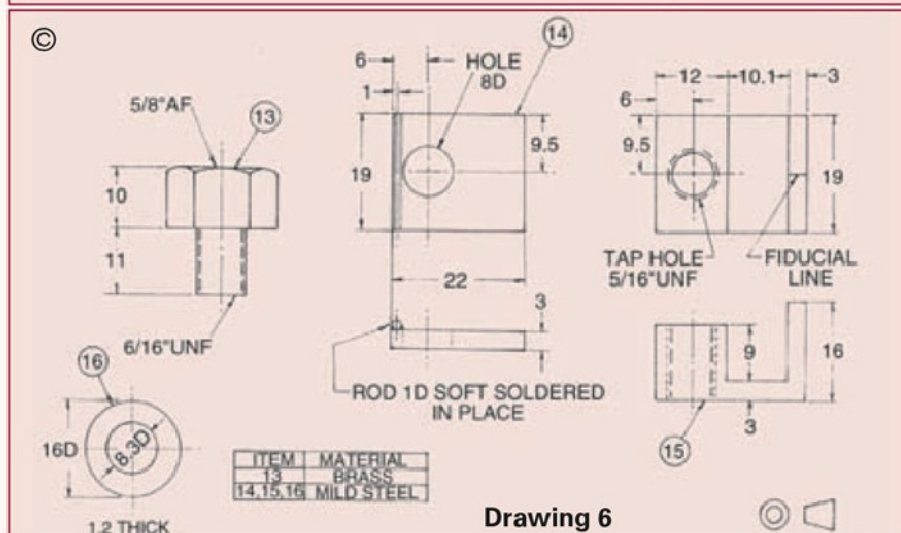
positive stop, but like the original depth stop it is inconvenient to use, because of the time needed to screw the nuts along the rod. Probably this is the main reason it has not had much service use; so recently it was decided to replace this system with something more user friendly –hence:-

Mark II

This later design is shown in **drawing 2(c)** and **photos 4 & 5**, and it substitutes a piece of $\frac{1}{8}$ inch diameter silver steel item 6 for the previous threaded rod. One end is threaded $\frac{1}{8}$ inch BSW to fit the existing left hand post, while the right hand post was opened out to 9.6 mm diameter (item 7). The new rod was also drilled to take the 6/0 taper pin albeit in a slightly different position. Two stop blocks of mild steel item 8 with dimensions 25 x 25 x 19 mm were drilled and reamed to 9.54 mm diameter to be an easy sliding fit on the rod (previously measured as 9.50 mm diameter).

The rod then had a flat milled along its length so that its thickness was reduced from 9.50 to 7.50 mm in that direction. This was an awkward multiple set up which can be seen in **photo 6**. The rod was forced back against parallels set in the rear slot of the drill/mill table and held down by clamps. The end mill height was set by reference to a pack of shims of the desired thickness, seen in the middle of the table. When each section had been milled one clamp was removed and refitted while the rod remained held in place with the other clamp. Finally to machine the flat towards the end of the rod it was necessary to move it axially; a level was set across the face of the flat to try to ensure its orientation remained constant.

The stop blocks were drilled and tapped $\frac{1}{8}$ inch BSW and each fitted with two brass



NEWTON TESLA CL 750 INVERTER DRIVE REVIEW



1. Inverter and motor set up for functional testing.

I was recently contacted by George Newton of Newton Tesla, which gave me a chance to pick his brains on some aspects of inverter set up. However the prime reason for his call was to enquire, whether, if he sent up on loan, a CL 750 inverter/motor package for a Myford Super Seven, would I be able to make time to fit it and try it out? That seemed to me to be a classic rhetorical question, and the package duly arrived on a next day delivery.

Readers may be familiar with the Newton Tesla ML packages which have been available for some time. The CL range does substantially the same job with simplified controls, but occupies less space and represents a significant cost saving.

Although I have already fitted a Eurotherm inverter to the Chipmaster, and am considering fitting a second hand IMO Jaguar Cub to the Myford VMC mill, both of these fall into the DIY category, as opposed to the Newton Tesla package which is professionally programmed and set up, supplied literally on a "Plug and play" basis, to use computer parlance. For the benefit of new readers, an inverter drive conveys the advantage of variable motor speed control, which in turn reduces the need to change belts, and allows the selection of optimum spindle speed.

Unpacking

The professional approach may be detected at the unpacking stage, the generously sized boxes, strapped together

as one, contain the expected impact protection material, but it then transpires that the motor box is actually less a cardboard box, more a mini pallet. The hardware comprises the inverter/control housing, and the matched three phase motor. The accompanying documentation includes a comprehensive instruction manual, certificates for the build / test schedule, and for the twelve month warranty.

Bench test

Like many others, my normal approach would be to ignore the instructions and charge ahead with bolting things on. However, as this unit was on loan, discretion prevailed, and the ten page manual examined first. The important points are first to undertake a visual inspection and report any transit damage (most unlikely), and second to set up the assembly on a suitable surface for a functional bench test (Photo 1). Wiring up doesn't require a degree in electrical engineering, just put the motor plug in the matching socket on the controller, and the 13 amp plug into the mains. Directions are then given which take you through the various controls to check out the system operation.

Bolting on

The instructions point out that the motor coming off and the new one going on are both weighty items, and a second pair of

Dave Fenner takes up the opportunity to try out the new model drive

hands would be useful for the manoeuvring. I worked alone with assistance of a suitable block of wood between motor and drip tray. The new motor fitted directly in place on the standard Myford mounting. It is mentioned that the motor is balanced with its key, so this should not be shortened. The pulley is locked in place by two grub screws at 90 degrees, one bearing on the key, and the second on the shaft. To avoid surface damage to the shaft, a copper disc was inserted below the second screw. (I save the scrap blanks produced by a hand punch kit for such occasions)

Mounting the inverter/control enclosure was a straightforward matter of marking out and drilling holes for four M4 bolts. As noted above, wiring is simplicity itself, and in fact I have continued to use the original lathe supply cable which, in addition to the original motor, also fed a pair of 13 amp sockets at the rear of the machine. One of these was a convenient outlet for the inverter supply. In terms of space taken, clearly the new housing (Photo 2) is wider and higher than the traditional Dupar reversing switch, however the forward projection is actually slightly less.

Controls

The controls comprise: three push buttons - emergency stop, start, and stop, and two rotary knobs, forward/reverse, and jog/speed. The operation of these is broadly self evident, but a brief explanation on the use of jog/speed may be useful. With this control turned fully anticlockwise to the jog position, the motor will run at jog speed (around 100 rpm) only while the start button is depressed. Turning the knob slightly clockwise clicks into the speed control mode, where the motor will start when the button is pressed, and continue until stopped by either the stop or Estop button. Motor speed is continuously variable from about 100 rpm to about 1800 rpm.

Spindle Speeds/ Inverter flexibility

Equipped with the standard motor, the Super Seven gives a theoretical total of sixteen speeds (fourteen recommended and shown on the machine data plate)

selected via the two speed motor pulleys, the four speed headstock pulleys, and the direct or back gear. Adding the inverter means that having selected any one speed as a datum, the actual spindle speed may be controlled down to less than 10%, and up to around 125% of datum.

Thus if the belts are set for the 1480 rpm spindle speed, the inverter gives control from around 110 rpm to over 1800 rpm, which probably covers 95% of requirements with no belt changing. If the belts are left in that configuration, and back gear selected, (a non recommended setting) then a spindle speed range of roughly 15 rpm to 230 rpm results. Thus we have complete coverage from 15 to 1800 rpm with no belt changing and just the engagement of back gear.

This of course sounds like perfection, and it very nearly is. There are however a one or two possible flies in the ointment. First the limitations of the lathe. Myford do not recommend using the two higher speeds in back gear, because the lubrication system has not been designed for these. In their handbook, the highest backgear spindle speed given is 161 rpm, (60hz motor) and this should not be exceeded. This limitation in the above belt setting corresponds to a motor speed of around 1200 rpm, but even accepting this we still have a comfortable overlap between the ranges. In a similar manner, if using the highest speed belt setting, Myford do not recommend exceeding their quoted maximum spindle speed. A further point arises if you want to do heavy, continuous work at low motor speeds, particularly if not in back gear. This is because the output characteristic of the inverter powered motor is constant torque up to about 1440 rpm motor speed, and constant power from there up. Thus although our motor is rated at 1hp or about 750watts, if it is taken down to 150 rpm, then although the torque remains constant, the output power falls in proportion to the speed to about 78watts. Simultaneously, the slow running motor loses out on cooling effect. If more torque is needed at low rpm then it is better to change the belts to suit.

Permutations and combinations

I have always found that engaging back gear entails getting the hands even more oily, and have tried to avoid it. Belt



2. Inverter control box located in place of "Dupar" reversing switch.

changing is quicker and cleaner. Looking further into the speed tables it would appear that with the inverter, just about everything can be done without backgear. Moving from the above arrangement to the 700 rpm set-up (move the headstock belt to position 4) will give speeds down to about 50 rpm, and then moving the motor belt to position B would take us down to under 20 rpm. Engaging backgear in this configuration could take you down to about 2 rpm. (Belt positions 4 and B are the designations given in the Myford handbook).

Preparatory paperwork

For the 1480 rpm setting, spindle speed approximates closely to motor speed, and can therefore be read fairly accurately from the control panel. For other belt settings, as my workshop does not at present boast a spindle tachometer, it seemed sensible to quickly draw the graphs to enable spindle speed to be read off for a given motor speed, which could in turn be dialled up from the control panel. This was done simply by plotting the points for standard motor speed against spindle speed given in the Myford manual, and drawing the line through the origin. Armed with this it then became child's play to select any ideal speed for a particular job.

Cutting metal

It was felt that a fairly severe test of the drive might be arranged by trying a heavy cut at fairly low speed in direct (not backgear) drive. Photo 3 shows a 1.75in. dia. piece of mild steel chucked in the three jaw. The speed was set to around 150 rpm, and a cut of around 0.180in. was taken, hand fed, initially with a gentle, fine feed, and then becoming progressively more forceful. The drive appeared to maintain its set speed, and ultimately, the limiting factor proved to be slippage of the countershaft to headstock belt. In subsequent use, switching from say 150 rpm up to 1800 rpm, by the mere twiddle of a knob brought a new found convenience. Previously I would probably have left low speed on for hole drilling out or pure laziness.

A week or so later, I made a start at cutting fins on Bentley cylinder barrels. The initial attempt using the cnc Orac was halted due to predictable difficulties with a front tool, and so the job was transferred to the Myford (using rear toolpost). The vari speed facility allowed progressive increases, eventually to around 550rpm, which seemed to give a good combination of cutting, whilst avoiding spraying out the brush applied coolant. As the motor was running at about one third rated speed it was felt worth keeping an eye on heat build up. Whilst not an accurate measure of internal temperature, after two hours of near continuous running, the motor casing felt only warm to the touch.

Use of clutch

I had earlier found on the Chipmaster, that after fitting the inverter, I tended not to use the clutch. With the new control, the start

and stop buttons give a smooth ramp up or down to speed. Users who are accustomed to "drive" with the clutch can of course continue to use it, but with the inverter I find it unnecessary.

Overall

With many of the items we choose for our workshops, there is frequently a make or buy decision. If belt and back gear changing is something of an anathema to you, then an inverter drive is likely to feature high on your shopping list. You may then consider either purchasing the entire package with all the hard work done, and ready to fit in around half an hour, or acquiring separately, the inverter, the motor, switches, cables, connectors and enclosure.

In the latter case, if you are using a motor of dubious provenance, it may not be engineered to take full advantage of the speed potential available, for which most modern motors are now designed. Furthermore, you will, (unless already familiar with the inverter) spend considerable time unravelling the mysteries of programming and control, with a good chance of not achieving an optimum setting. (The voice of experience.) Part of the programming activity at Newton Tesla, covers safety shut down aspects. The inverter settings are optimised for the specific motor and arranged to monitor certain parameters. If unsafe operation is detected, then the system automatically shuts down, protecting both motor and inverter.

One further potentially important point concerns radio frequency interference. I have a radio in the workshop, a few metres away from the machines, to which, now that the machines run quietly, I can actually listen. The DIY set-up on the Chipmaster still causes audible interference, the Newton Tesla unit on the Myford does not. My summary verdict has to be that if your budget will allow the package approach, or if your electrical know how is at all shaky, then give Newton Tesla a call.

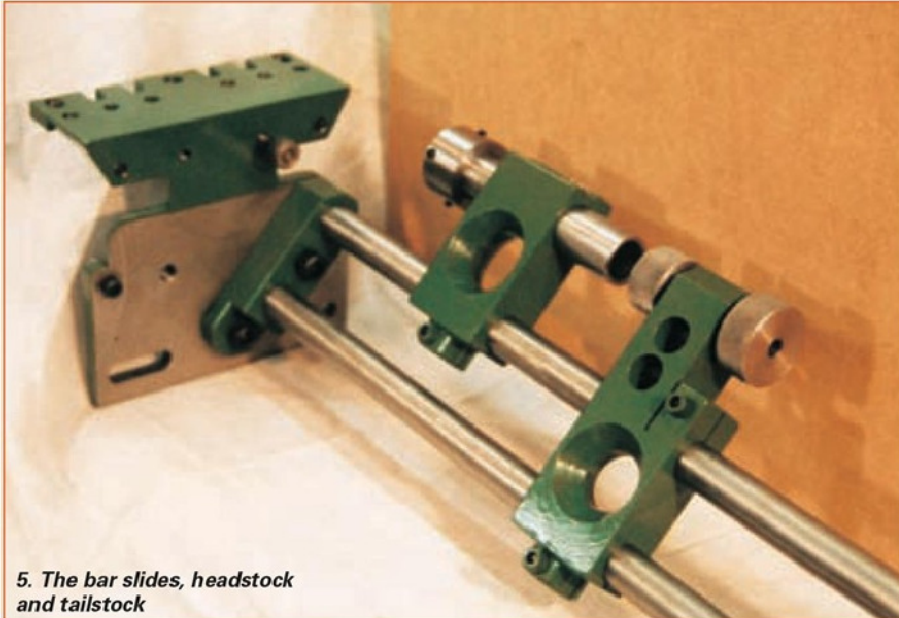
It sells itself

At a recent club meeting, I mentioned that the inverter drive had been fitted, and might be examined by interested members. Of two who visited that evening, one placed his order the next day!



3. Preparing to take a 0.180in. cut. The new motor can just be seen (blue) together with the makeshift swarf guard.

CONSTRUCTIO BENDING M



5. The bar slides, headstock and tailstock

Bar slides, headstock and tailstock

These details are shown in **Photo. No. 5**. You must first decide how long the bars will be, allowing for any space limitations where the machine is to be used. The maximum length of pipe from the start of the first bend to the end will be similar to the length of the bar. I made my bars from lengths of drawn bright steel, not perfect but better than I could have turned. Any blemishes were removed and emery cloth used to give a lengthways polish. They were not straight but when tried on a flat surface in various relative positions, it was possible to get the best match between the curves. Marks were made on each to show their ideal relationship for final assembly.

Saw cuts allow the bores in the headstock and tailstock blocks to be closed onto the bars by clamping screws. My stock of $\frac{1}{8}$ in. screws ran out so I used $\frac{1}{4}$ in. These are just adequate to deal with any undersize or ovality in the bars, but generally the clamping does not have the nice feel to it that it should have. Current design has reverted back to $\frac{1}{8}$ in. screws and I would further recommend using ground bar stock for the bars if you can get it, but remember it still may not be straight. An extra piece could be useful as a plug gauge. Turn, mill or file the bars to finish the ends.

A 10.25in. length of 2in. x 1.25in. section bright bar will be sufficient to make details 7, 8 & 8. and if the condition is reasonable be left unmachined on the face and sides. Detail 8. has two accurate bores reasonably spaced and parallel to each other and a less accurate cross bore only to remove weight. I find boring in the lathe gives the best control over hole size and

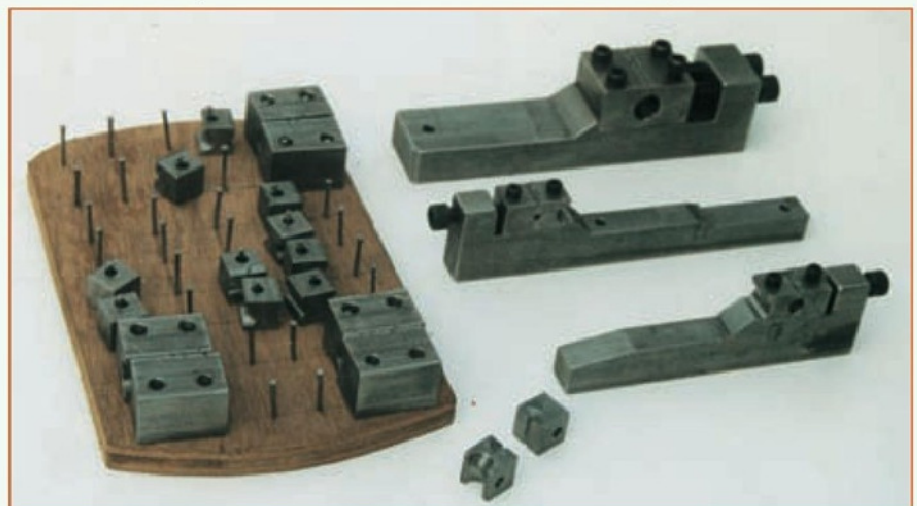
would use a 4 jaw chuck for the first bore and to skim the end face. This face would be clamped against the faceplate as the datum for the second bore done from the other side. While undersize check the wall thickness and work out the centre distance from the other hole. Correct if more than 0.010in. out. Use either faceplate or chuck to bore the cross hole and note that on this part it is not halfway between the existing bores. The block is not "handed" until you cut the step in the top face. Do this to the drawing with the datum side to the left of the left-hand view. Shape the bottom end but do not drill it until you have slit it and do not slit it until you are set up for the same operation on detail 7.

Detail 6. is clamped to detail 3. by two screws in two angular positions, the bottom screw is a pivot and the other fits

Ian Hunt concludes the description of his award winning design, which employs internal and external constraint.

either of two tapped holes. Check this function then use a 4 jaw to bore the top hole and skim the joint face. Shape each end but leave the second 0.750in. bore. I apologise for the 42 degree angle but this is to match the edge of detail 3. During my working life we had occasional problems where angles close to 45 degrees were measured from the wrong datum. The origin was often when the draughtsman intending 45 deg. found himself in some difficulty and instead of reworking the adjacent parts, issued work requiring 44 or 46 degrees. I always felt some sort of professional sin had been committed.

The outside shape of detail 7 should be sawn, milled and filed to shape. Using a chuck, the central 0.750in. diameter hole is bored from the left side and that side machined for a datum face. Now make a short spigot 0.750in. diameter with central clamping and fix this to your lathe faceplate at 2 inch radius. Use this in the existing bore to locate the part to bore the second hole. It is just possible to swing this in the gap of a Myford 7 as you have cut out the chunk which is too wide for the gap. Remove carefully and use the spigot location for the second hole in detail 6. Returning to detail 7 the ideal method would be to screwcut the large hole at the top, but as a swing of 5.4 inches is needed you may have to settle for drilling and tapping off the lathe. The drawing suggests two standard fine thread taps or you could even use B.S.F. This hole is for adjusting the far end of a long flexible arbor to



6. Large and small vices and various jaws

ON OF A PIPE MACHINE (2)

position the bullet head so if you cannot achieve perfect alignment, do not be too concerned. Detail 10 should be screwcut to a nice smooth, accurate fit in this hole.

Detail 7 has the same lightening hole bored and coned from each side as that on Detail 6 but has in addition, two more holes drilled through. I had difficulty painting inside these with a brush, so if you want to join them into a slot, do so. Both these details are shown with 0.062in. saw cuts to allow the distortion needed to clamp to the bars. Any saw cut from 0.010in. upwards will do, it depends on how fragile a saw you want to risk on this operation but narrower cuts look neater. The next item is to fit the three clamping screws so that the heads are on the upper side of these details when in use. Drill the tapping hole right through and open out halfway as shown on the drawing, not forgetting it is third angle projection. Tap, using the guide just made, fit the screws and have a trial clamping on the bars.

Assembly of bars, headstock and tailstock

The faceplate and spigot method of boring holes in two parts at the same centres should allow details 6 & 7 to be brought close together with the bars in place. If any problems appear, try rotating the bars to find a best position. In use the tailstock (Detail 7) will not need to be less than 3 inches away from detail 6 but must have free movement over the remaining length of bar. If you have found satisfactory bar positions and you can reconcile this with your previous matching of any curve in the bars they can now be fitted to detail 6. In this position. Drill the cross holes and fit the pins but make sure the block is the right way up first. If your mismatch cannot be so adjusted, detail 6. is the candidate for a rebore and a sleeve.

Headstock sleeve (Detail 15)

On a commercial machine the headstock is the major part, controlling the other functions and moving on a long slide for most of the machines length. It grips the pipe, moves it forward to space out the bends and rotates it when the next bend is in a different direction.

Ours is but a token effort but by gripping the length of unbent pipe with the sleeve, it moves with it and allows measurement from datums to space out the bends and will also indicate the length of pipe used in a bend. If you rotate the pipe between bends the angle can be read on the sleeve's engraved head against the edge of a rule located by the step on the top of the headstock block.

Use your biggest chuck and turn the sleeve to an easy slide fit in the headstock block. The head is engraved in 10deg. increments using a vee tool on its side in the toolpost. This will give a more definite end to the mark than a rotating cutter. If you do not have dividing facilities, here is a very easy way around it. Wrap a strip of paper round the chuck and mark so that when removed you can measure the chuck circumference. Use your calculator to divide this by 36 and to give you the distance from the end datum of each 10deg. mark on the paper. Make a distinctive mark every 30deg. as these are the longer lines to engrave. Tape the paper around and to the chuck and arrange a datum to read against.

If you are equipped for direct indexing from a gear on the lathe spindle with a 36 or 72 tooth gear you can use that. Bull wheels of 60 teeth are common on lathes but do not be tempted to engrave at 12deg. intervals or you will be doing mental arithmetic for ever after.

Your worst mistake will be cutting a long line where it should be short. I do the long ones first, then I know all the others are short. A dead stop to limit carriage travel would help to make a neat job, either a toolmaker's clamp on the bed or a length of scrap bar trapped against the headstock. The sleeve is tapped near the end for two opposed pairs of screws, these being offset so that pipes smaller than the screws can be clamped.

Bending spindle

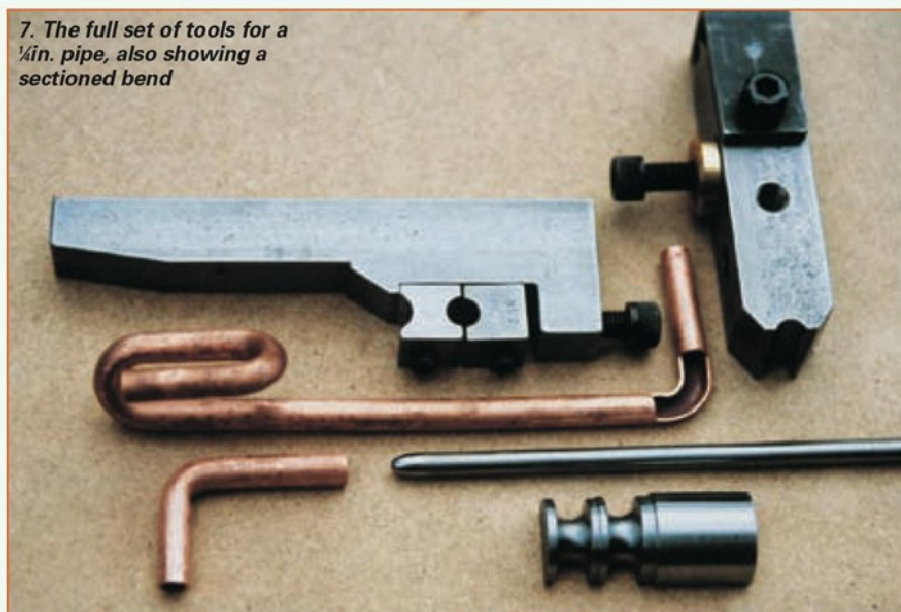
We left this item unengraved and without the hexagon to give you the option of indexing as just described and to buy a ring spanner. The engraved diameter is about twice that of the sleeve so you will

lose accuracy in spacing the divisions but the angular accuracy will remain the same. If you have no alternative to the paper method, consider using a faceplate to give you a longer circumference. I used a Myford dividing head for mine with a single point rotating cutter of about $\frac{3}{16}$ inch diameter. These are easily made using a short round tool bit fixed in a cross hole in a round bar.

If you have such indexing facilities and use them to produce the hexagon, you will probably grip the spindle at the head end and the hexagon end will need some auxiliary clamping or support while being cut. Fit the hexagon to the actual size of the spanner rather than the size it claims to be. Without indexing tools you can hold the stem in a machine vice with soft packing and space the six positions with a protractor measuring from the flats on the head.

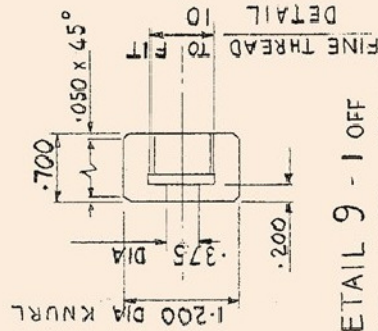
As the builder of the device, you are well aware that the spindle can be lifted out of its bearings and if the machine is held upside-down it could fall out. If however, the machine is to be handled by anyone else who may sue you for broken toes, consider fitting a capscrew in a radial tapped hole in the 1.490in. diameter to retain it.

Having engraved the spindle we need a zero mark to read against. This is on detail No. 19. File the flat to match the edge of the spindle and transfer the position of the zero line when the spindle flats are parallel to the back face of detail No. 1. This is the starting position for bends. Be sure there is clearance between the spindle bearing face and the end of this part. Now invert the spindle and repeat at the other end. Thereafter, be sure the two details 19. are always fitted in the correct holes.





2 HOLES .750 DIA CLOSE
SLIDE FIT ON BARS (DET II)

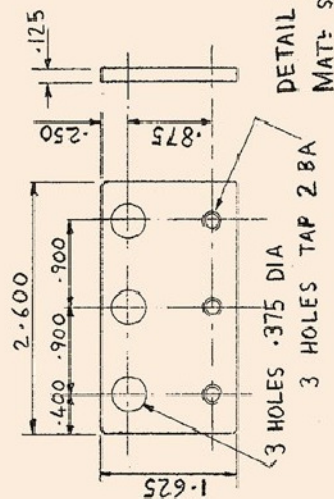


DETAIL 9 - 1 OFF
MAT: STEEL - 080N

1 HOLE TAP THRU .3125 B.S.F.

FILE FLAT &
MARK ON ZERO
LINE TO SUIT

ROUND CORNERS

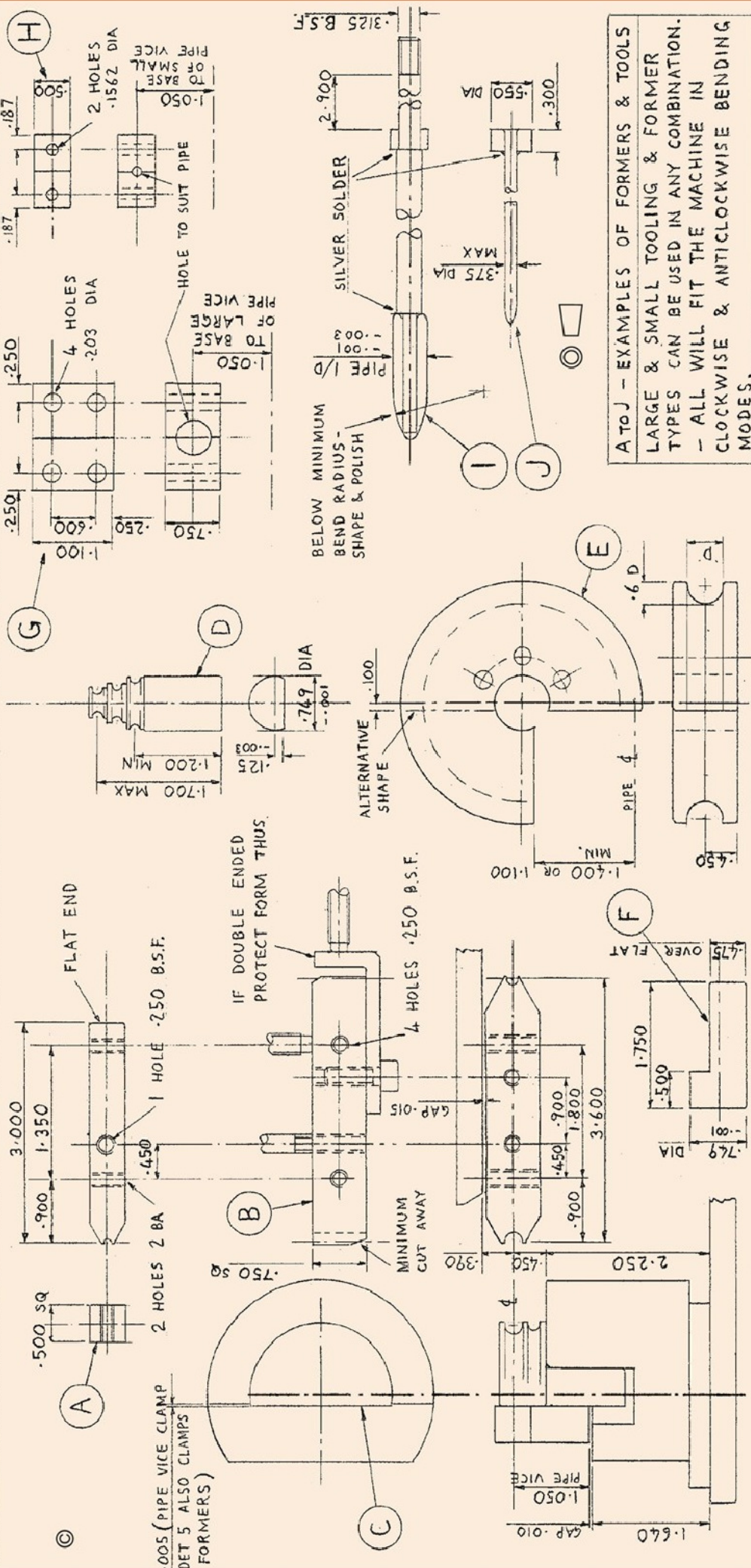


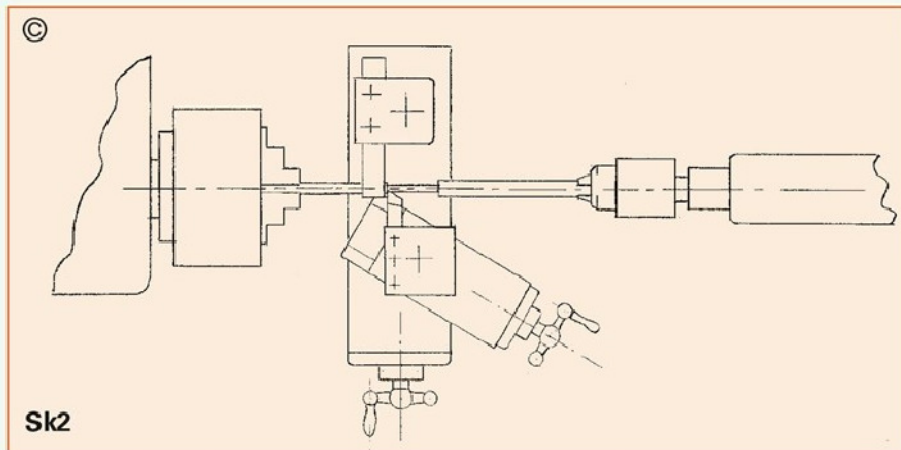
DETAIL 22
6 OFF
MAT: BRASS

DETAIL 20 - 1 OFF
MAT: STEEL O80 M 40

DETAIL 19 - 2 OFF
MAT: BRASS

DETAIL 21 - 1 OFF
MAT: STEEL O80 A 15





Pipe vices

Photo. 6 shows the large vice and both the small ones together with a few pairs of jaws located on nails on a storage board. The drawing sizes for details 16, 17 & 18, assume you will use $\frac{1}{8}$ inch and $\frac{3}{8}$ inch square steel stock for the jaws. If you are using metric stock adjust the sizes but maintain the 1.050in. height to the centre of the jaws. Changeover between the vice sizes is about $\frac{1}{8}$ in. to $\frac{3}{8}$ in. pipe. The reason for having two lengths of tail on the small vice, applies only on bends over 130deg. when the tail, having passed under the incoming pipe, may find the slot cut for it in Detail 3. insufficient to allow further rotation. If you only want to make one small vice, make the long one and if you ever encounter this problem cut its tail off.

Finishing and painting

A few small parts remain to be made which should not present any problems. We can then check over the machine, remove sharp edges, cut screws to length and make sure it is finished and clean. Painting is optional but it looks better painted. My paint store yielded a small tin of synthetic brushing enamel from Precision Paints Co. (L.N.E.R. Darlington Apple Green). Two coats were applied without a primer. It needs a few hours to dry properly which allows the brush marks to disappear and has proved to be quite durable.

Tooling

A full set of tools to cover every possible pipe size and bend radius would involve a lot of work and result in some tools that

would never be used. At the other extreme, only making tools when a job turns up, delays the job and makes the tool manufacture an inefficient one off operation. The best option is to make tools for sizes you expect to use and have a few part made tool blanks that can be easily finished to suit unexpected requirements. This can be applied to all the tooling except the formers, where there is no sensible part finished condition. I would advise keeping a list of tools made, so that eventually you can design your pipe work around existing tools. **Photo. 7** shows a full set of tools for a $\frac{1}{8}$ inch pipe.

Support pads

Examples of the types and sizes of tools are shown on the drawings. The small and large support pads parts A & B, are made from square bar long enough to allow the semicircular grooves across the ends to be produced by cross drilling and if possible, reaming. When the side of the hole is cut away about 0.6 times pipe diameter should remain and this made smooth and polished especially where the pipe enters at the back. The front corner will need to be cut away to clear the circular former which also has a 0.6 D. groove.

These pads are used suspended from two screws and have a small vertical float but no horizontal movement. This is constrained by tension and compression screws at the back and a pusher screw at the end. If you make the large pads double ended, you will need to protect the form of the unused end with an angle piece as shown. Making them single with a flat end like the small pads, avoids this. Pipes $\frac{3}{8}$ inch diameter and below should use the small pads. Loads on this part are

high and it may benefit from case hardening to reduce friction and prevent score marks from the pipe. **Photo. 8** shows three large pads.

Vice jaws (Parts G and H)

These are made from the same sizes of square bar as the pads, the large ones being 1.100in. long and the smaller 0.500in. long and are drilled a generous clearance size for the screws fixing them to the pipe vice bodies. They can be stored in this condition until you want to use them. Pipes over $\frac{1}{4}$ in. diameter would normally use the longer jaws but remember, the jaw length plus $\frac{1}{8}$ inch is the minimum distance between any two bends.

For drilling, jaws should be clamped in the pipe vice with their end faces level. A pilot hole will help the drill to cut to size and an ordinary drilled finish should give the jaw surface enough grip. The height of the hole from the base of the vice should be 1.050in. within plus/minus 0.005 inches. If this is a bit close, consider making a jig for a small starter hole from a piece of angle with good inside faces. Before removing from the vice, mark the top faces of the jaws with two or three random grooves across the joint face to identify them as a pair and indicate which face is the top. Separate the jaws and file a few thou. off the joint faces to ensure they can close on the pipe. In use the rear jaw is held tight by its clamping screw, while the front jaw is loose and the screw's function is to stop it falling off the vice or being dragged sideways if the pipe slips.

When pipes are bent through 180 degrees, the fixed jaw finishes up inside the bend and will need a step cutting out of its back face if the jaw width is more than the inside dimension of the bend. On small pipes this could be as little as $\frac{1}{8}$ inch and the jaw would need reshaping around its fixing screw. One cut away in this manner, is shown in **Photo. 9**. None of this applies until bends exceed 130 degrees.

Bullet head arbors

Two types are shown on the drawing. Type J is limited to 0.375in. diameter as it is clamped by the special nut (detail 9) and this must pass over the arbor. The other type is used for the larger sizes, passes through the tailstock screw and is clamped by a nut. If you reverse the tailstock block on its bars or just put its screw in from the



8. Three large support pads, one fitted with the protection angle piece.



9. The fixed jaw has been cut away to clear the pipe on a 180deg bend.

other end, other clamping possibilities become apparent. The bullet head is turned, filed and polished in the lathe until it looks right. Only its parallel diameter needs to be measured. So far I have never damaged one, worn one out or felt it necessary to harden one. The really tedious thing is producing the long shank which obviously cannot be larger than the head and is preferably slightly smaller. The shank carries the length of straight pipe to make the job from its first bend to the end so they can be very long and thin. If you can find the right material sizes and use the type 1 design, you can avoid the problem of turning long flexible lengths.

If turning is unavoidable I offer the arrangement shown in **Sk2**. A piece of square stock held in the rear toolpost is centre drilled and drilled from the headstock, the topside set at 30 degrees and a tool set up to turn down the bar as it emerges from the steady hole. A piece of tube in the tailstock drill chuck will constrain the reduced bar. Between the tool and chuck the bar is being twisted and as strength in torsion is proportional to the fourth power of its diameter, small diameters are weak in this respect. For example $\frac{3}{16}$ in. is 3.16 times weaker than $\frac{1}{4}$ in. diameter. For this reason you may need to work close to the chuck and turn in several short stages. If you are making several sizes, start with the smallest and open out the steady hole for each material size.

Catalogues from two M.E. suppliers offered copper pipe from $\frac{1}{8}$ in. to $\frac{1}{2}$ in. diameter with alternative wall thicknesses resulting in a possible 27 bore sizes, so I advise limiting your arbor production to the sizes you intend to use. **Photo 10** shows a bullet head inside a $\frac{1}{4}$ inch pipe bent around a 0.340 diameter former. Material inside and outside the bend has gone thick and thin as expected and the bore is very smooth. A bullet shape suitable for such a tight bend will be suitable for all larger bends and could be used further forward without fouling the inside of the outer wall. The 180 degree bends on the same pipe were produced with little effort in a single two second movement, but restarting to bend further required much more force. Perhaps the sliding surfaces were under pressure and the lubricant squeezed out.

Formers

Each pipe diameter will need a choice of bend radii, but fortunately it is possible to



10. Sectioned pipe reassembled with bullet head to show positioning.

combine two or three grooves in each former and again we have two basic designs available.

Referring to the drawing type 'D', these should be turned on the end of a length of steel bar so that there is something to hold on to while milling the flat. This type moves up and down in its location to align each groove with the pipe vice. In this case the vice sits on its base on the step of the bending spindle and this determines the working height. With the type 'E' former there is no vertical movement and it is the vice that is lifted into alignment with the groove in the former. Type 'C' uses both systems depending on which groove is being used. The clamp on the side of the bending spindle locks the vice, former and spindle into a single solid assembly.

Type 'E' formers are made from steel, cast iron or aluminium and can have a single groove as shown on the drawing or have two grooves, and then be used either way up. Only the semi-circular form is fully universal in this respect and if made to the 270 degree shape shown will need additional clamping holes. More fundamentally, if you bend much more than 180 degrees you cannot get the pipe off and this leads to the complication of split formers located and screwed together. All this type are bored through and locate on part F. The bending spindle offers a choice

of pitch circles for the screws clamping this type of former. **Photo 11** shows the locating spigot and the differing types of former.

Grooves

All these formers have grooves turned to a depth of 0.6 pipe diameters. The small grooves I made with form tools, and the larger by generating the shape with cross and topslide movements. To avoid cutting into the pipe, the corners should be rounded and polished.

If you are producing formers with 2 or 5 grooves, it is better if you draw them out to scale and make sure the pipe support pad can get to each groove, rather than designing it in the lathe. A further consideration is the strength of the groove sides, the bullet head stops the pipe collapsing inwards, the former stops it bulging outwards. Sharp bends end up tight in the groove because of this expansion.

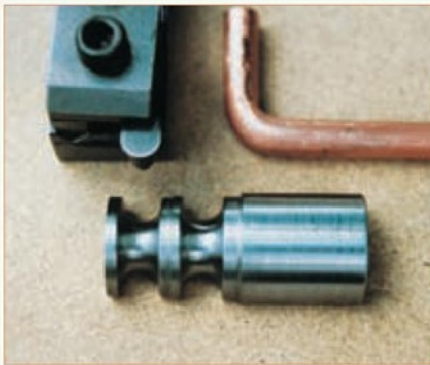
Not many of us will have form tools to produce the semicircular grooves in the formers. **Photo 12** shows one of a set of four tools I made with hardened silver steel tips soldered to mild steel shanks. To make the tip, start with a piece of silver steel rod a size larger than the form required and turn a short length to about a quarter of the diameter. Set the topslide to 6 degrees and turn and polish the tapered



11. Various configurations of former.



12. A form tool made by silver soldering a silver steel tip to a MS shank.



13. Carbide tip in holder with resulting former and tube

section to a fine finish. Cut off where taper is a bit larger than finished tool size.

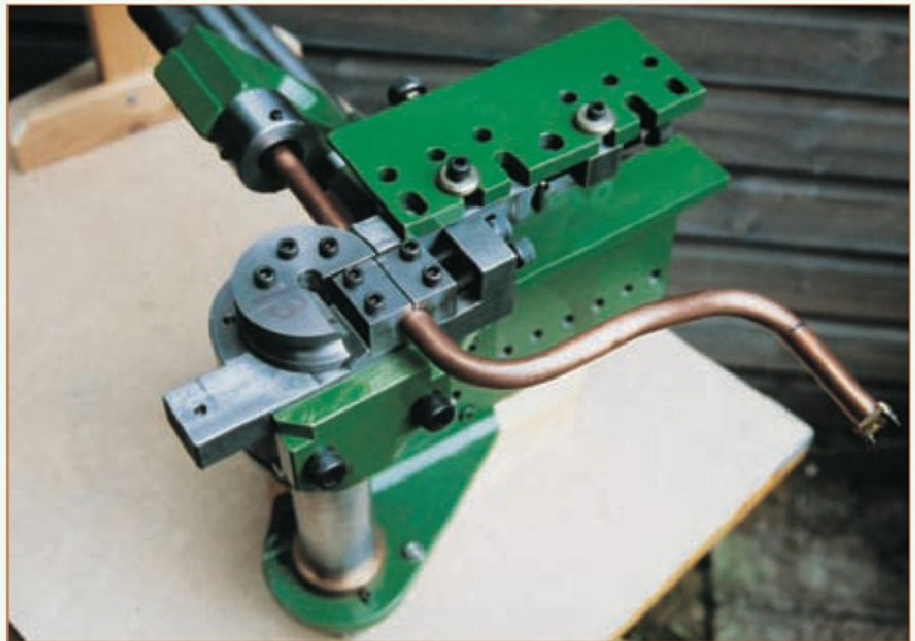
Use a piece of $\frac{1}{2}$ inch square mild steel to make the tool shank. Cut the end to the shape of a short parting tool with the end about the width of the form needed. Drill a small vertical hole through the middle close to the end, to locate the tail of the tip just made. File a step so that the tip can locate in the hole with about $\frac{3}{4}$ of the taper supported by the shoulder. Make sure the locating hole is through, not blind. You now have the shape of the finished tool, but the tip needs silver soldering in position and then hardening. First suppress your inhibitions about quenching overheated liquid solder. Select a gas burner of adequate size and apply heat to the body of the tool until the heat conducted to the tip is sufficient to complete the silver soldering. (Easy flow 650 deg C) Then transfer the flame to the tip which should rapidly rise to hardening temperature because it is of small volume and the shank is too hot to draw heat away from it. When cherry red (900°C) quench in water, brine, cooking oil or whatever is your favourite medium. All this should be over in a few seconds so you should not need to breathe the poisonous cadmium fumes from the overheated solder.

Check for hardness, clean up and make sure the front tapered part is clean polished and free of solder. At this stage I gave mine a very slight temper to a pale straw colour. Now, using the side of the wheel, grind the top of the tip down until it reaches the part of the taper which gives the right size. You can give the front edge a few degrees of top rake but at the sides it will be zero. Use water and be very careful not to overheat while grinding. These precious tools I use only for finishing, at slow speed and well lubricated.

I have been given many carbide tips over the years but the only one that justified making a holder is the $\frac{1}{2}$ inch tool shown in **Photo 13**. This is used for all formers above $\frac{1}{2}$ inch by generating a circular movement using cross and topslide movements to calculated distances. For example, a $\frac{3}{8}$ in. former would need an orbit around a $\frac{1}{8}$ in. radius and the topslide position calculated for 0.005 in. increments of the cross slide to 0.050 in. depth and then change to 0.002 in. increments when the topslide movements became too coarse. Finish each side of the form in turn.

Bending operations

Having made the machine and tools and



14. Formed pipe featuring several bends at different angles.

noted the function of the various parts made, only a few additional comments are needed. I have bent only copper, brass and stainless. If the material allows, anneal it unless the bends are quite large. Make sure the bullet head can move through the whole length of pipe without obstruction. Hold a short bar or piece of straight pipe in the vice and push fully into the former to set the vice at the right radius and height, then clamp solid. Mount the support pad on the underside of the angle piece and use the slots and screws to bring to its working position. If not using the headstock remove or swing to one side. Fit the arbor, adjust and lock the tailstock and use the screw to adjust the bullet head profile to be just clear of where you think the inside of the bent pipe will be. The former is a good guide for this. Rotate the spindle to be sure nothing will foul before the bend is complete. This includes whatever is used to turn it. Fit the pipe over the arbor and oil inside and out except where the pipe vice grips. An aerosol cleaner can be useful here. Check that the support pad can float vertically to seat the pipe in its groove and that it will not back away or move in any horizontal direction.

A single sweeping and fairly rapid movement gives the best bend, you can stop and restart if you need to but it is not quite the same. I suppose at the start all the material is soft, whereas at a restart it is partly work-hardened. When released the pipe will spring back slightly, increasing its bend radius and decreasing the angle of bend. The amount depends on the geometry and material, but overbending will correct this.

Conversion to opposite mode

As mentioned previously, the machine may be rebuilt to operate in the opposite hand. This has involved only a small amount of additional work on the parts and the conversion can be done in a few minutes. The reason for this facility is to cater for those pipes with several bends

where the next clockwise bend cannot be made because the pipe, pointing downwards, fouls somewhere, but would not foul if turned through 180 degrees and pointed upwards. After conversion, the required bend is made anticlockwise with the pipe upwards. All the same tooling fits either way.

A further option for situations where the bend radius is large compared to the pipe diameter, is to use the machine without the internal arbor and its mountings.

Conclusion

My last contact with our works bending machine started with a phone message "the seals are packing up". A visit revealed an oil tank at the temperature of the fryer in the local chip shop and about the same colour. The shop electrician had changed the controls to make it safer after an operator had trapped a finger. A consequence was that the dump valve which allowed the hydraulic pump output to return to the tank at zero pressure for most of the time, was permanently closed. The pump was constantly at full pressure instead of during just the short times when movements were needed. All the surplus oil was taken by the safety valve and the wasted energy turned into heat. A return to the original condition was agreed by all involved.

It must be twenty years now since, in management jargon, pipes were "outsourced", the machines moved out of the works and the people employed elsewhere. No chance for the next generation of engineers to see the process or need to know anything about it, their attentions replaced by modern specialisations unfortunately less applicable to the home workshop.



Supplier

Materials for the Pipe Bending Machine may be obtained from:
Blackgates Engineering, 207/209
 Wakefield Road, Drighlington, Bradford,
 West Yorkshire, BD11 1EB. Tel. 0113
 285 3652, email sales@blackgates.co.uk

INDEX FOR ISSUES 81 TO 92 OF MEW

The information contained in this index supplements that published in issue 83, and brings the information up to issue 92. A computer based index is also available for those with suitable equipment to run the software.

MODEL ENGINEER'S WORKSHOP SUBJECT INDEX

This section is arranged by Subject, listing Articles, Quick tips, and Letters to Scribe a Line. Columns five and six, e.g. 89 37 refer to the particular issue and page number.

Key to the Symbols used in this section of the index

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Column 7 A=Article, T=Trade, L=Letter, Q=Quick tip, S=Subject

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GEARS	M	GEAR CUTTERS NEW APPROACH	MAKING FORM RELIEVED CUTTERS	91	12	A
GEARS	M	RACK AND PINION SPL FORM	VARIABLE RATIO RACK AND PINION	85	36	A
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HISTORY	M	TWIN VERTICAL MILL	TWIN ENGINEERING MILLING MC	92	55	L
INST/SERV	C	HALF NUT MAKING	DRUMMOND HALF NUT REPLACEMENT	85	17	A
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MATL METAL	M	STAINLESS TYPES/DATA M2	MUSING ABOUT STAINLESS STEEL 2	84	26	A
MATL METAL	M	STEEL TYPES/SPECS	BRIEF NOTE ON STEEL SPECS	86	51	A
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MEASURING	C	NOVEL MEASURING DEVICE	HAHN AND KOLB GAP GAUGE	84	43	A
MEASURING	C	PARALLELS SEMI PRECISION	MILLING PROJECTS BEGINNERS 3	86	12	A
MEASURING	C	SINE BAR MAKING AND USING	TOOLMAKERS SINE BARS	92	38	A
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MEASURING	M	DIGITAL DIVIDING DEVICE	DIVISIONMASTER REVIEWED	92	30	T
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MODEL ENGINEER'S WORKSHOP COMPUTERISED AND INTERNET INDEXES

As noted in Trade Counter, the computer based index continues to be available from CAHW Systems. Supplied on two floppy discs, it is a DOS program which runs quite happily on a Windows system. Facilities are provided for View, Search, Sort, Edit, Update, and Print. Cost is £5-00 plus £2-00 carriage on non UK orders. CAHW can be contacted at 23 Fieldway, Berkhamsted, Herts. HP4 2NX

Readers with internet access will be able to have a look at the M.E.W. index posted on Colin Usher's web site.

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.

"MEW" Computer index

As can be seen in Scribe a Line the computer index which has been available since the early days of the magazine is in need of a new compiler. Because of this and the uncertainty this creates for future updates, the index is now available at a reduced price, rather than discontinuing its availability. This ensures that anyone who is prepared to obtain a copy under these circumstances can still do so.

The index has editing facilities so it can be kept up to date should updates cease to be available. It is a DOS based program but works perfectly on Windows systems and no knowledge of DOS is required. It is presently supplied on two floppy disks but copies on a CD should soon be available. A detailed manual is provided. **The price is £5.00 including P & P and can be obtained from CAHW Systems, 23 Fieldway, Berkhamsted, Herts, HP4 2NX.**

New from Chronos



Drilling hardened steel with carbide drill. Blue swarf can be seen in foreground.

As many of us have found with turning tools, carbide can give us benefits of longer tool life, increased speed, and the ability to cut harder materials. Chronos have recently announced two sets of solid carbide items. First is a set of six solid carbide metric drills (3, 4, 5, 6, 6.5, and 8mm). Not to be confused with carbide tipped masonry drills, these are very much precision items for metalwork, having four facet points.

For amateur drilling purposes, of the inherent advantages noted above, it was felt that the longer

tool life and the hard material capability would be the more relevant, and of these the latter would be feasible for experiment. The scrap box yielded a piece of 1in. by 1in. gauge plate which, some time ago, had been used to make a form tool. It had been hardened but not tempered, and while the exact hardness is not known, files simply skated over the surface. This was set up on the drill and attacked with the 6mm drill running at around 1000rpm, with the occasional brush application of Moly slip cutting compound. The drill went through quite happily requiring a little more pressure than when drilling mild steel with a high speed drill; the resultant hole and blue swarf can be seen in **photo 1**. The set of six solid carbide drills arrives in a wooden box, and is available from Chronos under code SCT025 price £29.95.

It is quite some time since I was involved in modifying cylinder heads, with the attendant changes to compression ratio and porting, and much fettling and polishing involved. I seem to remember hours spent with a power drill and high speed burrs. The all carbide burrs now offered by Chronos, should present the opportunity to use higher speeds, and hence get higher stock removal rates. I didn't have a gash head lying around, but thought that a length of 10mm thick alloy plate would suffice for a quick trial. The edge shown uppermost in **photo 2** had been cut with a plasma cutter, and was to say the least, more than a little rough. All the burrs have 6mm shanks, which conveniently fitted an air powered die grinder. It proved to be the work of just a few seconds to smooth off half the length as depicted. There are a total of twelve differently shaped burrs in the set, which comes in wooden stand with plastic cover, and is available as code SDY067B price £39.95.

All Chronos prices include VAT and UK mainland carriage. They can be contacted at Unit 8, Executive Park, 229/231 Hatfield Road, St. Albans, Herts, AL1 4TA or phone 01727 823 793, email sales@chronos.ltd.uk website: www.chronos.ltd.uk



Showing the rough cut edge and the section quickly smoothed with a burr.

Fireside Reading

Having fitted an inverter to the Chipmaster, I was left with the question of powering the (three phase) coolant pump, and for guidance decided to consult the two books by Jim Cox, "Electric Motors", and "Electric Motors in the Home Workshop", numbers 16 and 24 in the Workshop Practice Series. Strictly speaking these are new to me not the market, so their inclusion in Trade Counter is entirely due to my assessment that having found much to interest me, a few comments might benefit others. The first title looks at various forms of motor, induction, commutator, and stepper, gives advice on running three phase units from single phase supplies, and on identifying and using scrap equipment. The second, as the title suggests, is more workshop oriented, containing useful circuits for commutator motor speed control, and some unexpected but potentially useful information on recharging, maintaining, and recovering batteries. It too, examines the use of single phase power on three phase machines, gives some typical workshop applications, and considers the practice of remagnetising motors. **Both books are available from Special Interest Model Books Ltd. PO Box 327, Poole, Dorset, BH15 2RG. or from model engineering suppliers and bookshops.**

Cut to size Service from Folkestone (at Hawkinge)

Two sheet cutting machines have now been installed at Folkestone Engineering Supplies, a 50inch Edwards guillotine to handle up to 10gauge, and an Evolution saw for thicker materials. This means that customers can buy material cut to the size they require rather than going up to the next stock size. The sheet materials catalogue now includes brass (CZ108, CZ120), copper (C106), stainless steel, aluminium, and mild steel.

Folkestone engineering supplies can be contacted by phone on 01303 894 611 or at 62 Canterbury Road, Hawkinge, Kent. Email is metal2models.btoopenworld.com, and website: www.metal2models.btinternet.co.uk

MK.3. WIRE ERODER (1)

History and background

Readers of longer standing may recall that back in the last century, (well, 1999 to be exact), I penned a series of articles on the spark eroder. For the benefit of anyone who wishes to refer back, these were published in M.E.W. Nos .57,58,59, & 60., also there were follow up articles in Nos.64 & 68. The dates for these are as follows:- April, June, July, & August. 1999. and October 2000.

The electronics for this machine were originally designed by Robert Langlois of Ontario Canada, and I am still in debt to him for letting me use this design, and again my thanks. In November 2002 I received a telephone call from him in Canada saying that he was coming over to England in December on family business and could we meet. Naturally, I was most happy to do so. By arrangement he arrived in Charing and we had a very pleasant four hours interlude before he was compelled to continue with his busy schedule.

Part of this time was taken up in general topics but part of it was used to tell me about the new thoughts for adding to the spark eroder and making a wire eroder, using all of the electrics but designing a new "Head". This was a very interesting concept and for a short while afterwards I toyed with the idea of building a similar device, but then mentally placed it to one side. However it proved to be one of those ticklish problems that would not be put completely out of mind, and about six weeks later I again found it running round in my head. As at that time, I could not think of an alternative way of winding the spool, I therefore decided to follow the basic design.

Technology and design

The underlying idea of the wire eroder is to use the moving wire (which is then only marginally consumed in the pass) in conjunction with the electrical characteristics of eroder technology, to cut even the hardest material in a bath of electrolyte, rather as a wire cuts cheese. I do not propose to repeat all of the basics again as the fundamental principles are the same whether it is an electrode or a wire. To give some insight of the design of the Langlois System I have included a photo 1 of my first Mk. 1 Wire Eroder together with a sketch of the wire reeving (Fig 1) that I used on that machine, and a

1. Mk.1 Wire Eroder, electrolyte tank removed for clarity.



part GA drawing (Fig 2) to give some idea of it's workings.

The system was to use a single spool which holds a single layer of wire. This is wound on and off the spool at the same time. A sliding weight serves two functions, to ensure a controlled level of tension, and to accommodate the changes in loop length when the cutting section is moved. This winding requires to be "Precision" wound that is each layer must lay next to and not over the previous wire. This requires a mechanism to guide the wire and for this purpose, it is more straightforward to move the spool and hold the guides stationary, than vice versa. The design concept for this mechanism was used I believe was originally suggested at a meeting of one of the model engineering societies in Canada, by Matthew O'Boyle, who was at the time living in South Carolina. This system uses two opposing screw threads or the rotation of the "Bolt" and the "Nut" in the same direction but with a different rotational speed.

For example using a 24 tpi thread, gives a movement of $1000 / 24 = 0.04166\text{in.}$ So, if we wish to get say an 0.008in. movement from this system, it is necessary to rotate the shaft by one turn and also turn the nut in the same direction by a smaller amount. To this end it will be necessary to move the nut axially by $0.04166\text{in.} - 0.008\text{in.} = 0.03366\text{in.}$ which in turn equates to a rotational movement of 290.35 degrees.

All of these figures are arbitrary and would be rounded up to give a clearance to the wire and not down as the wires could then run back over the previous wind. In other words the 290.35deg. might be decreased to say 280deg. Ultimately, the precise figures will be dictated by the

Peter Rawlinson moves forward from the spark eroder to a continuous wire machine.

ratio of the numbers of the teeth that will be used on the two timing belt pulleys. In my case I used a ratio of 30 to 24 and a 24 tpi screw. This gives me a ratio of 5 to 4, and results in a movement per revolution equal to 0.00833in. This of course can be varied to give any desired movement within the numbers of the standard timing pulleys available. I had at this stage arranged to purchase a small amount of "Molybdenum" wire of 0.008in. dia., but I also obtained some fuse wire, this being 35 gauge tinned copper and is also 0.008in. dia. So you will see the reason for the initial ratio.

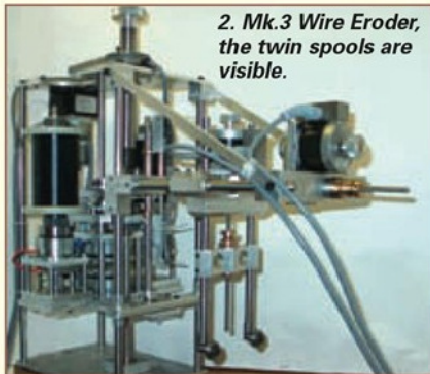
Sourcing wire

Mk. 1 was duly completed with a few amendments and a drawing of this one with it's twin axes of movement is shown to give the overall layout of the machine, but this was never tried in anger. At this stage I started to investigate the commercial availability of suitable wire on the market in England, and made a series of telephone calls to five wire suppliers. All of these people, with the exception of one, were most helpful, however each one of those tried had stopped production, but was able to suggest another company. In the end I found one who, although they did not any longer supply this material, found that they still had some in stock. They most generously offered it to me for the cost of the carriage which in the end was not billed either, and here I wish to thank them once again.

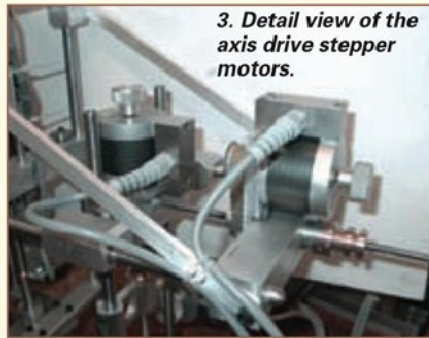
This material is very expensive it is available in 5 Kilometre reels, yes! 5000metres and a reel of 0.008in. dia. in the USA Costs \$1000. My wire is only 0.003in. diameter and the spool also specifies the breaking strain, which is 0.449Kg. Again there is 5 Km. on the spool and the whole thing weighs only about a pound. To give some idea of the size of this wire, it's about the same thickness as a hair from the head of my four year old grand daughter.

Two spool arrangement

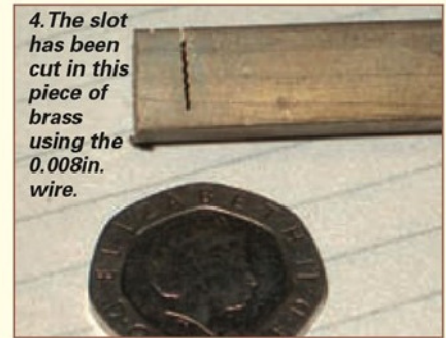
When I received this spool I took a long hard look at my existing machine and decided that this was not the way things would be done in industry. I assumed they would wind directly from the spool supplied and onto another spool of the same size. Somewhat reluctantly, I



2. Mk.3 Wire Eroder, the twin spools are visible.



3. Detail view of the axis drive stepper motors.



4. The slot has been cut in this piece of brass using the 0.008in. wire.

decided that it had to be rebuilt. This was not a decision to be taken lightly as there would be a minimum of 100 hours of design and manufacture involved.

The first problem was to obtain a second spool identical to the one with the wire on. This proved to be a much bigger problem than the wire as after trying a number of rewind specialists, it seems that all spools of this nature have to be returned when reordering. I also found it impossible to find out where they are manufactured, and therefore decided that I would have to make my own. As I had some nylon tube which I could turn down to the correct size and could obtain some 10mm plastic sheet for the flanges, no problem was then encountered. I have made these spools the same size as the commercial ones so that they can be interchanged. These then were the basic parts which determined the sizes of the wire eroder.

To go back again to the basic principles, the wire is to be wound from spool to spool and each spool moves vertically during this winding to layer or feed the wire. This has to be a continuous process and when the first full spool is empty the whole process is then reversed. However as we are working at 6 metres per minute, the time between reversals would be around 13 and a half hours. I have not therefore bothered about an automatic system for this reversal. When the time arrives, I will do this manually (via a set of hand operated switches built into the electric's.) The eroder has been designed to carry out all the other tasks automatically.

Let me here divert for a little and explain the sequence of operation. By working with two axes in sequence, it is possible by "dead reckoning" to cut out a rectangle, and by operating the two axes simultaneously, a 45degree cut can be made. I have also incorporated a pair of rotary switches to allow these arrangements. I have never seen a full size industrial version of these machines, but believe that they include some five or more stepper or servo drives and a very sophisticated software package which is not of course, available to the likes of us amateurs. I have therefore tried to do arrive at a workmanlike machine whilst avoiding such complication.

Transmission evolution

The drive system for my Mk.2 machine evolved around the use of four electromagnetic clutches whose position can be seen in Figs. 3, 4 and 5. Unfortunately these clutches, which were

purchased from a surplus equipment company, were too small and would not give sufficient torque for the drives. The machine during it's working cycle has no more load than it uses on a no cutting test but there is at all times a frictional load from the 5mm bore sealed ball races (six of them), on which the 20mm dia. guide pulleys are mounted. The two larger clutches were bought from a surplus company but they were his last two and I was therefore forced to buy the two smaller ones at list price from the main suppliers. This was a company called KEB and they were most helpful. I picked what from them was the cheapest solution. There were other varieties with easier methods of mounting, but we have to watch the pennies.

One of the main problems in the design was to arrange for the reversal of the spool layering direction whilst continuing the winding of the spool in the same (say clockwise) direction. This was all to be carried out with one 24 volt dc electric motor and gearbox. During my initial thoughts I looked into having a layering arm (as used on the older sewing machines for winding the cotton spools) but this would have made the machine very long and it was decided stay with the earlier technique, and move the spools vertically to obtain this layering. It was also decided that all of the mechanism should be mounted together with the spools on a floating platform. This gives a very neat solution. This route also allowed the re-use of parts of the previous

machines, hence avoiding waste of both time and money.

The Mk. 3 machine shown in photo 2 is basically similar to Mk. 2 and uses all the same principles. The requirement for reversal of the layering drive whilst maintaining continuous spool rotation has been solved by driving from a single motor gearbox through two electromagnetic clutches mounted on contra rotating concentric shafts. One of these shafts is driven by gears, the other by a timing belt, all from a common rotating pick up bush which slides along the main vertical shaft. Two of the five belt drives require counter or take up pulleys, to take up the slack on the belt as it is impossible to match the two sets of centres exactly. For the others, the belt tension can be adjusted by sliding the mounts in machined slots.

Switching of clutches and reversal of the main drive motor are effected by micro switches mounted at the top and bottom of the spool travel, and triggered by adjustable trips. These aspects will be covered in greater detail later in the electric's section. Suffice it to say there is little electronics but a considerable amount of electric's. For anyone who built the earlier spark eroder then 50% is already completed.

For example, if we say that the main motor's rotation is clockwise viewed from above, which will lift the spool on a right hand thread, feeding the wire from top to bottom, then pulling in the clutch adjacent to the gears will give an anti-clockwise

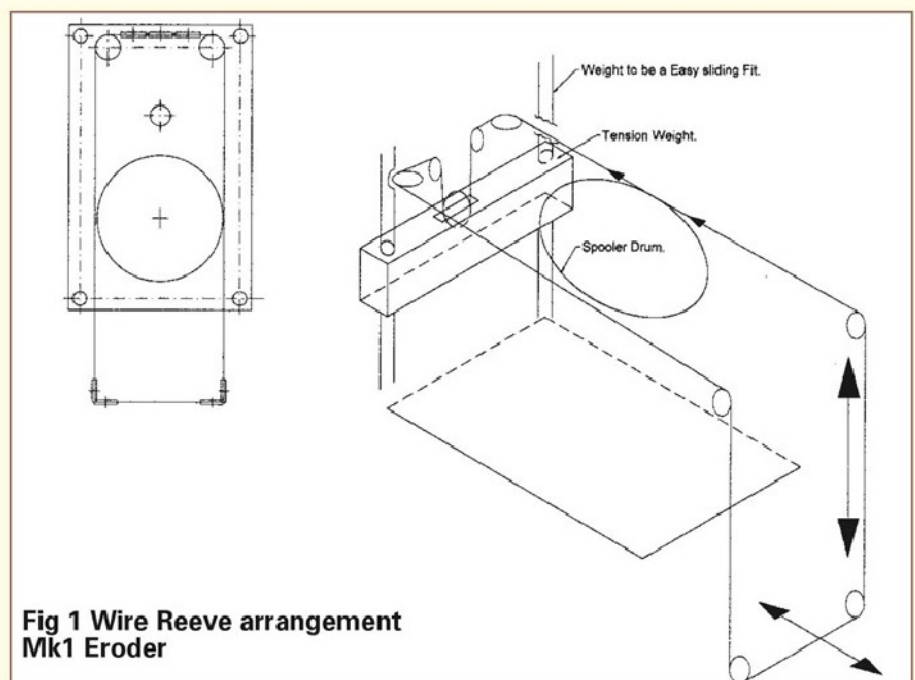


Fig 1 Wire Reeve arrangement Mk1 Eroder

Fig 2 Mk1 Wire eroder. Part G.A.

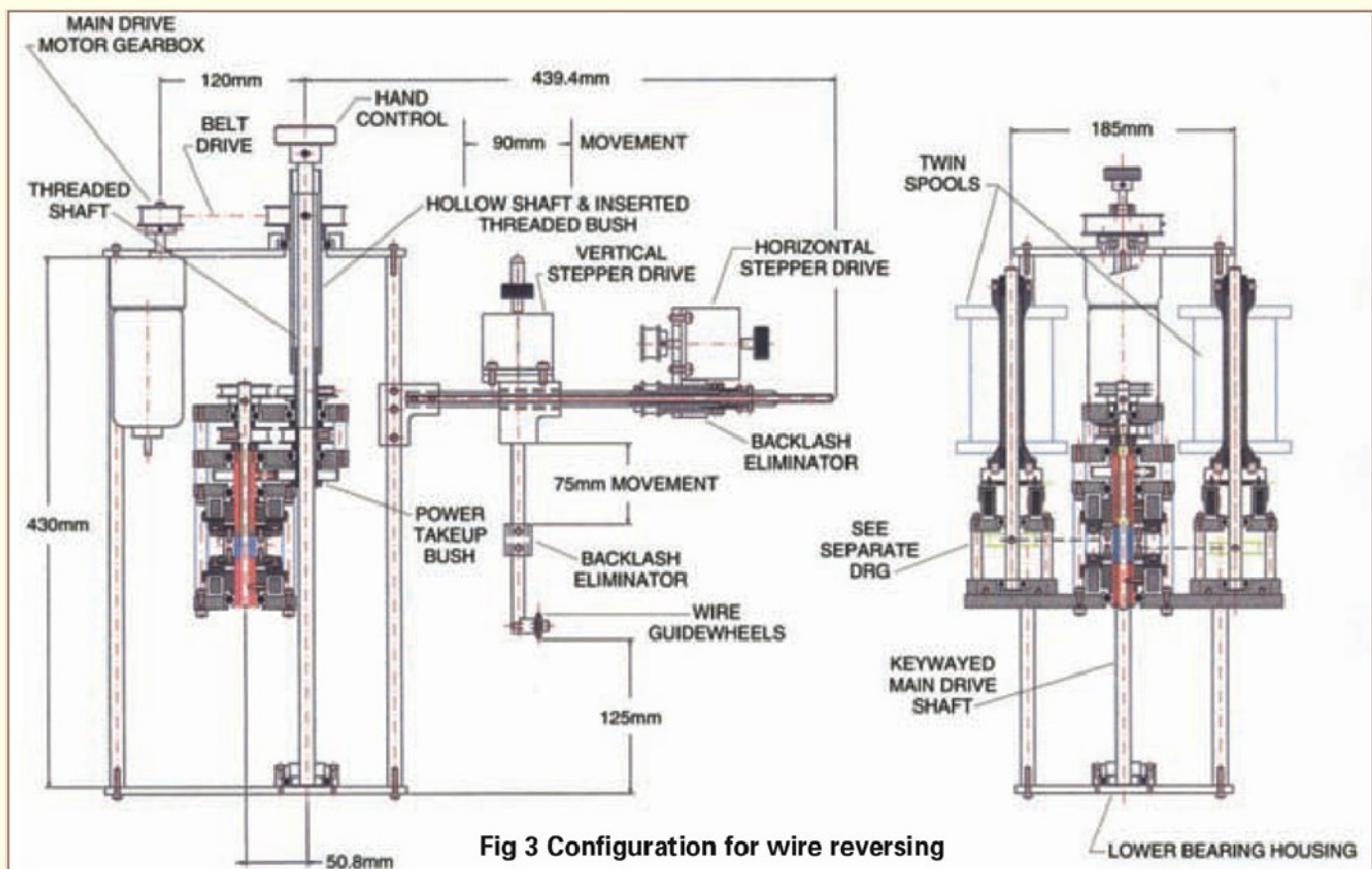
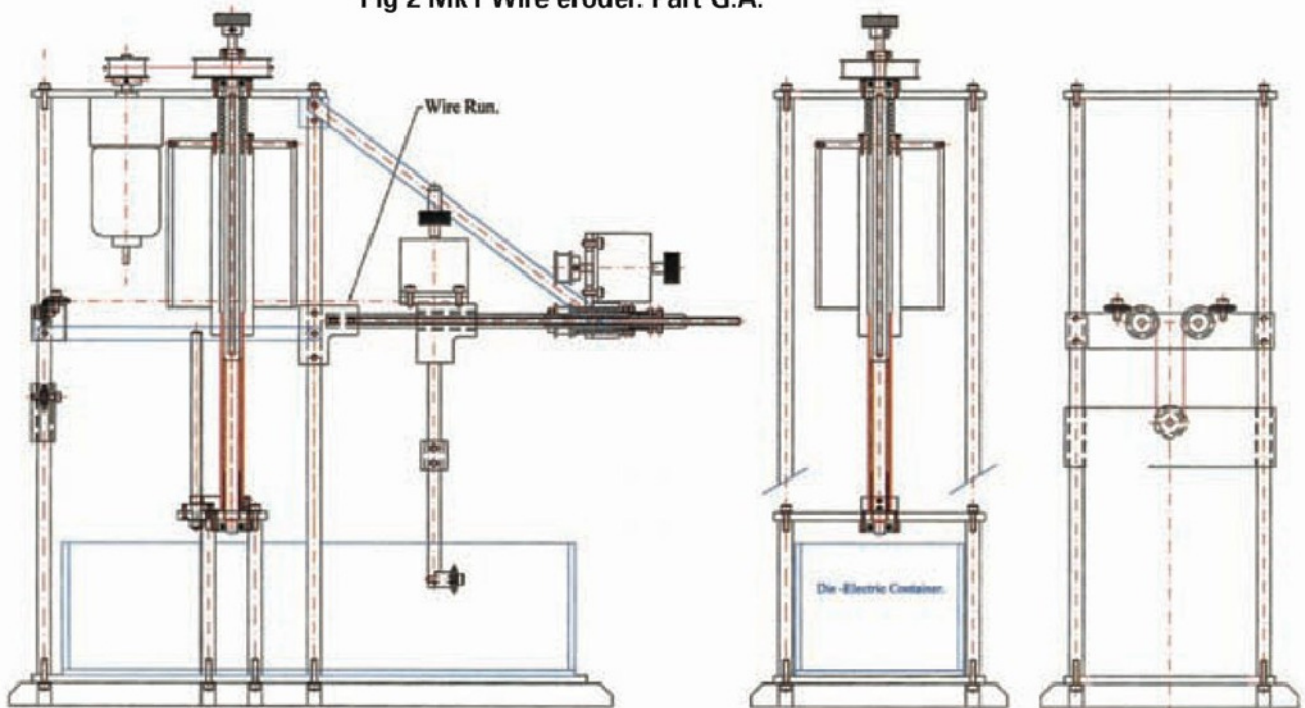


Fig 3 Configuration for wire reversing

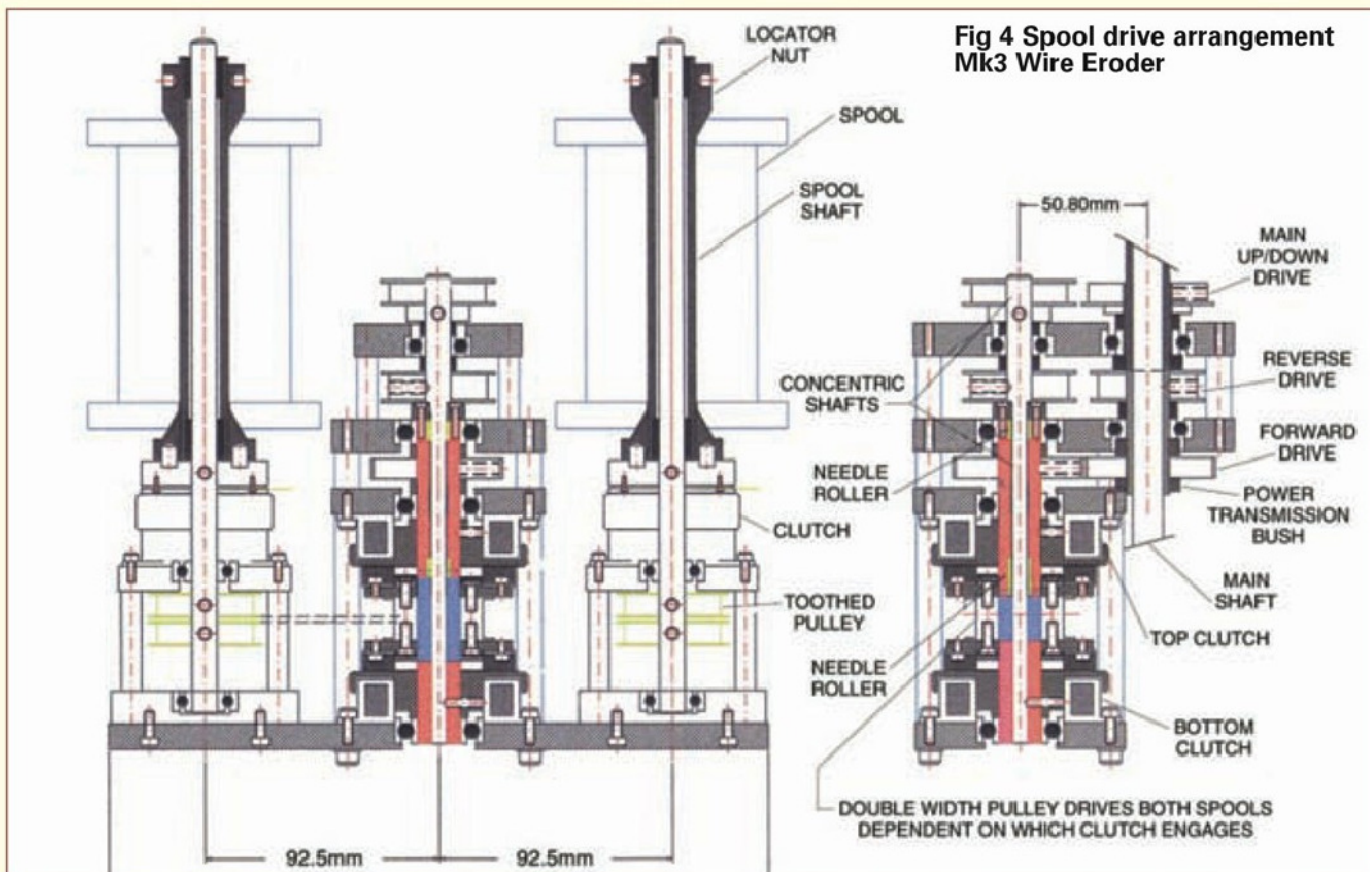
direction to the left hand spool. conversely if the clutch is pulled in on the belt drive then the same spool will run in clockwise direction. Each spool is also driven by a clutch and by selecting the appropriate clutch this will select the spool to be driven and the spool to free wheel.

This brings us to the wire. This must be under tension at all times and to this end each spool mount is fitted with a brake, consisting of nothing more fancy than a

10mm wide strip of cork which was found on the back of a table mat. This was ideal as it had it's own backing which allowed it to be bolted straight on to it's aluminium carrier. This is then fitted in such a way that the load can be adjusted, and also so that on the spool being driven it is not in contact all, this due to the type of clutch being used.

Mk.2 was built with a full oil bath, however it was decided to "Skeletonise"

the whole structure of Mk. 3 so that all moving parts could be seen working. This will require a spot of oil on the gears every so often but the construction is simpler and easier, as it only requires machined plates and tubular spacers, and as long as all the spacers are the same length no problems should be experienced. I also chose to produce purpose made studs for these connections rather than use studding, as these would then have an



accurate plain section which would help with the alignment

The majority of the bearings are deep groove ball bearings all fitted with rubber seals and lubricated for life, the only exceptions to this are the needle roller bearings that are fitted to the inner of the contra rotating shafts and here it will also be necessary to place a few drops of oil occasionally. To this end it would be wise to drill a small oil passage through the centre of the shaft with outlets just above the bearings. There are a total of twelve

ball bearings, four needle roller bearings, four oilite bushes, two linear ball bearings, and one sliding bronze bush.

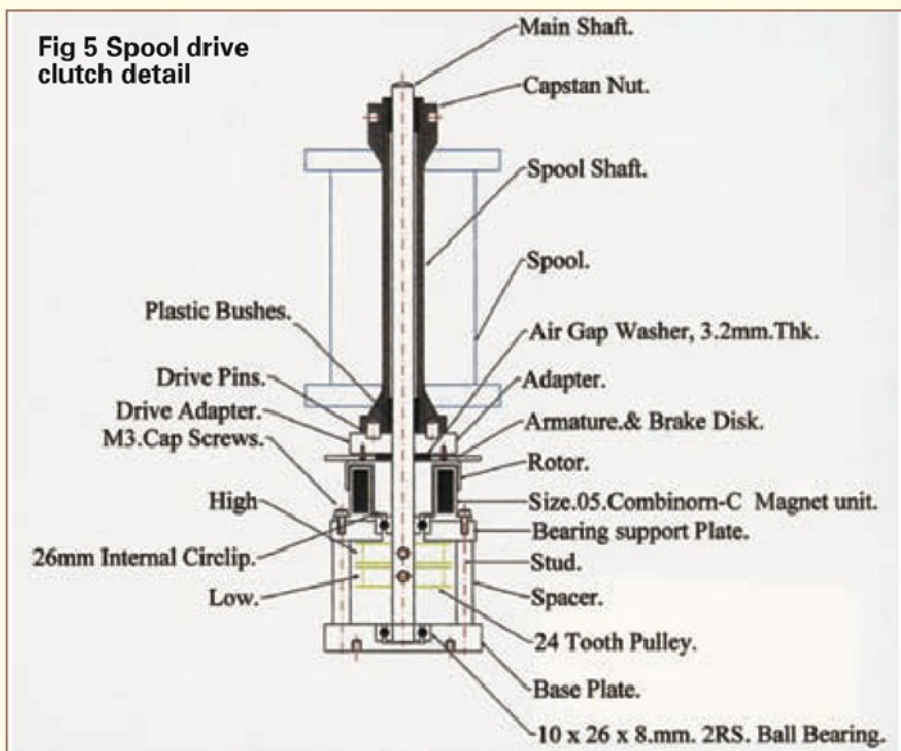
Keyway and distortion

The only problem that might be encountered in the machining is the sliding bronze bush, as this requires a long keyway some 53.5mm long, this being for the mounting of the fixed sliding key. Some time ago, I invested some hard earned pennies in a single 4mm wide broach which

I use for all internal keyways, making up guide bushes as they are required for specific jobs. The mating shaft also requires a long keyway, and how you machine this will depend on the equipment available. I machined the centre section first and then slid the shaft in the mill to complete the bottom section. The only other problem was that machining the long slot caused the shaft to bow. It was distorted approximately 0.020in. overall, and, although it still worked well in this condition, the main section wobbled like a drunken sailor. This did not affect the function of the machine, but to improve appearances, the problem was alleviated by removing the shaft, setting up between centres in the lathe and then pulling and pushing until it was within 0.002in. TIR using a dial gauge. I deemed this close enough, but you can still just detect the wobble.

I hope that this preliminary description will whet some appetites. The next article will cover the machining and other parts of the design and consider a mistake that I did not think could arise. I am always happy to help if I can but phone only please.

Peter Rawlinson, Charing, Kent
01233712158.



Suppliers

Model Motors Direct
01749 860111 - Alastair
J.A.Crew
01386 841979
KEB
01933402220 - Tom & Mark.
Maplins
0870 2646000
HPC Gears
01246268080

CHESTER CRAFT - A PROGRAM

A Quick Recap

First of all, thanks to all those readers who e-mailed me after reading my first article on choosing this lathe, installing it and early use. What I wrote clearly rang a lot of bells with those of you that had gone through a similar buying experience. I also heard from several readers who subsequently went off and placed orders with Chester, Warco or Engineers Tool Room for similar Chinese imports. You may also have read Ray McMahon's account of his new Warco BH600 in issue 87 and his modifications to give a pseudo clutch and improve positioning of the chuck guard, in issue 88. Having seen his photographs and inspected both machines almost side by side at Sandown Park I'm convinced they are almost identical twins. One might be forgiven for suspecting manufacture at the same factory in China. Even the paint inside the headstock casting is the same colour! There are however detail design differences, and no doubt the various importers make their own arrangements for quality control both in China and at the point of sale. It's now over 3½ years since I installed my CZ-300 and the following is a distillation of my experience combined with comments from other users. Don't worry guys, no names will be mentioned, unless you gave permission!

First the good news, for intending purchasers, the UK price of the short bed (570mm) version has fallen in price by about £250 since 1999. I put this down to a combination of increased competition, and economies of scale due to worldwide popularity. The Chester specification of the lathe now includes a halogen work light, rear splashguard and gap bed as standard. In my view, all valuable additions. Looking over the machines on offer at the exhibition, I couldn't detect any obvious signs of cheapening to offset the lower asking prices (e.g. Plastic replacing metal for handles, dials, covers, gears etc.) If you are going to purchase, check this out on a your target machine.

Several correspondents who have recently ordered these popular lathes report actual delivery times in the order of four to five months, so it sounds like the demand has exceeded the supply, or it may just be the timing of the next bulk shipment. Comments in internet discussion groups suggest that supply has been tight in North America as well, and their prices still seem to be lower than ours. What's new?

Omissions

Comments in Issue 87 from Philip Amos concerning his older Taiwanese machine reminded me of things I omitted to say, or were perhaps misleading in my article. The saddle (apron) dial on my Chester lathe is calibrated with exactly 147 divisions, 14.7mm per revolution. A check on the saddle movement, with a dti against the chuck face reads 0.578in. per revolution of the saddle dial. Close enough?

The difficulty of shifting the primary belt (motor to countershaft) from pulley to pulley stems from the fact that, both belts, the countershaft and the back gear, are contained within the headstock casting on this machine. Some of the older Taiwanese machines had the primary drive on the outside of the head casting. See Issue 87 page 53. An inverter drive would probably obviate this. Short of suspending me, and a camera, from the ceiling, **Photo 1** is the best I could do to illustrate the primary belt position location. You can just about see the motor, grey with fins, the primary belt to the top left and the secondary belt down the middle. Note also the helical cut back gearing.

The main spindle is threaded 2¼in. x 8tpi and to prevent the chuck or face plate from unscrewing when the lathe is running in reverse there are two dogs, secured by hex socket screws. These are shown in

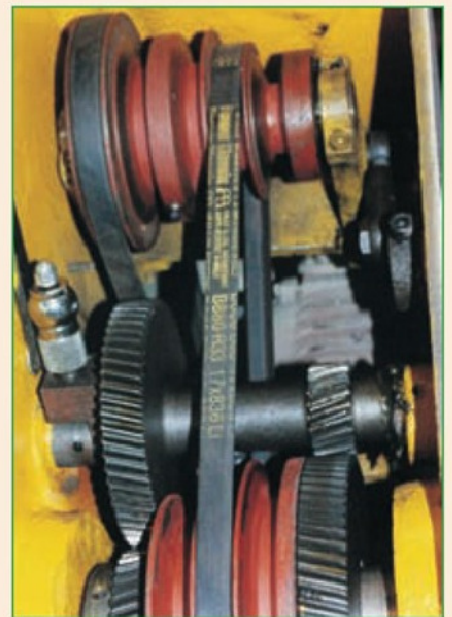
photo 2. One has been fitted and the other is in front of the Allen key. These hex socket screws pass through the dogs and screw into the back plate. The chamfered L shape of the dog fits over a chamfered ring on the spindle. Apologies for not showing these in fig 4 of the original article. I notice that the current geared head version of this lathe has a Camlock D1-4 spindle in place of the screw fitting, a feature typical of quality toolroom lathes.

In photo 2 you can see I use a piece of 18mm MDF placed across the bed shears to protect the ground surfaces from a chuck or the faceplate being dropped during fitting or removing. These chucks are on the heavy side to balance on one hand whilst rotating with the other. One could make a simple cradle to help offer up the chuck to the spindle as suggested by Mr F. J. Langfield, in Scribe a Line, Issue 89.

Screw cutting – filling in the blanks

As noted above, my lathe now dates back quite some time and **Photo 3** shows the screw cutting table then supplied. A, B, C, D, E and 1,2,3,4,5,6,7,8 are the two selectors for the "Norton" type box. The same early version table is reproduced in the manual and contains errors concerning

With the benefit of further experience, Mike Haughton gives a follow up to his article in MEW issue No. 8.

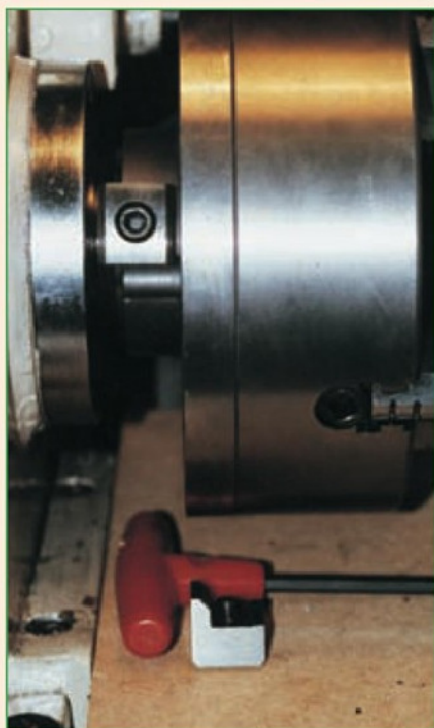


1. Headstock drive viewed from above. The motor (grey) can be seen below the back gears.

the pictorial arrangement of the wheels. I actually cut several imperial threads, only to find their pitches were not quite right! On occasions I ended up cutting the threads deeper than standard to get a fit! At the time, I blamed my poor technique or a movement in the engagement of the half nuts on the leadscrew whilst cutting the threads. Because these lathes have an imperial lead screw, for cutting imperial threads, the 127/120 gear should function just as an idler, whereas for metric threads, it is necessary to use the 127/120 compound gear to accurately cut the correct pitches. Hence the drawings of the gearwheel combinations are in the wrong places. (For imperial threads, the changewheels should be arranged as shown for metric and vice versa). Having sorted this out, it should also be said that the 5 X 8 selection arrangement gives a total of 40 thread pitches for any one change wheel setting, from 4 tpi to 112tpi is pretty impressive, and more than many respected toolroom lathes..

An imperial machine, of course is designed as such, and it is therefore frequently the case that the availability of metric pitches is less than perfect. Most of the commonly used pitches are listed,

TSMAN LATHE ESS REPORT



2. The safety dogs prevent the chuck from unscrewing in reverse. A sheet of MDF is used to protect the bed while fitting / removing the chuck.

but one sharp-eyed owner / contributor (John Carr) has pointed out that you can't cut an ISO M12 x 1.75mm pitch thread with the gears shown on the table, although an approximation is possible (1.7455mm) using the 32/40 changewheels. Prompted by this, further inspection shows that a number of the other relatively common metric threads are not shown either. The 0.35mm pitch is listed as a fine feed. Fine feeds output to the splined shaft rather than the lead screw and are used for power facing or auto traverse depending on the position of a lever on the apron. It may also be said that as this is a hefty machine, it is

quite likely that much of the small, fine thread work would be accomplished with dies rather than single point.

There is sufficient information in the screw cutting table to enable a spreadsheet to be created e.g. in MS Excel, to fill in the blanks in the tables and try out new change gears. John Carr kindly supplied his spreadsheet and I have embellished and moved it to a later version of Excel. Contact me by E-Mail if you would like a copy. I can also move the spreadsheet to MS Works for those who don't have Excel. Please specify which you would like.

Fortunately there is no need to take the gearbox apart to count the numbers of teeth in the Norton box! The supplied screw-cutting table tells you that for any of the numbered ratios 1 to 8 the lettered multipliers are A x1; B x2; C x4; D x8; E x16. The 1 to 8 relative ratios are 1.000; 1.1250, 1.1875; 1.250; 1.375; 1.500; 1.625; 1.750. These are all relative gear ratios factoring into turns per inch. As mm pitch they work as an inverse function. The tumbler reverse gears and the gears before and after them are a different pitch (about 17DP) from the change wheels but produce a 1 to 1 ratio so can be ignored in any pitch calculations. All we have to know to create a spreadsheet is the pitch of the lead screw, 8tpi, and an overall box output in T.P.I. for selector position A1 with known change gears in the chain.

8tpi is 8/25.4=3.175 mm pitch. None too useful with the Norton box ratios. To obtain mm pitches from an imperial leadscrew a 120 / 127 compound (back to back) gear is commonly used on these imported lathes. Hence 120 / 127 = 0.94488etc x 3.175 = 3.000mm. To cut some of the missing metric threads a new gear wheel of 28 teeth is required. This then allows the metric threads listed in Fig. 1, which gives us two of the missing pitches.

The effect of different gears, with any other number of teeth, in the train can be tested by substituting them in the spreadsheets. You can see the effect of a change ripple through as the program recalculates the new pitches in the table.



3. The threading plate with pictorial errors.

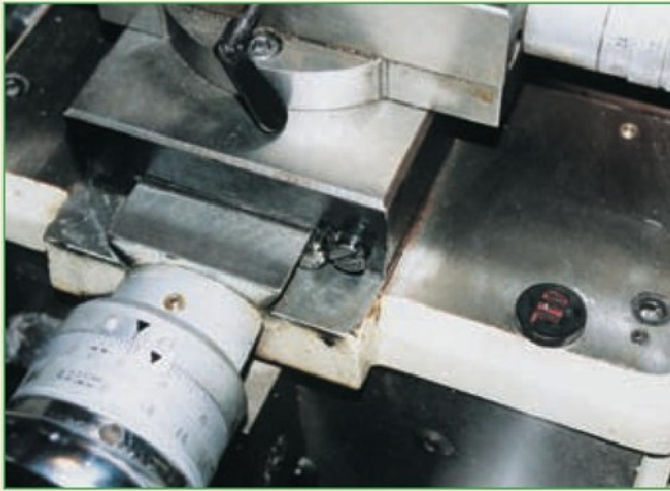
Of course the spreadsheet gives all the output threads, whether they are useful or not. I have not added any fine feeds to the spreadsheet as these introduce new reduction ratios in the carriage and operate on the rack or the cross slide. It's worth checking that you actually have the following gears in your set 46,40,40,32 and 30 in your set. Maybe another other reader has a better solution to the problem?

Taking measurements from the 46 tooth wheel to calculate the DP = (46+2) / diameter in inches. DP = 48 / 2.358 = 20.35. Mod = DP/25.4 = 0.80. The gears appear to mesh well with Myford change wheels, but the bore and keyway are different.

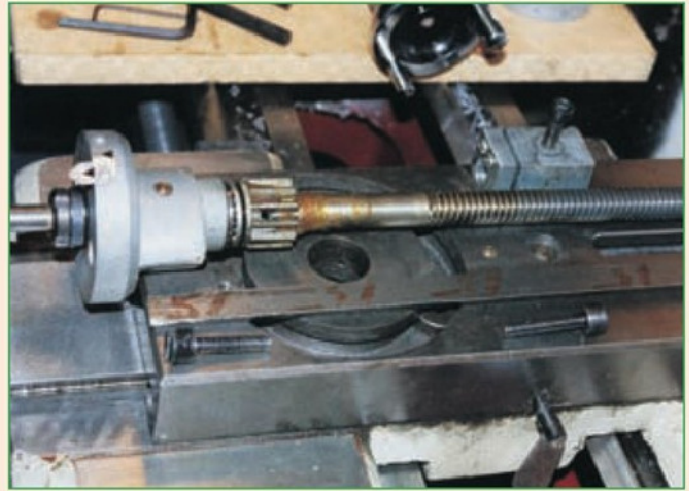
A blank for a 28 tooth gear should be (28+2) / DP = 1.474in. diameter. So far, I have not cut a 28-tooth gear; it's on the list! Anthony Mount, whose articles on improvements to the Warco BH600 lathe are appearing in "Model Engineer" has also been looking at the available pitches and reckons that with just two additional gears 28 tooth and 48 tooth, just about all the ISO metric pitches can be cut with the exception of 5.5mm

Fig 1 - Chester Warco Threads MM per turn, with new 28 tooth gear

Change Wheels	Change Wheel Ratio	Selectors	1	2	3	4	5	6	7	8
	1.20952	Selector Ratios	1	1.125	1.1875	1.25	1.375	1.5	1.625	1.75
28	4	A	5.25	4.66667	4.42105	4.2	3.81818	3.5	3.23077	3
127	8	B	2.625	2.33333	2.21053	2.1	1.90909	1.75	1.61538	1.5
120	16	C	1.3125	1.16667	1.10526	1.05	0.95455	0.875	0.80769	0.75
32	32	D	0.65625	0.58333	0.55263	0.525	0.47727	0.4375	0.40385	0.375
	64	E	0.32813	0.29167	0.27632	0.2625	0.23864	0.21875	0.20192	0.1875



4. Detail view showing the cross slide gib and its adjustment screw. The large, easy read dials are also visible.



5. The cross slide screw and gib components. One of the ball thrust races and the adjustable nut may be seen here.

Operational experience

Compared to a machine used 24/7 in a production environment, my lathe has had only average light domestic use. Never the less, a few problems have arisen.

Cross slide adjustment

Increased backlash appeared after some heavy intermittent cutting and was eventually traced to a slackening of the hex cap screw that holds the cross slide nut to the table. After more use, the cross slide became very stiff over the last inch or so of movement as it was wound out towards the operator and adjustments to the gib strip made things worse. Both the top slide and the cross slide are equipped with tapered gib strips, adjusted by screws at each end of the gib that position and then prevent the gib from sliding. **Photo 4** shows the end of the gib and it's front adjustment screw. There is another at the back of the slide. Things got worse and it became easier to wind the slide away from the operator, tightening as it came towards the operator. The gib could just be seen to be moving in its slot! This created a tendency to jam as the taper moved tighter into the housing.

Time to take the thing to bits and investigate. I removed the hand wheel, micrometer dials; lead screw seat, lead screw and two thrust bearings. **Photo 5** shows the damage to the end of the gib strip where the rear adjustment screw head had missed the end of the gib, due to poor manufacture. (Out of sight, out of mind!) The end of the gib strip was badly formed and not flat. After some thought, I ground the end of the gib flat and then at an angle of about 5 degrees away from the leading back corner that should be pushed by the head of the adjustment screw. The damage to the edge was filed away. The gib was not especially hard and the damaged area not a crucial sliding part. To help the rear adjustment screw find the end of the gib and not slide past it, a bronze washer was made with a concave front surface and the original screw fitted through it. The washer is the maximum diameter that will fit in the cross slide casting, (14mm). The head of the adjustment screw is about 12.6mm dia.. This modification has worked for some time, but eventually I shall get a replacement gib from Chester.

Photo 5 also shows the gib strip is numbered 15 and this coincides with a number stamped onto the saddle casting, just visible in **photo 4**. This photo also shows the white metal nut and hex head securing bolt. The nut is split to allow take up of wear, but this wasn't necessary. Note also, in the same photo, one of the two screw thrust bearings (better than the plain thrust washers fitted to many machines) and the auto traverse drive gear pinned to the shaft with a roll pin.

Whilst the cross slide was apart I decided to see if a little scraping of the dovetail ways could improve the tendency to tighten. Very little work with a flat, HSS parting off blade on the front part of the dovetail produced a noticeable improvement, so I assume I was simply removing very small high spots. I didn't do this job properly as no true reference surface was used. There are signs of light scraping by the manufacturer perhaps to hold oil, and also some deeper machining marks that had not been removed.

Once reassembled and adjusted the whole cross slide moves more freely and I intend to apply the same technique to the top slide in the future, to improve the feel of the movement. One thing I did notice was the lack of lubrication to the parts I removed. Clearly I have not been shooting enough oil into the ball bearing oilers. I applied a liberal quantity of molybdenum sulphide grease to most of the bits on reassembly. On the subject of oilers, there is one hidden out of sight on the top of the apron selector for auto facing or traverse. Have a look for it.

Forward / Reverse Selector

The lathe motor has always started satisfactorily in either direction but occasionally there is a loud buzzing noise, which can often be stopped by stopping the motor, starting it in reverse and then restarting it again. There has never been an occasion where the current overload, set at 11A has needed to be reset. This is a 240v single-phase machine. I am aware of other similar Chinese lathes in the UK that have had electrical problems, some of which are centred on the starting contactors or the forward and reverse micro switches. Control of the motor is by two low voltage micro switches operated

by cams. **Photo 6** shows the cams and switches on my lathe with the plastic cover removed. When first opened this cover, a few fibres of green string were extracted and the switch mounting screws tightened up. This seemed to help. A long-term concern is the as-cast roughness of the cams; see **photo 6** and the wear on the plastic cam followers. I plan to take a Dremel grinding point, or similar, to these cams in the near future. I am really no nearer to the source of the occasional loud buzzing, but suspect the three contactors. Has any reader any experience please?

Chuck Backplate threads

The machined finish on the threads of the two chuck backplates is less than perfect, and they collect swarf like there is no tomorrow. Because the hole through the back of the chucks is smaller than the bore of the backplate, cleaning them with a tapered wooden plug screwed onto the thread does not work. Cleaning them with cloths just tears threads out of the cloth! An 8tpi thread chaser is useful for cleaning out the threads but to avoid any possibility

6. Motor control microswitches with as cast cams and plastic roller followers.



of damage I turned and threaded a piece of polyethylene rod $2\frac{1}{2}$ in. x 8tpi and use this to clean out the threads. I don't think it will last long, but I can always make another, as the PE rod was a low cost car boot purchase. See **photo 7**. Alternatively I might make up a cleaning tool as described recently by Ted Wale.

Thread Indicator and cleaning

I still don't like the position of the thread indicator on the left of the carriage. It gets in the way of work close to the faceplate and is an excellent receptacle for swarf, being inclined like a bucket. Whenever possible, I remove it and clean it. See **photo 8**. Unfortunately there is no mounting hole to the right of the apron, as in the Warco model.

As with most lathes, the lead screw is also in the firing line of so much swarf that I think a telescopic cover would be desirable addition, but have yet to find one suitable. Has anybody found an inexpensive solution to this one?

As I write this, I have even more reason to wish the thread indicator were mounted to the right of the carriage. Having forgotten to remove it, I have just managed to auto traverse the indicator into the leadscrew drive coming out of the Norton box! Now I really must contact Chester for some spares!

Personal protection

Bigger lathes widen your horizons to larger jobs, higher cutting rates and more swarf, sometimes very hot! As I now have to operate the lathe from a stool, I'm much more in the firing line than I used to be. (Especially so, when I walk "personal" swarf into the house!) The chuck guard supplied is metal and obscures the view. I have replaced it with the clear plastic guard that was supplied, with the lathe, as an attachment to the carriage; a sort of travelling guard. **Photo 9** shows this shield fitted behind the chuck. I hacksawed a small piece out of one corner to clear the faceplate. See also Issue No.88 page 48.

Even this modification didn't control all the swarf so I adapted a magnetic base to hold pieces of 2mm Perspex cut and bent to suit the position needed for the job in hand. See **Photo 10**. The magnetic base allows positioning on any of the flat ground surfaces on the carriage, cross slide or top slide. I have made a couple of different sized Perspex shields to cover different machining set ups. The one in the photograph isn't really big enough being 6in. x 10in. before being bent.

The lathe is not supplied with a catch plate to drive work between centres so I usually use the faceplate and a tee nut, nut and bolt. To restore balance to the assembly, a second tee nut and bolt is used. This is hidden behind the tool post in photo 9.

Tailstock adjustment

As originally reported, this lathe turned pretty parallel between centres. Say within 0.001in. over 5 or 6in. with light cuts and a sharp tool. This performance went off with time and I suspected something was wearing. A check of the parallelism of



7. Polyethylene cleaning rod for chuck threads.

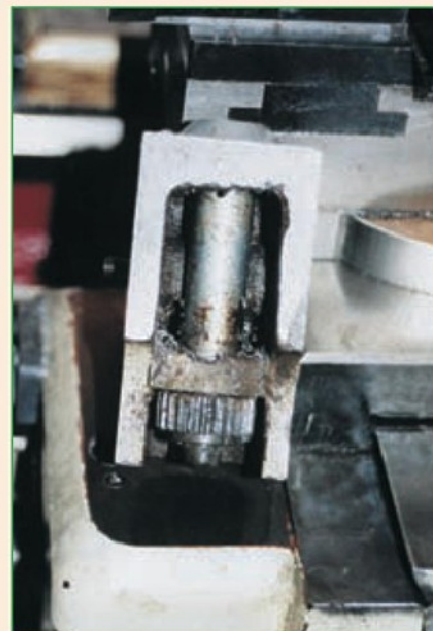
the tailstock barrel to the carriage, showed under 0.0005in. deviation horizontally and vertically over 4in. It seems that the tailstock had not worn, but had moved backwards on its keyway by about 0.005in. and this was soon adjusted out using the three screws provided. One locks the position, two and three push the tailstock backwards and forwards.

Photo 11 shows a failed attempt at resetting the tailstock set over with a DTI. In the end I resorted to the time honoured method of turning a bar between centres and measuring the resulting taper. Accuracy restored!

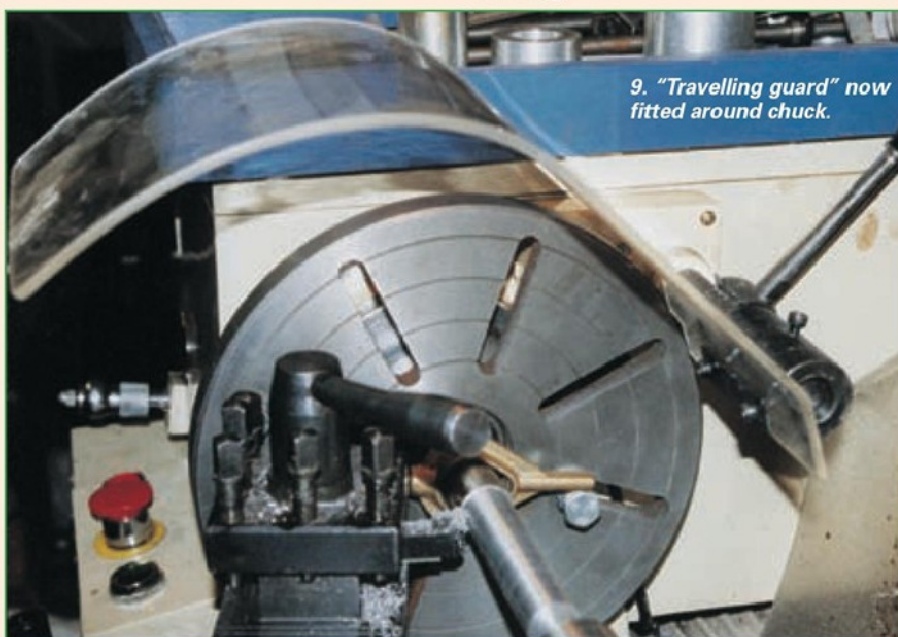
Accessories added to the lathe

Adaptors

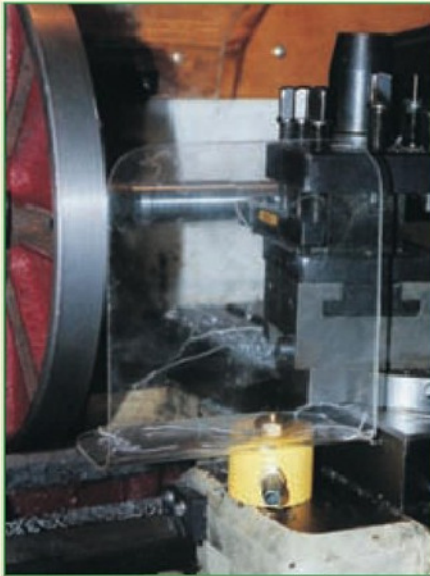
Because I upgraded from a Myford most of my taper tooling was 2MT and consequently used with step down 3MT/2MT adaptors. This was fine until I wanted to use a drawbar in the headstock. Attempts to drill through the back of an



8. The threading indicator removed for cleaning.



9. "Travelling guard" now fitted around chuck.



10. Home brewed Perspex shield on magnetic base.



11. Adjusting the tailstock set over.



12. The keyless chuck is a great timesaver, but not so good for tapping.

adaptor with a carbide masonry drill ended with the death of the insert! I now know you can buy backless adaptors for use with a drawbar from Chronos.

Keyless chuck

Pretty early on I bought a Vertex 0-13mm keyless chuck for use in the tailstock (3MT). See **Photo 12**. These are brilliant and save a lot of time. Their only drawback is if you try to use them for tapping,

withdrawing the tap causes them to release their grip.

Milling Collet Chuck

My original intention was not to do any milling on this lathe! As every job seemed to get bigger, I soon found that my Dore Westbury mill was on the lightweight side, and I returned to doing bigger jobs on the lathe until I could upgrade to a more substantial mill. To solve the drawbar

problem I bought a cheap 3MT metric collet chuck for screwed shank milling cutters from Chronos. **Photo 13** shows the chuck, the 5MT / 3MT reducer and a drawbar I made to use in the headstock.

Repeated use of the drawbar to eject the 5 / 3 MT headstock reducer damaged the $\frac{1}{8}$ in. Whitworth thread on the drawbar, so I added a disk big enough to hit the end of the adaptor when knocked forward. This collet chuck proved to be almost as nicely made as a 2MT Vertex one I use on the mill.

Screwed shank tooling

The above collet chuck is pretty accurate and sturdy. The metric collets are all screwed 20tpi so I made an adaptor to take slitting saws and another to allow between centres milling. Both were made by facing, centre drilling, turning down to 16mm and threading 20tpi at one setting. The rest of the machining was done in the collet. This has worked well, but the lathe isn't that flexible for milling operations.

Ball turning attachment

I will write this up properly for a later article.

Conclusions

There is an element of buyer beware, but the fact remains that these imports are good value for money. A good bang for the buck! But they are not perfect and watch out for build quality, which may vary with supplier. Don't be afraid to take them to bits to keep them running smoothly! By comparison, I believe that in the early 1980's, the cost of a new Colchester Student had crept up to around £7000. I hate to think what it might be today.

I have no connection with any supplier mentioned in this article. If you have any comments, would like to discuss the above further or would like a copy of the spreadsheet in Excel or MS Works, e-mail me at mikehaughton@tinyworld.co.uk. Or if you prefer, then continue the discussion in MEW by writing to Scribe a Line. Please don't send any unsolicited E-mail attachments.

I have recently found a Yahoo Internet discussion group for users of these imports. There are 200+ members worldwide, some in the UK using Warco lathes, some in North America using Jet; Grizzly; Birmingham; and Harbor Freight brands.

www.groups.yahoo.com/group/12x/



13. The 3MT milling chuck, with 5MT/3MT reducer, and draw bar.



References

www.chesteruk.net/;
www.engineerstoolroom.co.uk/;
www.warco.co.uk/;
www.chronos.ltd.uk/;
Vertex Machinery Works Co Ltd (Taiwan) does not appear to have a website;
Workshop Practice Series No17, Gears and Gear Cutting by Ivan Law.

LINK UP

Would readers wishing to make use of this facility please note that the maximum total value of items accepted for a 'For Sale' entry is £50.

To advertise goods of a greater value, please contact our Classified Advertisement Department. Please indicate clearly if an item is intended for Link Up.

FOR SALE

● For sale unmachined backplate casting, 5.375in. dia £10-00. MEW April/May 91, Aug/Sept 91, Aug/Sept 93, £4-00 each, all plus postage. Phone Ken on 01254 385 428

● For sale Quorn Mk.2 casting set, wheels, motor, book etc. Also ME plans and ME issues for Suffolk dredging tractor. Details from A. J. Lewis, 01276 64631

● For sale two Jacobs No. 34 1/2in. chucks 1MT and 2MT arbors and chuck key. £10-00 each. Single phase motor, 1/3hp 1120rpm with reverse switch. £18-00. 18ft. bronze strip 3/16in. x 22swg £5-00. Or possible PX for ML7 parts W.H.Y. please phone Mr T. F. Smith 01625 876038 (Stockport)

● For sale Murex Saffire 4 Welding torch £15-00 please phone 01286 678 584 (Caernarfon)

● For sale V. S. hydraulic drive £40-00 plus carriage. Phone 01322 330 556

● For sale ex washing machine multi speed pole changing motor as described by Les Rix in MEW No 20.

Good useable condition £12. Also Hotpoint W/M motor with electronic speed control board as described in MEW No 88. Good useable condition, motor £10, speed control and connectors £12, or £20 the pair. For all items prefer buyer to test and arrange carriage. Email G4EGB@Yahoo.com (Scarborough)

● For sale a quantity of MEW and ME magazines. Please phone Colin on 01332 517 439

WANTED

● Wanted. A copy of Model Engineers Workshop Issue No. 91. Please phone R Henshaw. Tel. 01327 351274

● Wanted. I require back issues of MEW from issue 1 (summer 1990) to issue 19 (Oct/Nov 1993) inclusive. Please phone 01603 811 199 (Norfolk)

● Wanted Consecutive copies of "Strictly i.c." to end of production, (I have from first iss. to Vol 5 No 30) but would take a complete set if reasonably priced. Also good "Willow" metal

cutting bandsaw 1ph, 3 wheel preferably with butt welder, or separate BW. Phone 01372 725095

● Wanted copy of manual for Coventry milling machine horiz/vert 18in x 6in. table, all expenses reimbursed. Please phone T McCabe on 353 71 916 6128 (Co Sligo)

● Wanted clock wheel and pinion cutters 0.6, 0.7, and 0.8 Mod. Anything considered. Please phone Colin on 01332 517 439

EXCHANGE

● Exchange 8mm Collets. I have the following to swap 0.5 (3) 0.6, 0.8, 1.2, 1.4, 1.5, 1.6, 1.7, 2.0, 4.0, 4.8 (2). millimetres. G.W.Costa. 5, Linwood Road, Ware, Herts; SG12 7JQ. Tel. 01 920 461 583. email smee.costa@virgin.net

● Exchange Clarkson Milling collets. I have spare 1/4in. 3/8in. and 5/8in. collets to swap for 1/2in. or any metric collets to fit small size chuck. Please phone M. Leafe on 01924 460 864 (West Yorks)

IN OUR NEXT ISSUE

Coming up in Issue No. 96 will be

Surface Mount Soldering

Chris Fouweather tells how.



Drawbar and Extractor for the Conquest Mill

George McLatchie gives his bearings an easier life

A Shaper Project

Harold Hall works with an oft forgotten machine.



Half nut Auto Release for Myford

Peter Foyle makes design changes

Issue on sale 13th February 2004

(Contents may be subject to change)

THE MIDLANDS ENGINEERING



First prize was awarded to Malcolm Leafe for his 1/4 scale Alba Shaper and Ancillary Tools

Dave Fenner makes the annual autumn pilgrimage to Castle Donington

south had been broken by a brief visit to Newton Tesla (who specialise in inverter drives) in Warrington, and so it proved most interesting to also discuss the various options available in "one to three phase conversion" with Transwave. Whilst also offering inverters, the majority of their business is in static or rotary converters giving fixed speed. It seems that the market is divided between those who wish to buy ex - industrial machinery, and proceed to operate with no rewiring, and those who wish to incorporate variable speed.

For the former, a rotary converter can be connected to the single phase supply, and the three phase machine is simply plugged directly into the converter. All of the original switchgear on the machine tool remains in place. A static converter may have added limitations on minimum as well as maximum motor sizes. Variable speed, which can be a major advantage in avoiding belt changes, moves one to the inverter solution, which may take the form of a DIY installation requiring substantial rewiring, or an engineered package as offered by either Transwave or Newton Tesla.

CNC and all that

Comments from several quarters seem to indicate that the "high technology" side of the hobby is growing in popularity. Demonstrations on the Pro Machine Tools stand showed c.n.c. milling small i.c. engine parts (some using a rotary axis) and also the latest turning software which now includes multi start and taper threading. Quantum CNC (Europe) Ltd. displayed the Micromill machine, with

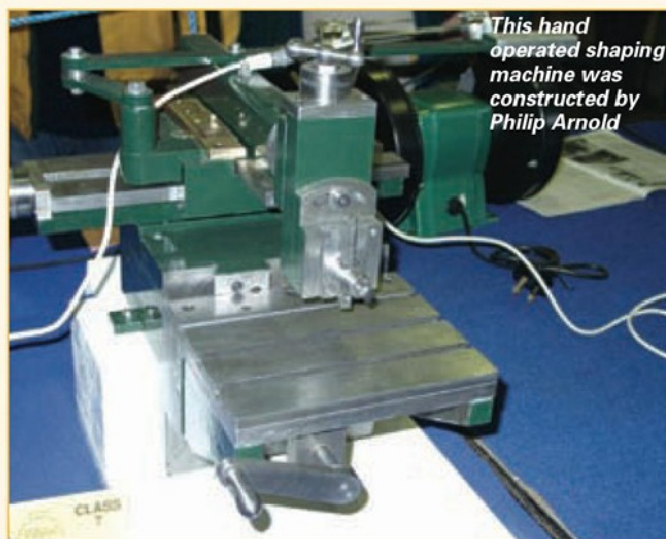
October is a month on the calendar which has the established attractions of both the Midlands Model Engineering Exhibition, and the Myford Ltd. factory open week. On this occasion I decided to also take time to pay a swift visit to the Donington Collection of Formula One and other racing cars, but that diversion is really outwith the scope of these notes.

Once again, the long drive south to Castle Donington proved more than justified by the variety, quality and quantity of the model engineering exhibits, which ranged from the truly massive 10 1/4 gauge locos to diminutive hot air engines. Chris. Deith, managing director of Meridienne exhibitions reckoned the total count of models on show to be between twelve and thirteen hundred. A number of interesting workshop equipment items were on

display, in competition and display classes, and also on club stands. A selection of these appears in the accompanying photos.

Within the Machine tools and Workshop Equipment, category, first prize was awarded to Malcolm Leafe for his one quarter scale Alba shaping machine and ancillary tools. This was indeed a superb composite display well deserving of the win, but does again prompt the debate regarding whether one category should encompass both workshop equipment intended for use, and models of machine tools, which may or may not be intended to cut metal.

Not all exhibitors attend all model engineering exhibitions, and so part of the time was devoted to finding out a little more about some firms with which I have had little previous contact. My journey

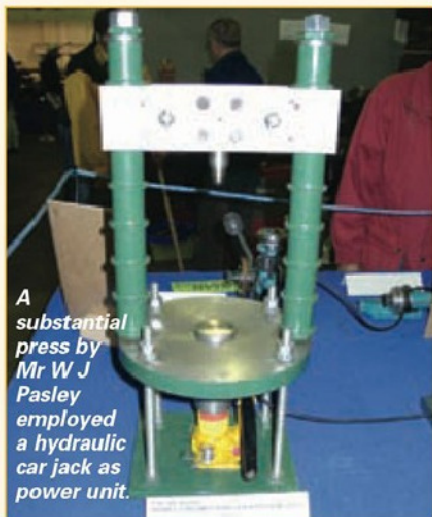


This hand operated shaping machine was constructed by Philip Arnold



Also by Geoff Ball, a power hacksaw with casting patterns.

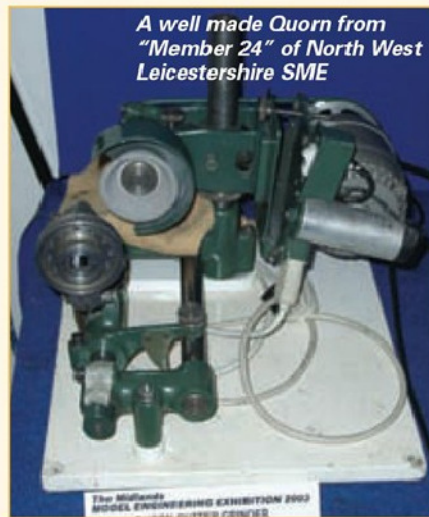
ND S MODEL G EXHIBITION



A substantial press by Mr W J Pasley employed a hydraulic car jack as power unit.



This Pott's milling attachment by Geoff Ball features improved spindle design.



A well made Quorn from "Member 24" of North West Leicestershire SME

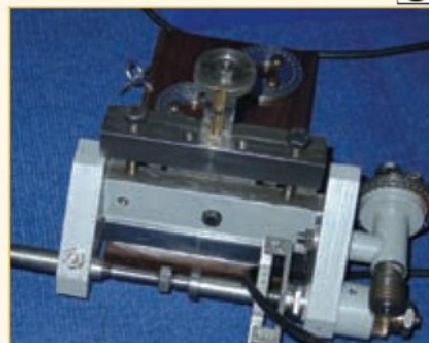


David Spooner's modified 8 inch bench grinder.

Chips off the old block

Nowadays, my workshop is almost exclusively metalwork. In the past I did from time to time indulge in occasional excursions into DIY, but have never really become involved in woodworking at small scale. This year, Proxxon have introduced a miniature planer – thicknesser, the machine being on display at both the Chronos and Jean Burhouse stands. My first reaction was that this would be intended mainly for dolls house constructors, but Graham Burhouse first produced a length of accurately planed material less than half a millimetre thick and then went on to explain that most of these machines were being snapped up by builders of model boats and scale railway wagons, where the ability to run off consistent planking would be a great

timesaver. The internal mechanism within the machine includes both in-feed and out-feed rollers, giving a consistent cutting rate and fine finish over the full length of the workpiece.



A small dividing attachment with additional plates, also on the NWLSME club stand.

Partmaster and Dolphin cad cam systems. Interestingly, whereas a number of the systems arriving on the amateur market, seem to have been developed with the hobbyist in mind, those handled by Quantum are based on accepted industrial programmes, with prices contained by cutting out some of the unnecessary frills. On the DivisionMaster stand, Tony Jeffree, known to readers as a contributor to MEW, was holding court, and entertaining prospective clockmakers with his wheel cutting engine, constructed as a demonstration vehicle for the DivisionMaster device. Over the duration of the show he was gradually surrounding himself with a growing number of gear wheels of many different sizes. The machine (which will be described in a future issue of MEW) had been constructed largely from Peatol lathe parts. The operation was particularly neat, in that after hand feeding the cut, the return stroke tripped a micro switch which in turn actuated the rotary index movement via DivisionMaster ready for the next hand feed. I didn't check accurately, but it probably cut each tooth in less than two seconds.



The planer/thicknesser from Proxxon will produce planks less than half a millimetre thick.

SCRIBE A LINE

Harold Hall writes:

Long term readers will be aware that an index has been published periodically in the magazine, typically as that in this issue. The index, with controlling program, has also been available on computer disk. Having been responsible for this from the first publication I am now of a mind that my involvement will soon have to come to an end. However, I am loathe to just close the door on the task as it is a valuable asset to readers who rely on the printed version and to the 100 plus who still regularly obtain updates for their computer version.

There are now a number of indexes available for the magazine, most on the Internet. I do believe though that they are not as comprehensive as mine which includes the following:- 1. It indexes subjects embedded in articles on another subject 2. Each entry has included in it, references to subsequent items relating to it, letters, corrections, etc. 3. Separate indexes for articles, letters, trade etc but which can be combined for viewing if preferred. For this reason also I would not like to see the index suffer an untimely death. Of course it is unlikely that I have seen all available indexes and if anyone could make me aware of an equal or

better index I would more happily draw my involvement to a close.

My reason for writing this letter, if you have not already guessed, is to enquire if there is anyone who would be prepared to take on the task. Payment for the index published in the magazine (every 12 issues) and also the 60 of so computer updates each year brings in a little financial reward, though it will not make you rich, it is more a service to the readership.

I have over the years provided around 100 computer programs to readers who have not obtained updates from me and as the program enables the user to update

David Haythornthwaite of Burnley writes:

Some time ago I saw a "Tiplap" boring tool grinder in an engineering auction and was lucky enough to obtain this at what I considered to be a very reasonable price. The machine was single phase and had a large diamond wheel with it. The machine (Photo "A") did not have any movement available for the height of the motor and there was no indexing arrangement for the tool holder. Whilst the grinder was useful enough for sharpening simple lathe tools, it was useless for sharpening end mills, slot drills or twist drills.

I therefore set about making a new motor head on the lines of the well known Quorn tool & cutter grinder but as I had already made a spindle (the basic spindle from the Spindles book in the Nexus Workshop Practice Series) I decided to make up a wheel head from standard materials to the same basic layout as used in the Quorn, utilising my existing spindle and the original motor. This proved to be most successful and gave me a most adaptable unit with rise and fall, together with fine tilt adjustment and a No.2 morse taper spindle which would take Myford collets. The wheel guard was sawn from the top of a small redundant fire extinguisher.

The original Tiplap unit only had one horizontal bar onto which the workhead clamped and therefore it was impossible to slide the workhead along the horizontal bar in a controlled manner in order to sharpen the flutes of end mills. I therefore fitted an additional horizontal bar to the base plate parallel to the original bar and fitted a rocking lever to the workhead as per the Quorn. Castings were obtained for the rocking lever and also for a "Quorn" toolholder which enabled me to make the machine just as versatile as the Quorn. The resulting machine is pictured in Photo "B" and as these items do come up for sale from time to time, readers may be interested in the conversion. The vertical bar is for a swinging arm to measure the relative heights of toolholder centre and grinding wheel centre. It fits onto the original guard base plate.

Now to the main point of this letter. The original machine came with an additional "toolholder" as per photo "C" which had "patent applied for" on the top of it. This item fitted in place of the normal toolholder and consisted of a casting in which a horizontal shaft could rotate. On one end of the shaft was a handle to turn the shaft and on the other end of the shaft, is a small cup wheel, which appears to be made of hard wood and which has 3 circular grooves on the face of it. I cannot imagine what this was used for, unless it was a kind of dressing wheel for a diamond wheel. I am a self taught model engineer with no commercial engineering experience. If any reader has used a Tiplap grinder and can enlighten me as to the use of this I would be most grateful.

David Haythornthwaite 01282 435843 (Burnley Lancs)



the index I am of the opinion that at least some are updating the index themselves. In particular, any of these would make an ideal candidate, though anyone who feels able to provide a couple of hours per issue would certainly not necessarily be unsuitable.

Should you feel able to consider the responsibility then a letter to me via the editor will start the ball rolling. I do hope that someone will be prepared to offer their services but should that not be the case then I will continue with the task at least for the next year or so but then will no doubt have to make a hasty retreat and would much prefer an earlier, "planned exit"

Eric Rumbo writes:

Mr David Dew of King's Lynn (issue #93) has raised a couple of points regarding my design for constructing form-relieved gear cutters (issue #91). He is indeed correct in stating that the profile of the cutting teeth produced by the method as published in the article is an ellipse, albeit one of low eccentricity with only 1.5% difference between the major and minor axes. He also questions my decision to introduce front relief to the cutter teeth and on reflection I would concur with his criticism. This latter matter is easily addressed when the fronts of the cutters are being shaped - simply make the angle zero. The ellipticity can also be removed with a somewhat more complex holder for the 'buttons' used to shape the cutting teeth. If instead of a holder which presents the buttons horizontally to the rotating cutters to be, the buttons are inclined inwards by the same angle as the teeth are to be rotated, then the ellipticity will disappear when the individual teeth are repositioned. The result will then be the circular profile which Mr Dew prefers.

However, I should point out that the underlying method for producing gearcutters using buttons is only approximate. There is no way that a circular button can produce a true involute shape. In fact the tables available for the dimensions of the buttons vary so that different authors have obviously chosen different quantities to minimize in their approximations. It is a pity that none of these authors have actually published their approach and most of them pre-date the PC so that better approximations may now be possible with proper programming. It may be helpful to consider what gears cut using button shaped involute cutters are not good for. They are not good for transmitting power, when properly generated gears should be used. The cutters we are interested in are to be used in mechanisms such as clocks where the motion is intermittent and minimisation of friction is very important. To this end if you compare gears of identical module cut using involute cutters and generated gears it is immediately obvious that the former have much longer skinny teeth than the latter. The gears are deliberately made with longer shanks to eliminate as much as possible any possibility of jamming causing large amounts of friction. The teeth are therefore already longer than we need, and deliberately so. The loss of a few thou' because of the angular shift in the

Jon Titus of Milford Massachusetts, writes:

Bob Margolis did an excellent job in his hands-on overview of the mini lathe supplied by Warco. Here in the USA, several suppliers offer the same or similar lathe to hobbyists. As an owner of the version supplied by Micro Mark, I thought I'd add a few comments.

I still kick myself for not buying more accessories for my little Unimat back in 1970. Now it's impossible to find these "ancient" bits and pieces. So, I recommend buyers of mini lathes stock up on accessories if they plan to keep the lathe for some time. Micro Mark (www.micromark.com) and Little Machine Shop (www.littlemachineshop.com) offer many. The latter company also supplies modification kits, tool mounts, and spare parts that should fit the model Bob described. Micro Mark just introduced a rocker tool holder that eliminates the need to shim tools in the supplied holder.

Ditch the forged or stamped metric wrenches supplied with the lathe, which I found useless. Instead, invest in a nice set of metric open-end and box-end wrenches. Bob complained about the use of an Allen wrench to remove the cover on the gear-change end of the lathe. As my first lathe project, I made a set of large wing screws out of brass scrap. Now it takes only a finger to remove or tighten two screws that hold the cover in place. (See attached photo.)

I've enjoyed using my mini lathe and expect to use it for a long time.

Two brass thumbscrews replace the original Allen screws.



cutter is therefore pretty much irrelevant. If you want to be a purist then the way to go about it is to recalculate the dimensions for the buttons to take this into account but as I pointed out I, at least, haven't been able to find out the minimisation technique chosen by the various authors of these tables. Perhaps someone ought to look into this.

There is another pointer why any correction is unnecessary. Eight cutter dimensions have been chosen to span the complete range from 12 to infinite number of teeth. When one compares the button dimensions between each of the eight cutters one finds that the differences are quite substantial. So that N teeth cut with Number M will be producing substantially different teeth shapes compared to N+1 teeth cut with Number M+1 at the transition point from one cutter to the next. These illustrate that the shapes are indeed not all that critical and that the amount of 'different', rather than 'error' because there is no absolute precision here, by tilting the cutter teeth after shaping will be irrelevant. The bottom line is of course that I have cut a number of gears using these cutters and they all work perfectly well. Incidentally, Mr Dew is welcome to contact me when he visits Queensland

Mr C E Hartland of Gillingham, writes:

My letter is in the form of three requests for help/information. The first is a problem of removing the No2 Morse taper from a drill chuck. It has a J6 taper into the chuck and I wish to renew it because of damage to the No2 taper. I have heated it, soaked it in release oil. I have even frozen the taper and warmed the chuck to no avail; it will not release the J6 taper from the chuck. So help, any ideas? I am reluctant to hammer at it for fear of damaging the chuck.

The second, is their anybody with knowledge of bluing steel using platinum chloride? This is a hygroscopic compound and I believe gives a deep blue sometimes

seen on the screws in older watches and clocks.

Thirdly, having read the 'History of Cambridge Instruments' reference is made to the superior hot lacquering on their scientific instruments and microscopes. This lacquer was given the name 'Dragons Blood' but no mention of its components. Can any body help on this one. Incidentally, Leica now owns the company and they make electron microscopes. I have made enquiries there, but no one knows.

Mr G Mc Latchie of Carlisle, writes:

Recently the electronics on my CL300MM lathe failed, and as I am not electronically minded, I had to seek professional help.

I phoned Clarke UK and was told that they couldn't give me a replacement control box, but I could send it to them at a cost of £45 for the first hour, and it would also cost for replacement parts. If it was the board, it would be expensive.

Next I sent the control box to an electrician acquaintance in Leicester. He said he couldn't repair it even after seeking professional help.

When it was returned, my next port of call was an electronics firm locally. They collected the box and said they would give me a free quote. Their quote was for £235. That is why it was free.

As I have dealt with Chester, I thought I would give them a call, as their Conquest lathe was similar to the CL300MM. I spoke to Graham, their engineer, who told me they had a reliable USA sourced controller at £120.00. After talking to him, I decided to purchase it, and the package arrived within a few days. With Graham's help, I had it fitted, and the lathe working within minutes. Compared to the old control box, it looks far superior. On the old unit, the two amp fuse blew quite often, and over the years, I have had to replace numerous fuses. The new board has a five amp fuse.

Since fitting the new board, I decided to check dimensions of the 300watt motor, as I am thinking of replacing it with a 400w.

Malcolm White writes by email:

My project is the construction of the engineers clamps detailed in issues Oct 91 and No.25 and involves the cutting of long lengths of thread. The problem I encountered was that the cut thread meanders down the length of stud for no apparent reason. (the stud appears to snake as though it has been bent - photo attached.) The $\frac{1}{4}$ 40TPI die was trued and started by holding the $\frac{1}{4}$ BMS rod in a collet in a mill drill and clamping the dieholder to the bed, so it was perpendicular when the first half-dozen threads were cut. I also used tap cutting fluid as a lubricant. Any pointers on how to avoid this result will be most appreciated.

Also, I've read instructions on how to produce knurled finishes, but my attempts have always led to the first revolution of the knurl being miss-aligned with the second and subsequent revolutions. This seems to relate to the pitch of the knurl and the circumference of the work, but no mention is ever made of this in the articles which I've read. Have I got the wrong end of the stick or is this pertinent?

Dave Fenner comments: I too have experienced problems producing long threads with dies. It can help if the thread is part cut by single point and finished with a die. For producing lengths of screwed rod, I have put the die in the chuck, and fed the work through a close fitting guide bush held in the tool post. On knurling, within a batch of identical components, I have managed to produce both correct and incorrect "half pattern" knurls. It seemed to help repeatability if the (straddle type) tool was set to depth and then forced across quickly. Other readers may care to offer the benefit of their experience.

Whilst checking, I found it was 250w not 300w as in the manual. This may be the reason it was slowing down when taking a cut.

As I now had time to play around with the old control, I replaced the variable speed switch, and surprise, surprise, the old control box is once again in working order. So much for the professionals. This little trip around the mulberry bush may be of interest to others who may encounter the same problem.

Allan Tudor of Solihull writes:

The recent articles on the various versions of the mini-lathe have been very helpful, so now I would like to add my observations on using mine, which is a CL300M.

Changing chucks has been greatly eased by the use of a thin strip of metal, say 70mm by 10mm, at the end of which is attached a short pin, about 4mm long. The strip is held in the left hand, with a nut hung on the pin, which is then manoeuvred in line with a chuck stud. The nut can then be spun on to the stud with the fingers of the right hand. When removing the nuts they can be caught in a small box placed under the chuck.

Mandrel speed is very easily measured by counting the revolutions of the leadscrew gear, in standard power traverse configuration, against a stopwatch, and multiplying by 16.

I have covered those parts of the leadscrew not used by the half nuts with adhesive tape to keep swarf away. Also at the left hand side of the carriage are two tapped holes for fitment of a travelling steady. These can be used to fix a suitable shaped plate to act as a swarf shield, particularly to protect the carriage traverse



plunger have been deepened slightly, in the casting.

I find it pays to keep an eye on the adjustment of the small Allen screws that control the cross-slide nut. These can be seen on the top face of the cross-slide. Nip them up gently to just take out the fore and aft play in the cross-slide.

As the mandrel has such a large bore, it has been a very easy matter to make a simple handle for manual operation. The four spanner notches in the mandrel adjusting nuts can be used as one half of a "dog-clutch" for positive engagement of the handle. The mandrel bore can also be used to locate a dividing device, using the change wheels provided. There have been many schemes shown in MEW and ME for such devices, which can be adapted for this lathe.

The electronics seem to run rather hot. I have packed out the unit from the headstock by about 5mm, for air circulation. I am planning to fit a tiny cooling fan to the bottom face of the unit. These fans are used to cool the CPU in computers, run on 12 volts, and may be bought for about five to ten pounds in electronic shops. Care should be taken to avoid the entry of swarf into the unit.

If I can muster enough courage I may lift the headstock with a view to lubricating the gears and shafts. Incidentally, I always run in low gear to ease the load on the motor. There is plenty of speed in low gear.

Mr. B R More of Tonbridge writes:

I read with great interest the article on Plastic Injection on by Chris Fouweather (No 92 Aug/Sept. 2003). It takes me back

gears at the left end of the apron.

A simple (crude!) carriage clamp has been made which is attached at the right side of the apron by means of the M6 tapped hole provided for the threading indicator.

The tumbler reverse control knob was very hard to use, as the spring rate was high. A lighter spring has improved matters, and the detent holes for the

Martin Connelly of Sleaford, writes:

In the article on Alex Gray and his workshop in the October 2003 issue of Model Engineers' Workshop there was a picture of a micrometer bed stop of "unknown provenance". This is an identical item to the one on my Smart and Brown model M lathe. I have enclosed a picture of mine and a matching hard point can clearly be seen on the saddle. There is also a matching one on the far side of the saddle allowing the carriage to be stopped accurately when moving either to the left or to the right. It should be noted that the micrometer stop is double ended and is not mounted the wrong way round as it may look in the photo.



The Smart and Brown micrometer stop

36 years when a holder for a lens end bulb was required to fit on a non-contact tensile tester. The mass had to be kept as small as possible, therefore all ferrous, non-ferrous materials were excluded; so it was decided to have a go at designing an injection moulding machine to produce simple moulding less than three-quarters of an ounce.

The design was based around a pneumatic cylinder secured on a sturdy frame mounted on a thick mild steel plate. The mould's 'X' axis was adjusted from the back by a screw attached to the base plate. Side registration or 'Y' axis was made by clamping plates attached to the main frame by $\frac{1}{2}$ in. Whit. screwed rods. When the mould was in position, the left clamp and back were locked. The right clamp was used for clamping and releasing the mould.

The mild steel heater block assembly was attached to the frame by three bolts and compression springs. The springs lifted the block with the nozzle just clear of the mould, thus allowing the mould to be removed after moulding. Three cartridge heaters were evenly spaced around the bore to eliminate hot and cold spots. Temperature control was a simmerstat; this gave some form of control. A glass thermometer measured the temperature. The nozzle was fitted with a spring loaded valve but resembled the nozzle in fig 1. in Chris Fouweather's article.

After a trial run the following information was gathered:

1. The nozzle temperature was important
2. The heater block requires a funnel to take the moulding material
3. The heater block required a temperature gradient to prevent a material pre-melt (hotter at the bottom than the top)
4. The injection rod was repeatedly used to push the material down the barrel until full; the nozzle valve prevented the material escaping.
5. The block must be insulated for temperature control, also to prevent burning the operator.

Mould

The maximum mould size was 2in. x 2in. x 2in. made from dural, brass or mild steel. Use a centre or spotting drill to produce the 90deg. countersink. As a rule of thumb the runners should be thinner than the thickest section of the moulding and should be as short as possible.

The gates are produced by a needle file in one half of the mould only, joining the runner to the mould cavity. A small gate will increase the temperature of the material as it is forced through and will increase the pressure on the injection rod.

To separate the mould, file slots in one half to allow the tip of a screwdriver to be inserted. An alternate method was to tap one half of the mould to take a grub screw for jacking the assembly apart.

An alternative method to remove the air from the mould was to planish the mating surfaces up to the cavity. To produce this effect a $\frac{3}{4}$ in. dia. steel ball was soldered to a rod. The rod was the handle. The planisher was positioned and tapped with a hammer.

The final finish of the cavity was

produced by masking the surfaces and getting the local garage to sand blast the cavity.

In conclusion, having burned oneself, I fitted a perspex guard to the machine and wore a visor, long sleeved overalls, also cotton gloves. Finally, I am not sure, referring to Chris Fouweather's article, that experience has an advantage. At least you are not governed by traditions and can approach the method with an open mind.

Bob Davis writes by email:

We all pride ourselves on being safety conscious these days but hazards come in the simplest forms sometimes. The other day I was about to jam a 3MT chuck into the tailstock when out of habit I inserted a finger to check it clear of swarf. (Yes, I know one shouldn't) but habit and all that.

This time was different. I was wearing a pair of posy latex gloves. Suddenly, slup and my sweaty oily digit is vacuum sealed into the barrel, and I am now secured to the lathe as part of a large and heavy tailstock! With no one around all sorts of imaginings were racing through my brain as to what to do. Fortunately I was able to wriggle free with some subsequent light bruising.

Latex gloves are now widely worn in industry as skin protection but as I have found can bring risks also. I have not seen this publicised anywhere as yet but strongly believe that it is worthwhile to bring it to readers attention in order to spread awareness.

Mr M. Higgs of Southampton, writes:

I saw in the December issue of MEW, the question about anti-scale paint. I was recently given a book by Bill Bryson called "Heat Treatment, selection and application of tool steel". It is a very good follow on from Tubal Cain's book, and covers preheat temperatures, soak times, quench fluids, double tempering, metal composition, and tempering tables with Rockwell hardness tables. The book mentions two types of surface protection, stainless steel foil wrap, or paint, but does not give any brand names. I have spent months on the internet searching for products available in the UK. One is Precision Brand tool wrap distributed by Morgan Leigh Ltd. The other is ZYP Coatings NDB Stop-Off, distributed by Pyrotek Engineering Materials Ltd. of Milton Keynes. It says in their advert, "Do all coating for heat treating, scale and decarburization control"

I have emailed both companies to check on product suitability, and whether they sell to the public, but have not had the courtesy of a reply from either.

Dave Fenner comments: Water based stop off carburising paste is also supplied by Vacuum & Atmospheric Services of Smethwick. It is not cheap, and their smallest pack size is 5Kg. There may be a niche market here for a ME supplier to repack in smaller units.

Joe Lloyd of Huddersfield writes:

The accompanying photograph and general details relate to a stationary steam engine I found in a scrap yard. It was suffering from a gross dose of neglect when found. I have had the unit sand blasted and given it a coat of paint to stop it rusting but cannot find any details about it. I would therefore be obliged to any of your readers who can identify it and better still supply drawings (all reasonable expenses would be reimbursed). Is it commercial? Or is it a one off? The castings are quite substantial and to have made just one would have been grossly uneconomical.

The base plate is $6\frac{1}{4}$ " w x 14" l x 5" h and could accommodate an 8" flywheel. The cylinder is 1" bore x $2\frac{1}{4}$ " stroke. I would imagine an engine of this type would have had governors and may be a water pump.

I have been in touch with all the more obvious companies to no avail. Any help would be much appreciated. joe_lloyd@hemscott.net



TO HELP YOU GET THE BEST FROM THE MODEL ENGINEER EXHIBITION

These notes are written purely for guidance. Full information is contained in the Competitors' Information booklet which is sent to every entrant as part of the information package. If you have an item and are unsure as to the Class into which it should be entered, leave that section blank and we will take care of it. The Judges have the right to move any competition exhibit into another class if they feel that by doing so its chances of gaining higher marks or a more appropriate award are improved.

If the item is offered as a Loan exhibit please indicate this by writing Loan on the form in the box identifying the Class. Loan models are not judged but carry all other privileges associated with competition entries.

Part built models are particularly welcome in the Loan Section; visitors like to see work in progress, and entry does not preclude the item being entered in competition when completed.

The classes listed below are those associated with mainstream model engineering.

Club exhibits

Where a club is exhibiting, each model should be entered on a separate entry form and clearly identified as a club exhibit by entering Loan/Club in the class section box. This ensures that we have a full record of all models on display during the show and facilitates matters of administration and insurance.

Additional forms

If you do not wish to deface your copy of the magazine we are happy to receive photocopies of the entry form, one for each model. We will be pleased to send out extra forms if required, so if you know of a modeller who is not a reader of one of our magazines but who you think may wish to participate, please advise them to contact our Exhibitions Office (01322-660070), or simply photocopy the entry form for them.

The success of the show depends largely on the number of models on display. Your work could well be the stimulus which inspires someone else to start in the hobby. There can be no doubt that this event is our showcase on the world of modelling in all its aspects. Every modelling discipline needs more and more participants, and it is by displaying not only the crème-de-la-crème, but also examples of work of a more achievable standard, that people are encouraged to join into the wonderful world of modelling, in whatever aspect.

We look forward to seeing a sample of your work at the show!

COMPETITION CLASSES

Engineering Section

- A1 Hot air engines.
- A2 General engineering models (including stationary and marine engines).
- A3 Internal combustion engines.
- A4 Mechanical propelled road vehicles (including tractors).
- A5 Tools and workshop appliances.
- A6 Horological, scientific and optical apparatus.
- A7 General engineering exhibits — not covered by the above

Railway Section

- B1 Working steam locomotives 1in scale and over.
- B2 Working steam locomotives under 1in scale.
- B3 Locomotives of any scale, experimental, freelance or based on any published design and not necessarily replicas of full size prototypes, intended for track duties.
- B4 Scratchbuilt model locomotives of any

scale, not covered by classes B1, B2, B3, including working models of non-steam, electrically or clockwork powered steam prototypes.

- B5 Scratchbuilt model locomotives gauge 1 (10mm scale) and under.
- B6 Kitbuilt model locomotives gauge 1 (10mm scale) and under.
- B7 Scratchbuilt rolling stock, gauge 1 (10mm scale) and under.
- B8 Kitbuilt rolling stock, gauge 1 (10mm scale) and under.
- B9 Passenger or goods rolling stock, above 1in scale.
- B10 Passenger or goods rolling stock, under 1in scale.
- B11 Railway buildings and lineside accessories to any recognised model railway scale.
- B12 Tramway vehicles.

Marine Models

- C1 Working scale models of powered vessels (from any period). Scale 1:1 to 1:48
- C2 Working scale models of powered vessels (from any period). Scale 1:49 to 1:384
- C3 Non-working scale models (from any period). Scale 1:1 to 1:48
- C4 Non-working scale models (from any period). Scale 1:49 to 1:384
- C5 Sailing ships and oared vessels of any period - working.
- C6 Sailing ships and oared vessels of any period - non-working.
- C7 Non-scale powered functional models including hydroplanes.
- C8 Miniatures. Length of hull not to exceed 15in for 1:32 scale; 12in for 1:25 scale; 10in for 1:16 scale; 9in for 1:8 scale. No limit for smaller scales.
- C9 For any model boat built from a commercial kit. Before acceptance in this class the kit must have been readily available for at least 3 months prior to the opening date of the exhibition and at least 20 kits must have been sold either by mail order or through the retail trade.

Scale Aircraft Section

- D1 Scale radio control flying models
- D2 Scale flying control-line and free flight
- D3 Scale non-flying models, including kit and scratch-built
- D4 Scale flying radio controlled helicopters

Model Horse Drawn Vehicle Section

- G1 Carriages & other sprung vehicles. (Omnibuses, trade vans etc.) Wagons, carts and farm implements. Caravans.

Junior Section

- J1 For any type of model, mechanical or engineering work, by an under 14 year old.
- J2 For any type of model, mechanical or engineering work, by an under 16 year old.
- J3 For any type of model, mechanical or engineering work, by an under 18 year old.

All entries will be judged for standard of craftsmanship, regardless of the modelling discipline, i.e. a boat will not be competing

against a military figure. Providing a model attains sufficient marks it will be awarded a gold, silver or bronze medals

Model Vehicle Section

- K1 Non-working cars, including small commercial vehicles (e.g. Ford Transit) all scales down to 1/42.
- K2 Non-working trucks, articulated tractor and trailer units, plus other large commercial vehicles based on truck-type chassis, all scales down to 1/42.
- K3 Non-working motor bikes, including push bikes, all scales down to 1/42.
- K4 Non-working emergency vehicles, fire, police and ambulance, all scales down to 1/42.
- K5 Non-working vehicles including small commercial vehicles (e.g. Ford Transit). Scale from 1/43 or smaller.
- K6 Any available body shells including Concours, in any scale or material, to be judged on appearance only.
- K7 Functional model cars/vehicles which must be able to move under its own power of any type. Can be either free-running, tethered radio controlled or slot car, but must represent a reasonable full size replica

DUKE OF EDINBURGH CHALLENGE TROPHY

Rules and Particulars

1. The Duke of Edinburgh Challenge Trophy is awarded to the winner of the Championship Award at the Model Engineer Exhibition.
2. The trophy remains at all times the property of Nexus Special Interests.
3. The name of the winner and the date of the year in which the award is made will be engraved on the trophy, which may remain, at the discretion of Nexus Special Interests Ltd, in his/her possession until required for renovation and display at the following Model Engineer Exhibition.
4. Any piece of model engineering work will be eligible for this Championship Award after it has been awarded, at The Model Engineer Exhibition, a Gold or Silver medal by Nexus Special Interests Ltd.
5. No model may be entered more than once.
6. Entry shall be free. Competitors must state on the entry form:
 - (a) That exhibits are their own bona-fide work.
 - (b) Any parts or kits that were purchased or were not the outcome of their own work.
 - (c) That the model has not been structurally altered since winning the qualifying award.
7. Nexus Special Interests Ltd. may at their sole discretion vary the conditions of entry without notice.

COMPETITION RULES

1. Each entry shall be made separately on the official form and every question must be answered.
2. Competition Application Forms must be received by the stated closing date.

LATE ENTRIES WILL ONLY BE ACCEPTED AT THE DISCRETION OF THE ORGANISERS.

3. Competitors must state on their form the following:
 - (a) Insured value of their model.
 - (b) The exhibit is their own work and property.
 - (c) Parts or kits purchased.
 - (d) Parts not the outcome of their own work.
 - (e) The origin of the design, in the case of a model that has been made by more than one person.

NOTE: Entry in the competition can only be made by one of the parties and only their work will be eligible for judging.

4. Models will be insured for the period during which they are in the custody of Nexus Special Interests Ltd.
5. A junior shall mean a person under 18 years of age on December 31st in the year of entry.
6. Past Gold and Silver medal award winners at any of the exhibitions promoted by Nexus Special Interests Ltd. are eligible to re-enter their model for the 'Duke of Edinburgh Challenge Trophy.'

Past winners at any of the exhibitions promoted by Nexus Special Interests Ltd. will not be eligible for re-entry into the competition unless it has been substantially altered in any way.

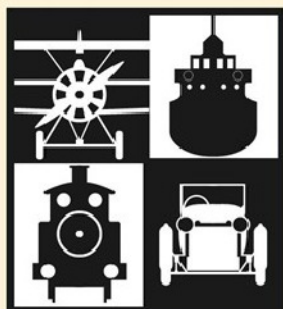
7. Nexus Special Interests Ltd. reserve the right to:
 - (a) Transfer an entry to a more appropriate class.
 - (b) Describe and photograph any models entered for competition or display and to make use of any such photographs or descriptions in any way they may think fit.
 - (c) Refuse any entry or model on arrival at the exhibition and shall not be required to furnish a reason for doing so.
8. Entry into the competition sections is not permitted by:
 - (a) Professional model makers.
 - (b) Anyone who has a financial interest in the direct supply of materials and designs to the public.

NOTE: If unsure, please contact the Competition organisers, prior to the show.

9. The judges' decision is final. All awards are at the discretion of the judges and no correspondence regarding the awards will be entered into.
10. Exhibitors must present their model receipt for all models collected at the end of the exhibition and sign as retrieved.
11. The signed release for each model must be presented to security staff when leaving the exhibition complex with display model(s) after the close of the exhibition.

IMPORTANT NOTE PLEASE MAKE COPIES, INCLUDING PHOTOGRAPHS, OF ALL INFORMATION RELATING TO YOUR MODEL, AS NEXUS WILL NOT ACCEPT LIABILITY FOR ANY LOSS.

CLOSING DATE 16TH DECEMBER 2003



THE MODEL ENGINEER EXHIBITION

Please return completed form to:
Model Engineer Competition, The Leys,
Church St., Twyford, Bucks. MK18 4EU

ENTRY FORM - COMPETITION & LOAN MODELS

ENTRY NO.

OFFICE USE ONLY

CLASS	ENTRY NO.

PERSONAL DETAILS (Please print)

Surname Forename(s) Age

Address

Post Code Home Tel: Daytime Tel:

Model Club or Association

Have you entered before? (Y/N) Do you purchase or subscribe to a Nexus magazine? (Y/N)

How many years have you been a modeller?

Mail Order Protection - please tick this box if you would prefer not to receive mail from other companies which may be of interest to you ☐

MODEL DETAILS - PLEASE TICK BOX IF MODEL IS FOR LOAN

Entry Class (competition entries only)

Model Title (to be used for catalogue and display card)

Model Description

Model Scale Length Width Height Weight

Type of construction

Parts not made by you and commercial items.....

Have you supplied a photograph? (Y/N)

Are you supplying Judges Notes? (Y/N)

Value of model (Highbury Nexus will not insure the model unless a value is entered) £

Name and address of local newspaper

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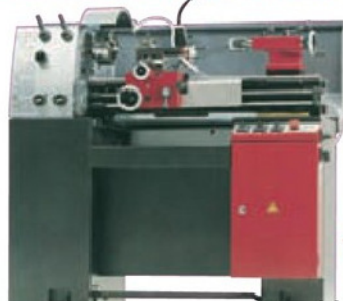


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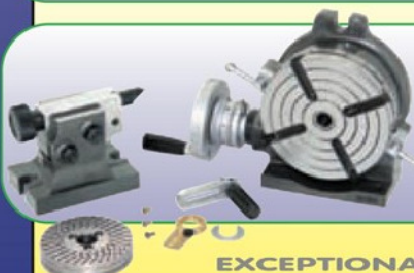
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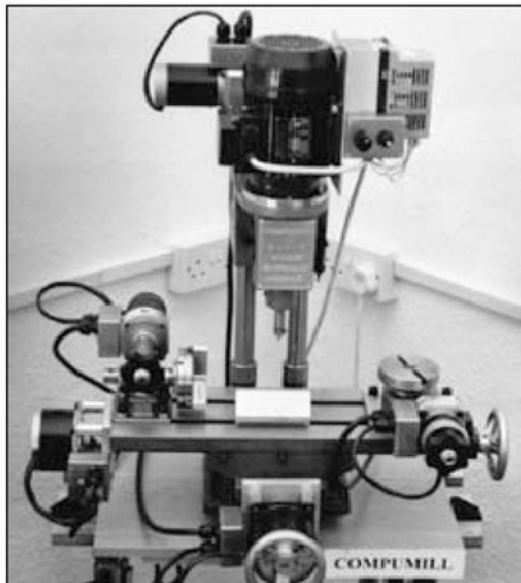
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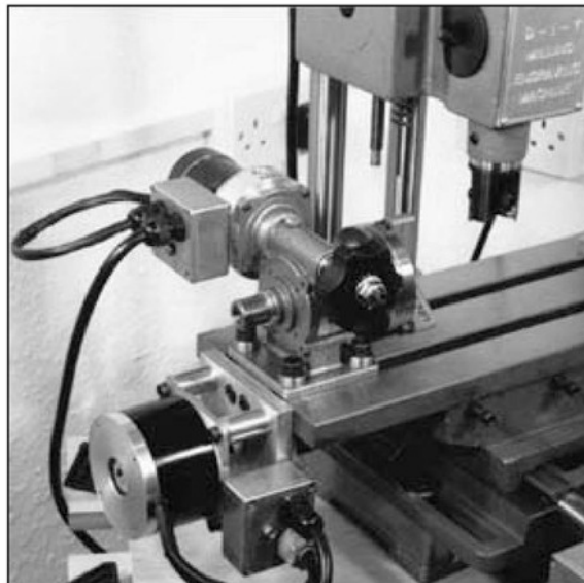
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A sample of our current stock includes:

Lathes

Hardinge HLV-H, 5"x 18" super precision, well equipped, superb condition.....£3950
Myford Super 7, clutch, cabinet stand, equipped.....£750
Myford Super 7B, gearbox, industrial cabinet, excellent condition£1150
Smart & Brown A, feeds & gearbox, equipped inc. collets.....£975
Colchester Bantam 1600, 5" x 20", equipped£1275
Colchester Student 3100, 6 1/2" x 40", late vari speed model, equipped£2250
Harrison M250, 5 1/2" x 30", (long bed) equipped, almost as new condition.....£2750
Harrison M300, 6" x 25" gap bed, equipped, superb£2450

Mills

Harrison vertical, 30"x 8" T, power feed, geared speed change, nice condition.....£975
Top mill, 45" x 10", (bridgeport copy) power feed, DRO, crome slides, 1990.....£2250
Bridgeport, 42" x 9" T, power feed, good usable machine, priced to clear£ 900
Bridgeport, 48" x 9" T, power feed, vari speed head, DRO, crome slides, 1995.....£3450
Denford vertical, (similar to Myford VMF) 30" x 7" T, R8 quill etc£1350
Warco Major geared head, 29"x 8" table with power feed, on cabinet.....£ 875
Adcock & Shipley 1ES, vert/hori, 30"x 8" T, power feed etc£950
Emco FB2, mill/drill, geared head, 24"x 6" T, power feed, cabinet stand£1275

Various

Startrite 18-10 vertical bandsaw £795. Startrite 200 horizontal bandsaw, very late
£700. Eagle hand opp surface grinder £395. Astra scorpion 250 pull down cut off
saw £475. Fobco 10/8, heavy duty pillar drill, 3mt, 10 speed £700. Meddings MF4
10 speed pillar drill £375. Kingsland 45 ton, 5 station universal iron worker £2600.

Sheet Metal machinery.

4ft hand rolls £395. Edwards 1M pneumatic guillotine £450. Edwards 4 ft straight
edge folder £450. Duplex free standing nibbler £195. Other machines, please
enquire.

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ALL MODEL STEAM ENGINES REQUIRED

Any gauge, any condition including static
models, unfinished projects **OR JUST
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Light duty suitable for Myford size
machines Medium duty suitable for
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Only £89.50 including VAT and P & P

As reviewed in Model Engineers' Workshop No. 87

As successfully displayed at The Harrogate Show 2003

System comprises of:

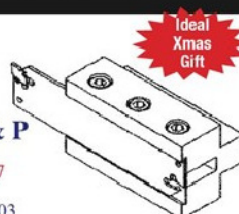
Five 2mm wide carbide inserts, double-ended adjustable insert blade, blade holder,
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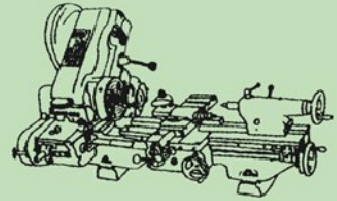
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LATHES

BOXFORD TUD 41/2" x 20" MK11 3 jaw chuck, cabinet stand, hand feeds.....	Choice £395
BOXFORD CUD 41/2" x 20", changewheels, 3 jaw chuck, cabinet stand.....	still only £750
BOXFORD AUD 41/2" x 20", gearbox, 3 jaw chuck, cabinet stand.....	In really nice condition...£1250
BOXFORD CUD 5" x 22" MK11, c/wheels, 3 jaw chuck, 4 way toolpost.....	£1400
BOXFORD BUD 5" x 22" MK11, c/wheels, power cross feed, T-slotted cross slide.....	£1400
BOXFORD AUD 5" x 22" MK11, gearbox, power cross feed, T. slotted cross slide, cabinet stand.....	very nice £1625
BOXFORD 1020 INDUSTRIAL 5" X 20", Geared Head, Power Feeds, Cabinet Stand.....	Clean Machine £1750
BOXFORD 1130 INDUSTRIAL 5" X 30", Geared Head, Gearbox, Power Feeds, 3 & 4 Jaw Chucks, Splash Tray and Light.....	£2450
COLCHESTER BANTAM 1600 model, 5" x 20", geared head, power feeds, gearbox.....	£1400
COLCHESTER BANTAM 800, 61/2" centre height x 30", between centres, 11/4" bore, 16 speeds, D13 camlock fitting, 3 & 4 jaw chucks.....	In very nice condition and 240 volts... from new £3450
COLCHESTER BANTAM 2000, 61/2" centre height x 30", between centres, 11/4" bore, 16 speeds, D13 camlock fitting, 3 & 4 jaw chucks in very nice condition.....	£3250
COLCHESTER BANTAM 2000 As above but Latest model made.....	£3750
COLCHESTER STUDENT Square head, 1500 revs / 2 speed motor model, geared head, gearbox, imperial / metric, power cross feed & gap bed, dual dials, 3 Jaw chuck, taper turning, coolant, etc.....	£2950
COLCHESTER MASTER 6" X 36", Gap Bed, Gear Box, Power Feeds, Coolant.....	Nice £1750
COLCHESTER MASTER SQUARE HEAD 6" X 36" Precision Lathe, Gear Box, Power Feeds, Chucks, Dickson Tool Post in nice condition.....	£2250
COLCHESTER MASTER 2500; Short and Long Bed Lathes well equipped.....	As is from £2450
COLCHESTER TRIUMPH 6" x 25", 3 jaw chuck, Dickson tool post, very nice ex. college.....	Each just £3950
CVA 14; 6" x 30" complete with collets and 3 jaw chuck.....	£2250
HARRISON L5, 41/2" x 24", fully tooling, complete with clutch.....	one of the best start up deals £950
HARRISON 140, 51/2" x 24", geared head, semi gearbox, 3 jaw chuck, gap bed, power feeds, clutch.....	£1400
HARRISON 140, 51/2" x 24", geared head, gearbox, gap bed, power feeds, tooling, coolant.....	£1725
HARRISON M250, 5" x 20", gearbox, power feeds, 3 & 4 chucks, Ex-services.....	nice condition £2950
HARRISON M250, 5" x 20", gearbox, power feeds, 3 and 4 chucks.....	nice condition and 240 volts from new £3250
HARRISON M250, 5" x 30", long bed, gearbox, power feeds, chucks, Acutric III DRO on cross-slide, dual dials.....	In very nice condition £3250
HARRISON M300 6" x 24" precision lathe, geared head, gearbox, power feeds, 3 jaw & 4 jaw chucks.....	Choice £3250
HARRISON M300 6" x 24" precision lathe, geared head, gearbox, power feeds, 3 jaw chuck, Dickson toolpost.....	This machine is 240 volts as new and in very good all round condition £3550
HARRISON M300 6" x 40", geared head, gearbox, power feeds, gap bed, 3 jaw & 4 jaw chucks, fixed steady.....	In very nice condition £3,450
HOBBYMAT MD65 21/2" x 12" screwcutting lathe with changewheels and some tooling.....	£425
MYFORD ML7 31/2" x 19" lathe, 3 jaw chuck.....	we have a large selection of this popular model...£750
MYFORD ML7B 31/2" x 19" gearbox, 3 jaw chuck and tooling.....	£1250
MYFORD SUPER 7 31/2" x 19" changewheels, 3 jaw chuck and tooling.....	Choice £950 - £1150
MYFORD SUPER 7, 31/2" x 19" 3 jaw chuck, power cross-feed.....	Late model Choice
MYFORD SUPER 7 31/2" x 31" changewheels, 3 jaw chuck and tooling.....	Choice £1400
MYFORD SUPER 7, 31/2" x 31" (long bed) power cross-feed, induction hardened bed, industrial stand and doors, green machine.....	£2950
MYFORD SUPER 7B 31/2" x 19" gearbox, 3 jaw chuck and tooling.....	£1250
MYFORD SUPER 7B 31/2" x 19" gearbox, Power Cross Feed, cabinet stand, tooling.....	£2750
MYFORD SUPER 7B 3" x 19" gearbox, Power Cross Feed, 3 jaw chuck and tooling on stand.....	excellent condition from new and NOT re-conditioned £3450
MYFORD C7 CAPSTAN LATHE Complete.....	£1200
RAGLAN CAPSTAN 10" x 24" 6 Station Turret, cut of slide, collet chuck (lever) & collets, bar feed, variable speed, coolant.....	£950
SMART AND BROWN collet lathe complete with cross / top slides and collets.....	£345
SMART AND BROWN 1024 tool-room lathe, full screwcutting gearbox and power feeds complete with 3 jaw chuck and equipment.....	give away at £750
VICEROY TDS 1 GBL 5" x 24", gearbox, power slides, 3MT tailstock complete with fixed steady.....	£1250
WEILER L2220 variable speed precision lathe 100mm x 450mm complete with accessories and collets.....	£1225

TOO MANY LATHES TO LIST!!

MILLING MACHINES

V - VERTICAL, H - HORIZONTAL

ARBOGA F3 Universal Milling Machine Complete with Collets 1/16" - 5/8" & 2MM - 20MM, Suds and Light in all round good condition.....	£3250
BOXFORD VM30 vertical variable speed / 30 INT head, table 21 1/2" x 6" & Abwood vice and chuck.....	£1500
BRIDGEPORT vertical belt head 2 speed (short motor) head, R8 powered head, gearbox table, 42" x 9" table.....	£1650
CENTEC 2B Horizontal, 1" arbor, table powered, 3 ph motor, single phase main motor.....	£725
CENTEC 2B Vertical/horizontal, quill feed 2MT head, 25" x 5" table, pedestal model.....	£1400
ELLIOT '00 OMNIMILL V/H 3 Morse taper quill universal head, 28" x 71/2" powered table.....	£1850
ELLIOT Turret mill R8-10 speed 70-3000 rpm, table 45" x 10" (powered).....	£1500
HARRISON horizontal, 31" x 8" powered table.....	still good value £625
HARRISON HV 30 INT swivel head & clutch, 30" x 8" table/powered.....	£1650
HARRISON Vertical 30 INT swivel head & clutch, 30" x 8" table / powered.....	£1650
MARLOW VERTICAL TURRET TYPE MILL, 3 MT, 28 x 7".....	A favorite mill for its height under the head £950
SIP RF30, vertical milling/drilling machine complete with accessories.....	Still only and New £799
TOM SENIOR M1 horizontal, 25" x 6" powered table, 1" arbor.....	£575
TOM SENIOR M1 V/H, 25" x 6", 2 MT, 1" arbor.....	Selection £1200 - £1450
TOM SENIOR ELT MAJOR, 2 MT quill feed head, powered 37" x 81/2" table in.....	£2,750
VICEROY AEW vertical mill, 30 INT swivel head, powered table 34" x 8",.....	Very clean £1625

DRILLS

ARBOGA ER 25 / 25" Radial drill speeds (8) 100-2900 RPM.....	clean table £1425
ASQUITH 14-54 001 Mk2 (5mt) radial drill.....	£3950
BOXFORD 2MT pedestal drill.....	£295
FLOTT TB6 precision bench drill, 450 - 9000rpm.....	£425
FOBCO 1/2" bench, tilting table.....	£325
FOBCO 1/2" pedestal drill tilting table.....	£345
MEDDINGS 1/2" pedestal drill.....	£245
MEDDINGS 2 MT pedestal drills (new type lighter drill).....	Choice £275
POLLARD CORONA pedestal 1/2"/1MT.....	From £100
SIP HDP 600B 5/8" / 2MT bench drill, table operated by rack, speeds; (16) 162 - 3000 rpm.....	New £175
STARTRITE Mercury 1/2" 4 speed bench drill.....	£225

GRINDING / BUFFING

CLARKSON MKI Tool and cutter grinder complete with universal head and centres.....	JUST IN £550
EAGLE 4W wet surface grinder + magnetic chuck.....	£725
HERBERT drill grinder + followers.....	As is £245
HERBERT tool and cutter grinder.....	As is £425
JONES & SHIPMAN SURFACE GRINDER complete with 18" x 6" magnetic chuck and coolant.....	£2250
MILFORD 12" Pedestal Grinder.....	£325
VICEROY Grinder, pedestal model.....	£145

VICEROY Buffers, pedestal models.....	each £250
VICTOR EAGLE surface grinder, 21" x 6", complete with + 14" x 6" magnetic chuck, dust extractor & coolant.....	£1250

MISCELLANEOUS / FABRICATION MACHINERY

PULTRA EQUIPMENT just in including dividing head, vertical slide and milling spindle.....	from £95
FLAMEFAST PB250 power burner.....	£395
JUN-AIR 18-50 compressor 120psi / 50 litre tank.....	£425
HPC TWO STAGE twin compressor.....	£675
GABRO 24" box and pan folder.....	£325
BATY digital vernier 6" with metric / imperial, origin and absolute buttons.....	NEW £35
EDWARDS 39... x 16g treadle guillotine with all its stops in very nice order.....	£625
ALCOSA hearth.....	Just in £245
WELLSAW 4" hacksaw.....	£325
RJH vertical 4" finisher + built in dust extractor.....	£625
RJH horizontal 4" finisher + built in dust extractor.....	£625
BOXFORD 8" SHAPER, powered table.....	Very Clean £425
OMT Optical Measuring Tools universal boring head, 40INT, boxed + tooling.....	£345
ELLIOT 4" light type dividing head, tailstock and two plates.....	£375
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ABWOOD SWIVEL/TILT 6" vice in all round good condition.....	£375
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TRIUMPH BURNED 4 Jaw Chuck.....	£245
SIP 7" bandsaw, horizontal & coolant.....	New £750
DUPLEX D29 toolpost grinder.....	£345
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BURNERD, D14 lever collet chuck + collets.....	£400
BURNERD, LO lever collet chuck + collets.....	£400
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MYFORD 254" rear tool post.....	New £40
MYFORD Vertical slide / fixed type (copy).....	£99
LOCKWOOD Quad Headed 2MT Die Holder.....	quality equipment New £40
LOCKWOOD Quad Headed 3 MT Die Holder.....	quality equipment New £40
LOCKWOOD Test Bar / 2mt Boxed.....	quality equipment New £99
STARTRITE 352 woodworking band saw.....	£975
STARTRITE 14-S-5 woodworking band saw.....	£775
ALCOSA GF 080/1 Rapid Melting Furnace.....	£300
COLCHESTER D13 Burned 4 Jaw 8" light body independent chuck.....	one off £225
MICROMETERS and associated measuring tools.....	Still packaged as new
SIP 1 TON MOBILE CRANE Manufactured 2000 (used just once).....	As new £375
MITUTOYO grade A set of slips.....	£245
MITUTOYO 103-913 metric set micrometers.....	£275
AJAX 6" hacksaw.....	£425
SURFACE plates from 12" x 12" to 36" x 36".....	Very nice from £30
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RJH finisher 4" wide belt, pedestal.....	£245
STEEL STOCK / different stock rolling in almost daily.....	to callers only
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SWAGE BLOCKS.....	£125 / £145
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- 10 micron Accuracy



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Cobra Lathe

- Centre height: 70mm • Distance Between Centres: 250mm
- Speed Range: 100-200rpm • Metric or Imperial Leadscrews



Cobra Mill

£339

- Variable Speed Control
- Spindle Taper: MT2
- Table Size: 145 x 240mm
- Metric or Imperial Leadscrews



DB8 Lathe

£850



- Centre Height: 105mm • Distance Between Centres: 400mm • Complete with 3 & 4 Jaw Chucks, Fixed & Travelling Steadies & Face Plate
- Hardened & Ground Bedways • Accuracy Report

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£999



- Centre Height: 125mm • Distance Between Centres: 550mm • Thread Cutting Gearbox • Complete with 3 & 4 Jaw Chucks, Fixed & Travelling Steadies & Face Plate • Vee Bedway • Accuracy Report

Model B Super

£670

- Maximum Swing: 420mm
- Distance Between Centres: 520mm
- Cast Iron Construction
- Metric or Imperial
- All Tapers MT3
- Supplied with 3-Jaw Chuck, Drill Chuck & Arbor and more!



£1100 Centurion

- Distance Between Centres: 520mm
- Centre Height: 210mm • Spindle Bore: 28mm
- Powered Crossfeed • Separate Motor for Lathe/Mill
- Complete with 5" 3-Jaw Chuck, Lathe Tools, Change Gear and more!



Conquest Lathe

£395



- Centre Height: 90mm
- Distance Between Centres: 325mm
- Large MT3 Spindle Taper
- Spindle Bore: 19mm
- Now C/W Quick Change Toolpost
- Variable Speed Range 100-2500rpm
- Metric or Imperial Leadscrews

626 Turret Mill

£1340

- Table Size: 156 x 745mm
- 1.5HP Motor
- MT3 or R8 Spindle
- Metric or Imperial graduations



Champion Mill/Drill

£585

- 1/2HP Motor
- Table Size: 150 x 630mm
- Complete with Drill Chuck & Arbor
- Ground Cast Iron Column
- MT3 Spindle



Craftsman Lathe

£1550

- Centre Height: 150mm
- Distance Between Centres: 570mm
- Swing in Gap: 450mm
- Powered Crossfeed • Spindle Bore: 36mm
- Complete with 3 & 4 Jaw Chucks, Fixed & Travelling Steadies, Face Plate, Machine Stand, Accuracy Report & much more!

