

AUGUST/SEPTEMBER 2004

MODEL ENGINEERS' WORKSHOP

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**PCD
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methods

**100th
ISSUE**

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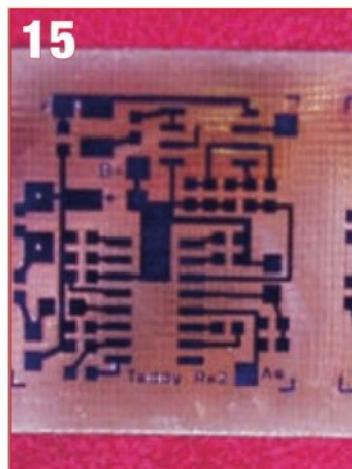
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Front Cover



Positioning holes on a
PCD is easily achieved
with a rotary table, but
it can be done
accurately without.
Harold Hall tells how,
on page 18.

See pages 39-41
for special
centennial prize
draw offers!

Back in print

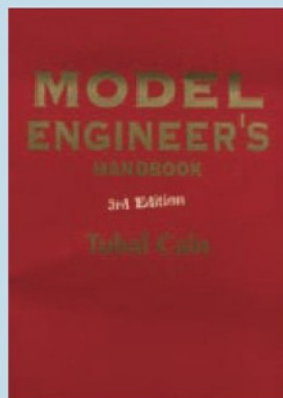
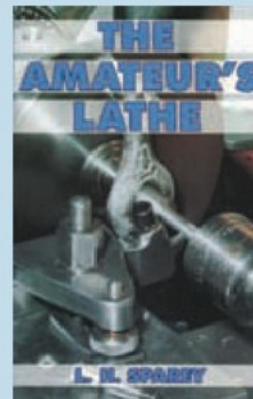
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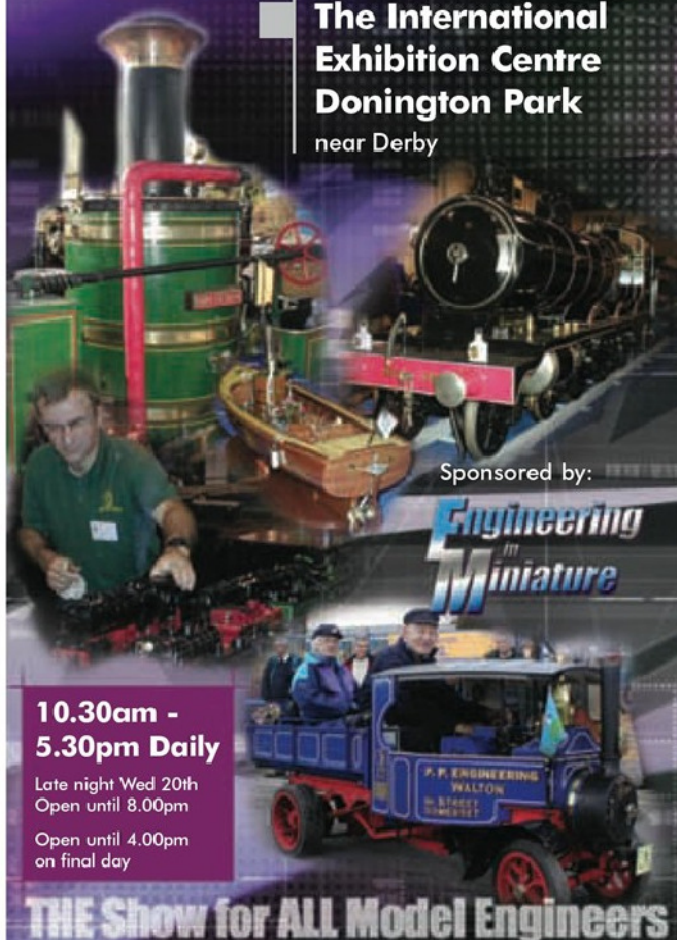


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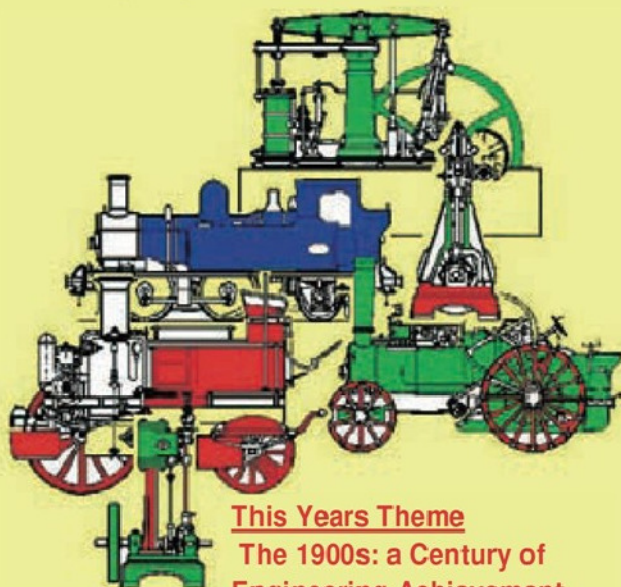
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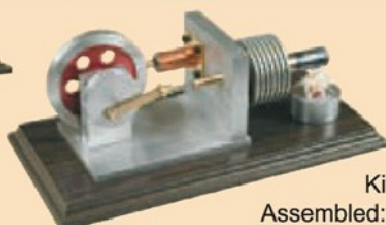
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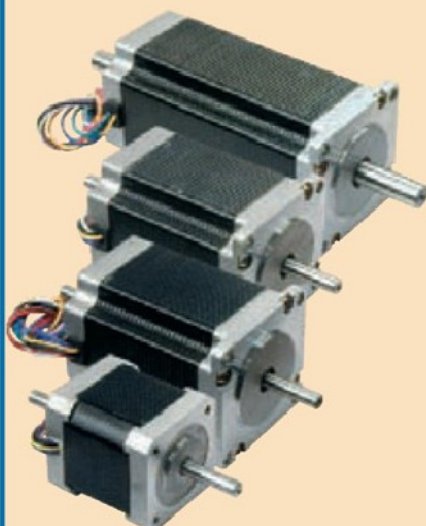
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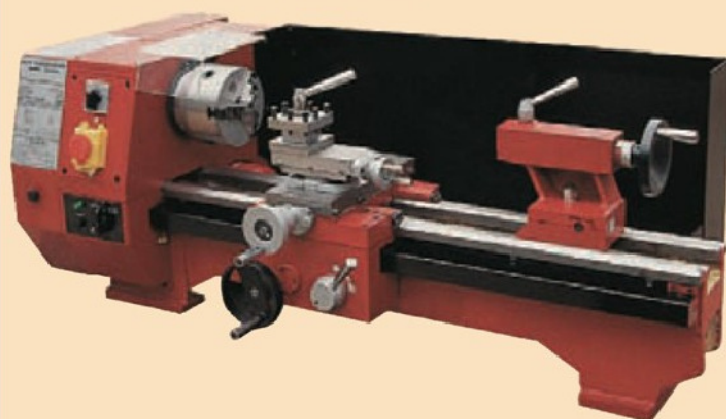
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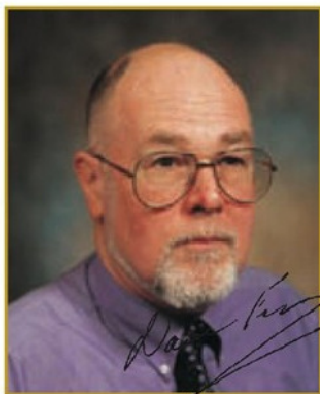
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ON THE EDITOR'S BENCH

Centennial Issue

It may be considered that this, the 100th issue of Model Engineers' Workshop signifies a major milestone in the magazines history. To mark the occasion, I have twisted the arms of my three predecessors, Stan Bray, Harold Hall, and Geoff Sheppard, and persuaded them to offer some reflective comment. In addition, a number of "Competitions" are featured which are by way of giving something back to readers. Highbury Leisure are offering six subscriptions, for which the details will be found on the relevant advertisement. The format of "Trade Counter" has been changed for this issue, and several suppliers have very generously made available some extremely worthwhile prizes to be won by readers. As well as this, owners of Myford Series 7 lathes will find the chance to win a bed and saddle regrind. See page 51.

Of course 100 issues of MEW are somewhat dwarfed by the longevity of sister magazine "Model Engineer", now well in excess of 100 years, but the continued success stands as a testament to the concept for such a publication, originally proposed by Stan Bray as a quarterly specialising in workshop aspects. Any magazine is of course only as good as its contributors, and my personal vote of thanks goes out to the many who put pen to paper (or fingers to keyboard) and produce the wide range of articles which in turn makes the editorial function such a pleasure. Sadly, some have passed away, but they are fondly remembered through their words of wisdom.

Bob Loader, Peter Rawlinson, Dyson Watkins, Tony Jeffree and Harold Hall are regular long term authors, whose work has covered many interest areas, and some of which has already appeared, or is expected to appear, in book form.

Topics I would like to bring in to MEW at some time, are "Pneumatics" and "Hydraulics" in the workshop, also "Induction heating" as applied to heating for forging and for melting metals. While it would probably be quite possible for one of our established contributors to research the subjects, it is highly likely that we have readers with extensive professional experience of these areas, who may care to share their expertise. I would be most pleased to hear from potential authors keen to pick up one of these gauntlets.

I do occasionally receive phone calls from readers enquiring as to whether an article based on their latest workshop project would be of interest. The answer is

almost always "Yes", and I would encourage anyone who may be thinking about preparing an article to get in touch and discuss the topic. I am always happy to offer guidance on presentation etc.

In his comments, Geoff Sheppard notes some changes which have occurred over the last decade, in particular the availability of high quality low priced tooling which plays a part in influencing the make or buy decision. It is also interesting how changes in one area may spur on development in another. A current case in point is the low cost carbide cutters from J B Tools. In the smaller sizes they really need much more than the 2000 - 3000rpm spindle speed typical of most small mills. Modern industrial machining centres may have anything up to 50,000rpm on tap, and for older equipment, a spindle speed increaser may be added, but at a cost of around £1500.00, considerably beyond the typical amateur budget. Dick Stephen has been looking at the possibility of a DIY version, and early indications are that this will indeed be feasible and the unit is now up and running. Peter Rawlinson has also been experimenting, this time on a procedure for soft soldering using a resistance heating technique similar to spot welding. The speed increaser will be described in issue 101, and it is hoped to have a write up on the soldering technique in due course.

Missing Identity

Would the reader who sent in his interesting account of moving a Colchester Student Lathe single handed, please get in touch. I have the draft text and photos, but no covering letter.

Good News for Clockmakers

The many friends of Alan Timmins who felt that he was less than fairly treated (issue 98) will be pleased to know that he and I have enjoyed a lengthy discussion and better appreciate each other's viewpoints. It was also learned that Alan has recently been working to modify the Isaacs pinion mill design, in order to improve performance and make it more amenable to supply in kit form, in that the major components are now iron castings rather than steel fabrications. Kirk Burwell (who bought over the Hemingway business last year) was displaying the pre-production prototype on the Hemingway stand at Harrogate, and it certainly has all the hallmarks of an item that will be of interest to clockmaking enthusiasts. It is hoped that an article on its construction

will be featured in a future issue, and that further items for horologists such as a wheel engine and depthing tool, will follow, in turn to be added to the Hemingway range.

Courses at Northbrook College

Mr P. Beckett of the Engineering Dept at this college in Worthing wrote to let readers know of the courses run by them and aimed at model and amateur engineers. The courses are run through the Adult Education Dept. under the titles "Model engineering" (Monday 6.30pm - 8.30pm) and "Open Access" (Tuesdays 6pm - 8.30pm) The courses are run on a term by term basis with no entry requirements (and no exams). The Tuesday course is open to people who want access to a full equipped machine shop and are taught according to needs. The range of equipment extends beyond the usual mills, lathes, drills, and grinders to include facilities for casting, fabrication and welding.

Interested readers may make contact direct to Mr Beckett (direct line 01903 606 438) or through the Adult Education Dept (01903 606 348).

Dates for the Diary

Bristol Model Engineering and Hobbies Exhibition

August 20th-22nd. Success built up over the last two years has ensured that this is now accepted as one of the major UK shows. It will feature an operational workshop, and displays will include locos, boats, aircraft, gas turbines etc. The location will be as before, the Leisure Centre, Thornbury, which benefits from free parking, and is conveniently located for access from M4/5. Further information can be obtained from the website: www.bristolmodelengineers.co.uk

Midlands Model Engineering Exhibition

Donington October 16th -21st (late night 20th) Organised by Meridienne Exhibitions this is a firm favourite with both visitors and exhibitors. Personal experience suggests that the show warrants at least one full day, and if your diary allows two, then a visit to the Donington racing car collection next door really puts the icing on the cake.

Advance Tickets adult £7.50 senior £6.50 Family £19.00.

BLASTS FROM THE PAST



First, we hear from Stan Bray, to whom must go the credit for the "MEW" idea, and who occupied the editorial chair for issues one to six.

Stan Bray

Who am I and how did MEW start?

"My drift into model engineering with hindsight seems to have been inevitable. My father was a locomotive driver, although obviously he must have started, as did everyone, as a cleaner and fireman and followed what was in those days a very long and hard road to become a driver. Several uncles were railway employees, including one who was firing on the top link at Kings Cross. My first recollection of our own home was that of seeing the locomotives stabled at Hornsey in North London, parked at the bottom of the back garden and as Hornsey was where my father was stationed and the entrance was little more than a few yards from the house I was a frequent visitor. I knew a large number of the staff and was not only made welcome at the shed but had frequent footplate trips as well.

With the start of the war my school closed, most of the pupils being evacuated although some of the older ones joined the forces and so it was a case of finding work. It was made quite clear that the railway was not considered suitable. I obtained an engineering apprenticeship, at the princely sum of 14/- (70p) per week with an annual increment of 1/- (5p) per week for the next five years at which point my wages would go to £2-10s-0d (£2.50) per week and started to learn about milling machines, etc, although a considerable proportion of the time was spent on capstan lathes and power presses as the firm was engaged on

Reflections and perspective comments from previous editors. To commemorate this 100th issue, I asked my three predecessors to compile some reflective background notes relating back to their time in office.

war work and although I attended classes to study for City and Guilds, in the factory, production took preference over the learning process.

I later served in Palestine and on my return from there applied for my old job, the company being obliged by law to reinstate me even though work was limited and with the return of members of the forces they were over staffed. The result was a rather boring time on a spot welder doing production work, instead of the anticipated tool room appointment. Finding this irksome I joined the Metropolitan Police Force and set myself up with a workshop, making "O" gauge model locomotives and rolling stock. As the result of encouragement from a fellow officer I branched out to make machine tools and a wide range of models. I also for a period attended the local technical college to take further examinations.

The intention had been to possibly return to engineering at the end of my police service, but once again I found an industry not wanting staff, this time because it was beginning to contract and so for a period I taught metalwork and engineering practice at a secondary school. This led indirectly to an interest in writing and finally in turn led to employment on the editorial staff of the company that was then publishing Model Engineer.

The Start of MEW

Working at the Model Engineer office involved a round trip of about a hundred and seventy miles a day and after a couple or so years I found this rather too much and it was agreed that I should finish full time employment but continue my association with the company in a variety of ways, including a regular column in the magazine and writing a number of magazines known as specials. These generally took the form of thicker than usual publications that were published at irregular intervals. There were a number of different ones but by far the most popular was one called World of Model Engineering that invariably sold out very rapidly, with a constant stream of requests for further issues. All this gave me considerable experience in model press publishing and it seemed obvious from feedback that there was a call for a magazine devoted entirely to workshop matters. The management had changed by

that time and it was very difficult to persuade them that there was a call for such a publication; even after several meetings they were not entirely convinced but did agree to publish at three monthly intervals, with the proviso that if the publication did not sell a certain number of copies after two issues it would cease.

So work started on the first issue of MEW and the finished magazine was taken in for perusal by management who were not willing to publish it without first vetting the content. This led to quite an argument as there was no model making in it and they would not agree at first, that without models it would sell. Finally and reluctantly they did agree to go ahead and I eagerly awaited the first copy. To my amazement although basically unaltered a number of photographs of models had been inserted. This led to yet more words, but now I was on much stronger ground as not only had the magazine sold well, but also because of the demand, a reprint had become necessary, something never before heard of. Issue two did not contain unrelated pictures of models and again there was a reprint and so the magazine was launched.

Unfortunately for me it was a victim of its own success as some while afterwards the company decided it should be published bi-monthly instead of at three month intervals. At that stage little copy was coming in and most of the articles involved making things in my own workshop as well as photographing and drawing them and preparing the magazine for publishing. I was also involved in other publications and had contracted to write a couple of books, it was therefore obvious that I was not going to be able to do the lot and so rather reluctantly agreed to help the company find a new editor for MEW.

As luck would have it a number of articles had by then been received from Harold Hall and it was obvious from those, that he was the man for the job, if he would accept it. I contacted him and he agreed to take it on. This was ideal as Harold had far greater knowledge of modern methods than I have and as a result of his efforts the magazine went from strength to strength.

Well there ended my engagement with MEW except as an avid reader, and occasional contributor. I still like to consider it as my baby and have a certain amount of pride in having started it.



Harold Hall then took up the baton for issues 7 to 28

Harold Hall Accidental Outcome

"Being editor of MEW came about, surprisingly, as a consequence of an out of control car causing a near head on collision with mine, resulting in a broken ankle and eight months off work. For some four months I was not allowed to put the foot to the ground so sedentary activity was the order of the day and I decided to write a few articles relating to some workshop tooling I had made. These I sent to the Model Engineer magazine for consideration and was informed that they would be more appropriate to MEW which had very recently commenced publication. Stan Bray, the editor, liked them and asked if I could I produce more. As a result, five of my articles appeared in issue 5 and two in issue 6. No doubt these were a major factor in me being considered for the editors chair.

By issue 7, I had become the editor and as articles were in very short supply, eight of my articles appeared in that issue, though being the editor this was not acknowledged. Still, with a limited pool of contributors, I continued to produce a number of articles for each issue, though not in that number. Not having any substantial contact with those of a similar interest I was not able to do any arm twisting to expand the author pool. However, a few readers did start producing articles quite regularly, and well before the time I relinquished the post (issue 28) articles were available in greater number, though still not plentiful, and my involvement gradually reduced to an article or two per issue. My thanks are to those who helped in no small way to further the magazine in those early days and it is gratifying to see some still producing articles.

Changes over time

Having maintained contact with the publishing team, it is interesting to see how dramatically some things have

changed, some visible to the readers and others not. Total page numbers have reduced whilst advertisements have increased. In the early days this meant a larger number of pages to be filled with editorial matter contributing to the problem of insufficient articles available. This was though, offset by there only being six issues a year at the time. On the plus side for the reader, the magazine is now in full colour, whilst in the early days most of the magazine was in black and white.

On the hidden side, technology has obviously resulted in major changes. Whilst I feel I had the short straw, so to speak, when it came to filling the magazine, the organisational side was easy due to living only some 15 minutes from the office where the practical side took place. Being a novice, I could visit the professionals on a regular basis. Other than for word processing the use of computers was nowhere to be seen.

Drawings were still produced using pen and ink and the page layouts using the method of many years of "cut and paste" using knife, scissors and glue etc. Whilst as a novice this was easy to appreciate, it was less easy to make even minor last minute changes. During the early days, Alex Gee was the in-house sub editor for the magazine, also having his own magazine to produce. His help and subsequently that of Ted Jolliffe, editor of the Model Engineer, was invaluable.

One move towards modern methods was the use of OCR (optical character recognition). As most articles were received on paper this had to be typed into a computer before editing could be undertaken. This was time consuming. Providing the article received was not "hand written" it could be scanned into the machine which would then attempt to interpret what it saw as alpha/numeric text. Unfortunately, the initial machines were not that accurate, even though expensive, and many errors appeared, typically B being read as 8 or vice versa. For the editor looking for significant changes to the content of the article, these individual character errors were easy to overlook. This resulted in many apparent spelling errors, a fact that the more demanding readers were quick to inform us.

Drawings received were usually pencil sketches and needed redrawing. Even this was not without its problems as draughtsmen more usually creating

drawings for other publications, typically aero modelling, were not accustomed to producing industrial calibre engineering drawings. As a result I considered encouraging authors to use CAD, realising though, that any movement in that direction would be a slow process. This led me to consider a broader approach and expanded the idea to the readers also. I produced an article on the subject and additionally a review of a number of CAD programs. The latter was very time consuming and I doubt if ever so much work had produced so few pages. This was certainly not the case with feedback with many more letters on the subject than on any other. Many were very much against the subject being aired but even more very appreciative. Whilst I did not see any real movement in the CAD direction I know that many articles are now prepared in this format and would like to think that perhaps I had a little hand in prodding things in that direction.

Another subject that provoked a large amount of feedback was my series of articles on a home-made digital readout, many against the inclusion of electronics but again more in favour. For the record, a tree close to my workshop was struck by lightning with the resulting static causing

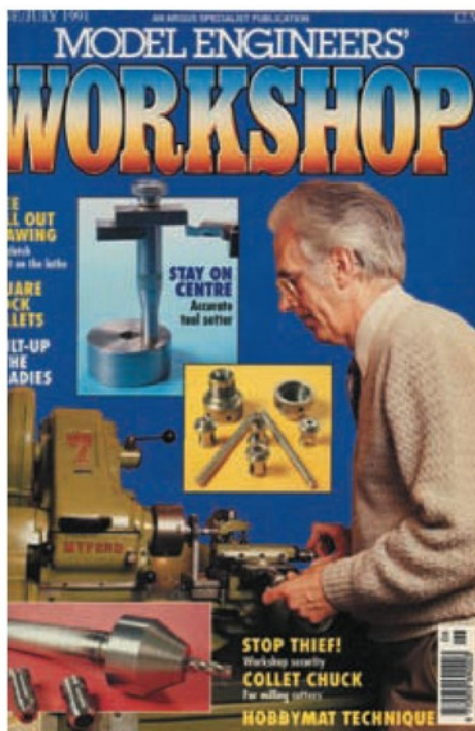
a failure of many of the integrated circuits used in the DRO. So much for the reliability of modern electronics.

The prominence given to the Myford Series seven in the magazine (largely due to the number of articles featuring my workshop) also brought comment from non Myford owners.

Because of this I added an annex to my workshop equipping this with Hobbymat machines. As I had help from a friend (seen on the front cover of issue 24) with the construction, whose name is John Woods, I chose to write the series featuring the workshop under the pseudonym of John Steele.

When I took on the task of editor I considered it would be

one taking me into my retirement years, as it was it lasted only until I was 61. It was probably, amongst other things, the pressure to fill the magazine, working to deadlines, and even more so my difficulty with working with other people's text (I have never read a book in my life) that made me decide to call a halt. Even though it was for a short period I have never regretted having taken on the task, and whilst leaving gave me an extended retirement I have been able to continue with writing articles for the magazine, a task which I very much enjoy. I would like to finish by thanking the very many readers who have by their letters encouraged me, both whilst editor and subsequently."





Geoff Sheppard then assumed the challenge, taking us into the new millenium and on to issue 78.

Geoff Sheppard Out of retirement - into MEW

"My involvement with M.E.W. started just a couple of weeks after I had taken early retirement from the aerospace industry, with an early-evening telephone call from someone whom I had met on a couple of occasions. It was explained that Harold Hall had decided to relinquish the editorial chair and that a "mutual friend" had suggested that I may be available and interested in taking on the job, and would I like to be considered for the post? It didn't

take me long to work out that the "friend" was my old co-conspirator from the Primrose Valley model engineering holidays, Stan Bray.

I had been a regular subscriber to Model Engineer since having been introduced to the topic by an enthusiastic metalwork master at school, but was aware that there were many owners of home workshops who were interested in other aspects of hobby engineering, the restoration of older vehicles being just one of them. Having purchased every issue of M.E.W., it seemed to be just the magazine for this wider audience and I had admired the work that Stan and Harold had put into launching and developing the new venture.

Having been involved in the model engineering scene since the late 1940s, I had contributed a few articles to M.E. over the years and had also written a short series for the short-lived Model Mechanics in the 1970s. I therefore knew a few of the then Argus team, and after taking advice from some of my old contacts, I decided to accept the offer when it came.

I was grateful for the support of Harold and his established contributors and also for that of Ted Jolliffe and Mike Chrisp of M.E., and was soon able to get to grips with the job. One of my early objectives was to reach out to this wider audience and to attract contributions that would extend the scope of the magazine. Harold had put a lot of effort into trying to interest readers in new techniques, particularly in demonstrating how information technology could be adapted for our purposes. His evaluation of a number of CAD systems involved much work, but was not widely appreciated. Indeed, when I took over, I was informed by one reader that "computers have no place in our workshop activities". It was interesting that by the time I handed over to David Fenner, most of my correspondents were quoting an e-mail address on their letters.

Technology for the amateur

Not that many years ago, the machine tools and processes used in our home workshops were very similar, apart from size, perhaps, to those used in industry. More recently, industrial developments have become less and less applicable to our operations and the gap has been widening rapidly. I tried to encourage those contributors who were prepared to experiment with newer techniques and it has been gratifying to see that some of these have become established. Most model engineering exhibitions now feature two or three trade stands that supply computer numerical control systems for the home workshop and they always seem to attract a great deal of interest. One application which arose from discussions with one of our contributors has now been developed to the stage where it is selling in significant numbers to industry, so perhaps we have done a little to reverse the trend.

And the future?

It will be interesting to see the way in which the home workshop develops over the next few years. Items of tooling that were popular with the home constructor, perhaps because of lack of availability or the cost of the commercial item are now often readily available at a sensible price due to the efforts of our excellent and supportive trade suppliers. The emphasis has therefore changed. I am sure that the ingenuity of our readers will continue to provide us with some fascinating projects that will explore pastures new. I look forward to the next one hundred issues of M.E.W."



FIRESIDE READING

The Compact Lathe by Stan Bray

Building on the success of the first edition published in 1990, this second edition includes relevant information on current machines. The introduction acknowledges that there is no fixed definition of what constitutes a "Compact" lathe but notes that portability is one guide.

On first picking up the book I instinctively flicked through the pages from back to front and in the process discovered several features which will be particularly welcome to novices. The three appendices are devoted to a number of data charts and a glossary of terms, and the second part of the book carries chapters which look in some detail at a number of compact lathes, both in and out of production. This information will be useful to beginners and experts, who may be offered a small machine, or see one advertised but have scant knowledge of its specification.

Part one (142 pages) covers many topics on using a small lathe (much of the advice would readily read across to larger

equipment) with chapters covering a range of subjects which includes safety, care, tools, centre height, three jaw, four jaw, faceplate, between centres, screwcutting, dividing, and milling. The text is amply illustrated by numerous photographs and line drawings.

For the beginner with little or no previous knowledge aiming at small scale work, this book gives comprehensive guidance, and for the more experienced enthusiast, contemplating a shift to less weighty items, a useful source of reference.

The Compact Lathe is published by Special Interest Model Books price £8-95 ISBN 1-85486-227-8.

Milling - A Complete Course by Harold Hall

Following on the success of the similar "Lathework", Special Interest Model Books have now released Milling - a complete course, which is in essence a complete self

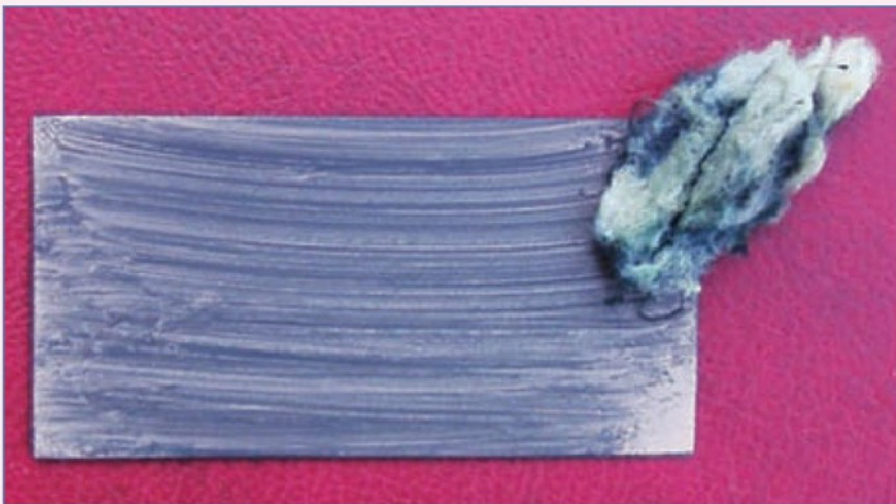
tuition course through the medium of a series of eight projects. The book is based on the series of article "Milling Projects for Beginners" published in Model Engineers' Workshop, and will be welcomed by many newer readers who may have difficulty in obtaining backnumbers.

The book takes the raw beginner through to a level of fair competence, while the more experienced enthusiast will find that the projects presented form useful additions to the armory of workshop equipment.

Following an introductory "Getting Started" chapter, the projects in order are: Tee Nuts, Angle Plate, Clamps, Parallels, Boring Head, Dividing Head, Grinding Rest and Accessories, End Mill Sharpening Fixture, Tool and Cutter Grinding Head. Thus for the novice, some simple essential accessories are tackled first, leading on to more complex items later. The design for each item has been thought through with the amateur enthusiast very much in mind. Each will easily perform its intended duty, but the design avoids unnecessary complication, and can be constructed on typical home workshop equipment.

The book is printed in 210mm x 148mm format, extends to 144 pages, is priced at £6.95, and should be available from good booksellers. ISBN 1-85486-232-4

THE PRODUCTION OF HIGH QUALITY PRINTED CIRCUIT BOARDS



1. The copper is cleaned with "Duraglit" type media.

Over the years I have made a number of printed circuit boards for odd projects using an etch resistant pen (DALO) or a fine permanent marker. Although the technique works the result is hardly elegant and if you want a second one you have to start again as you just draw on the printed circuit board to suit the components you use. The technique is described in some detail in **reference 1**. A few years ago, a friend and I tried to print directly on the copper surface of the board without success. I then remembered the old modellers trick of ironing a photocopy onto balsa wood. A quick trial revealed that it worked so we looked around for some suitable paper with which to try the technique. As my friend's father had been a printer, he was fairly knowledgeable about different paper types and produced a pack of glossy ink jet paper of unknown parentage. A few simple printed circuit board designs were produced in a computer package, **inverted** within the program and printed out onto ordinary ink jet paper. Next day my friend took our image and the glossy paper to work and copied the image onto the glossy paper. Photocopying and laser printing are essentially similar processes in that they both rely upon styrene polymers being fused to paper with heat. On his return, we ironed the image onto the copper side of the PCB and immersed the resultant sandwich in water. Twenty minutes later, the paper fell off the back to leave our

image (now **reversed** back) as a perfect replica of our printed circuit. Twenty minutes in the etching bath produced a near perfect printed circuit board of a quality as good as anything I had seen in most commercial electronic kits.

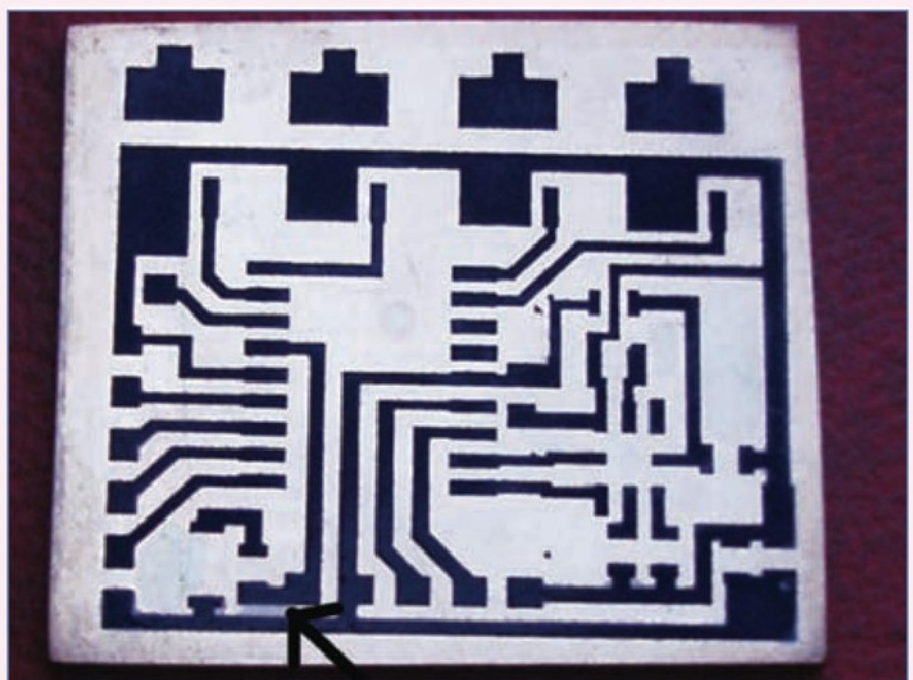
Then came a horrible discovery. As we

Chris Fouweather describes his DIY techniques

did not know where the original paper came from I ventured out to buy some high gloss ink jet paper. To my horror they all worked but all resulted in the paper as well as the black image being firmly stuck to the copper. To cut a very long story short we did find a replacement. Some months later I found several references to the technique on the web. We had re-invented the wheel. I also discovered that there is a commercial system available at considerable expense which does not work as well. Stick with the paper described below as it is about £8 for twenty sheets and you will not be disappointed.

Printed circuit board software

There are numerous software packages commercially available together with some free/shareware. I have no experience of most of them as I use a bit of a fudge to



2. Black toner remains on the copper. Also, the arrow marks a small area of clay.



3. A typical aquarium air pump.

design my boards as invariably I use very small components which are placed much closer together than the standards require and I attempt to refine them by graphical methods to avoid wires that could cause problems on small boards attached to vibrating and crashing helicopters/planes etc. It matters not as the principles of this process can be used for making anything from copper/brass including rubberstamps, small locomotives etc.

Step 1: Design

You need to design your board and get it to the correct size. You can use a professional package such as EasyPC but I cheat. To get the sizes right I use a free package from Express PCB in the USA (reference 2). It is not really intended for making your own boards. The idea is to email the design to them and they ship back the completed printed circuit board. Nevertheless I find it useful and easy to use but I am sure there is something better. I then print it out much larger than full size and scan it back into a graphics package like Paint Shop Pro. The edges can then be tidied up, after which you can print it out at the correct size and see where the components can be placed closer together and where things need easing. When I am happy that it is satisfactory, I **reverse** the image and transfer it to Word (the word processing package) and copy it as many times as I need. The advantage of using Word is that you can alter the size of the image by right clicking and selecting size and copying is just a matter of control/C and drag and drop. Finally, print it out onto photo quality ink jet paper Epson part no. S041126 using



4. A plastic aerator, longer lived but less effective.

a **laser printer**. If you do not have a laser print it out with an inkjet and photocopy it onto the same paper. It might sound a bit long winded but it works. The type of paper is critical so if you have a go I will give you the details. If you have the proper software and laser printer, you can do it in one step. The only disadvantage is you cannot squash things up as easily. The significance of using a photographic package such as Paint Shop Pro or Adobe Photoshop is that you can scan in any image and manipulate it in the software. This becomes much more significant when you want to etch a photograph of an owl or locomotive nameplate. You could also use any of the CAD drawing packages if you want accurate reproduction.

Step 2: Cleaning

This is by far and away the most important step. I have tried a whole range of cleaning products such as metal polish, chrome cleaners etc. They all work to some degree but the most reliable I have found are the Brasso/Duraglit type products which consist of wadding in a round tin. The wadding holds just the correct amount of abrasive which does not scratch the copper. Take a small quantity of the wadding and rub along the copper in one direction and then at 90deg. As you do this you will see the copper shine and the wadding will turn black due to the copper oxide removal (Photo 1). It is a bit messy but if done carefully is reliable. Add some washing up liquid to the copper and rub the board between the fingers. You will see the black copper oxide being removed. Do this thoroughly and then place under the water tap to remove the detergent and copper oxide. Keep your fingers away



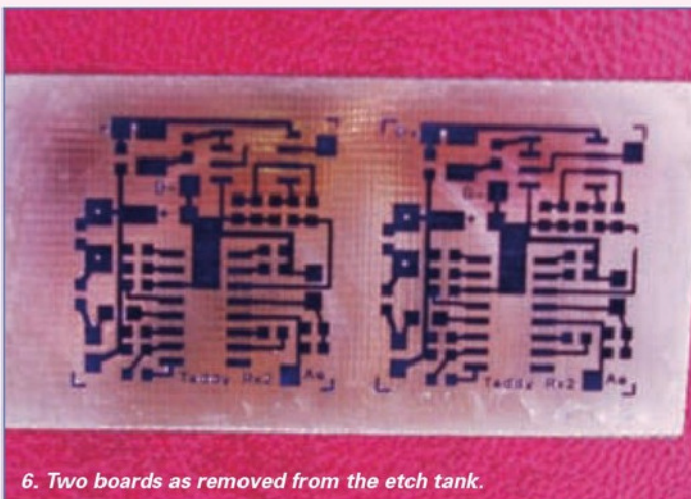
5. A four inch airstone suitable for larger boards.

from the copper surface from this point on. Allow the board to dry in a vertical position or if in a hurry you can dip the board in acetone or cellulose thinners. I cannot stress too highly the importance of the cleaning process.

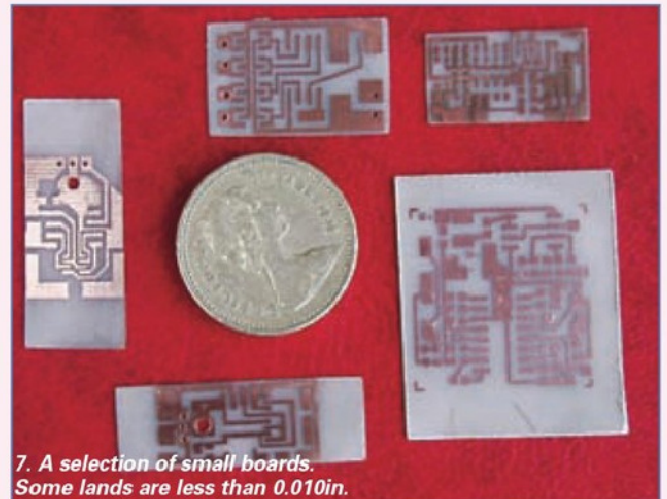
Step 3: Iron on resist

Cut up the paper with your reversed image (you did remember to reverse it!) and iron it onto the cleaned copper board. You need to put the board on a few sheets of toilet paper with one sheet on top of the image. Place your PCB/paper sandwich on a piece of flat melamine board and press fairly hard with a domestic iron for about 1.5mins. Depending upon your iron the thermostat will need to be set somewhere between silk and wool. The time of contact could be between 1.5 and 2 minutes. Allow the board to cool before putting it into warm not hot water and leave for about 10 mins. The paper will either fall off or can be easily peeled off with a pair of tweezers. You sometimes get the odd failure with the ink falling off as well. If it is not too bad just touch it up with a fine permanent marker but leave to dry for two hours. Failure of the toner to adhere to the copper is normally due to poor preparation of the copper surface

One problem with this simple technique is that the clay from the paper attaches itself to the copper. This can normally be removed by rubbing the board between wet fingers. If this is not successful, you will need to use a stiff paintbrush and water and "tease" the clay from the offending areas. The clay shows up as white between the printed circuit



6. Two boards as removed from the etch tank.



7. A selection of small boards. Some lands are less than 0.010in.



8. Rubber mould taken from etched copper sheet.

tracks. This tends to be more of a problem where the tracks are very close together.

You now have a positive image of your printed circuit board. i.e. Where the black toner is visible is where the copper will remain after etching. An example is shown in **Photo 2**. I have left a small area of clay adjacent to the arrow for illustration. The paper described above works but other papers especially the higher quality types result in the whole board becoming covered in a tenacious film of clay which is impossible to remove without damaging the toner resist.

Step 4: Etching

The equipment you need for etching will depend upon the size of board you intend to make. I have invested heavily in a mint sauce jar and aquarium pump but commercially available bubble etch tanks are available for those who want to work at a larger scale.

You can either use ferric chloride or sodium persulphate (you can get both at Maplins). The advantage of the latter is you can see the etching taking place but the solution does not keep as well and is more expensive. You also need to be able to keep both solutions at about 45degC for the etching. It goes much quicker if you bubble air into the solution. The easiest solution is to purchase an aquarium air pump and air stone. The smallest commercial pump is about £12 complete with a small air stone which is adequate for JAM JAR size technology. If you are operating at a much bigger scale than this, you need a bigger pump. The pump I use is shown in **Photo 3**. One point worth mentioning is that the air stones are attacked by Sodium persulphate but not ferric chloride. After a few hours they disintegrate. A less effective but indestructible aerator made of plastic segments is shown in **Photo 4**. The pump may come with a regulator which is just a clamp to restrict the air flow. The flow should be adjusted to produce a steady stream of small air bubbles. I normally use the domestic microwave to heat the etching solution and stand the jar in a bath of hot water. As the temperature drops, I add water from a kettle. It is hardly "high tech" but it works fine. If you want to etch bigger boards/other large components you will need a bigger aerator. **Photo 5** shows a suitable four 4inch long airstone

After 15-30 minutes, the etching is complete and you can remove the board.

Photo 6 shows a couple of boards as they are removed from the etching tank with the resist still attached. You then use thinners or acetone to take off the print and voila one board. You clean the board with Duraglit again followed by the detergent and finally a good wash. A selection of etched boards is shown in **Photo 7** where some of the finer lands are less than 0.010in. I normally dip the board in a liquid flux and allow it to dry. You are then ready for soldering.

If you are making a double sided board then there is an issue of registration on both sides. It is perfectly possible to iron the resist on both sides at one go and so etch both at the same time. As double sided boards are somewhat fiddly I try to ensure that the reverse side is simple and there is plenty of room for misalignment. You can then etch one side with the reverse side protected. "Fablon" is ideal for the purpose. I just went down to the local hardware shop, asked for the most hideous pattern, and came away with a big piece for 10p as it had been in stock for two decades!

Etching components other than printed circuit boards

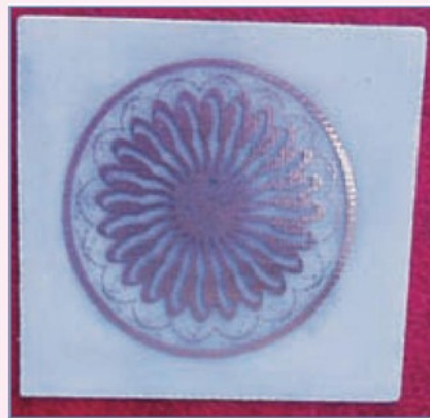
I do not have much experience of anything other than printed circuit board production although I have made a mould for a rubber stamp by etching a piece of 1/8in. thick copper sheet. **Photo 8** shows a rubber mould taken from an etched copper sheet. The defects are in the rubber mould not the etched copper. During some of the experiments undertaken to produce these moulds we etched some PCB material to see what detail could be reproduced. Most of the samples have long since disappeared but one remains and **photo 9** shows some of the fine lines which are less than 0.005in. The result has convinced me that the production of locomotive nameplates would not be any more difficult. More recently I have come across details for the production of small scale locomotives by etching brass sheet.

Reference 3. I will at some stage give it a try. Put simply if you can draw it, photograph it, and get the end result into some form of drawing package you can etch it in either copper or brass. With a change of etchant you can clearly do other materials if the toner resist will stand the chemicals. The toner will not survive caustic soda so aluminium would be difficult.

Conclusion

For a very small investment you can easily produce high quality printed circuit boards in less than one hour from pre existing artwork. The technique is accurate enough to cope with small surface mount components should you wish to leave behind the rather boring task of drilling holes in printed circuit boards and then all that threading of components from the back.

You frequently see printed circuit board designs in magazines. All you need to do, to make an exact copy, is to scan the magazine design into a graphics package, tidy up any defects due to printing, reverse the image and proceed as



9. Experimental decorative board with fine lines under 0.005in.

described above. Alternatively the technique is sufficiently accurate to produce a whole range of components from stamps to nameplates and even complete small scale locomotives.

Health and safety

Both ferric chloride and sodium persulphate should be treated with care. Ferric chloride will etch many metals including stainless steel. I doubt whether the local authority would be pleased if you put large quantities down the drain and it would not do the sink or the copper pipes much good. I normally use copious amounts of water for disposal. Sodium persulphate is a powerful oxidising agent and should be kept away from oxidisable materials such as sugar. Both substances come with comprehensive data sheets and you are advised to read them carefully. Eye protection is essential with both products especially when using sodium persulphate. Ferric chloride stains the hands and clothing.



References

- Reference 1
<http://www.capable.on.ca/rcstuff/etching.htm>
 Reference 2 www.expresspcb.com
 Reference 3
<http://www.prototrains.com/etch1/etch1.html> and
<http://www.prototrains.com/etch2/etch2.html>

Suppliers

sodium persulphate, ferric chloride, etching tanks, Dalo pens, printed circuit board, PCB software:

Maplins (most large towns)
Farnell www.farnell.com/uk tel. 0870 1200 200

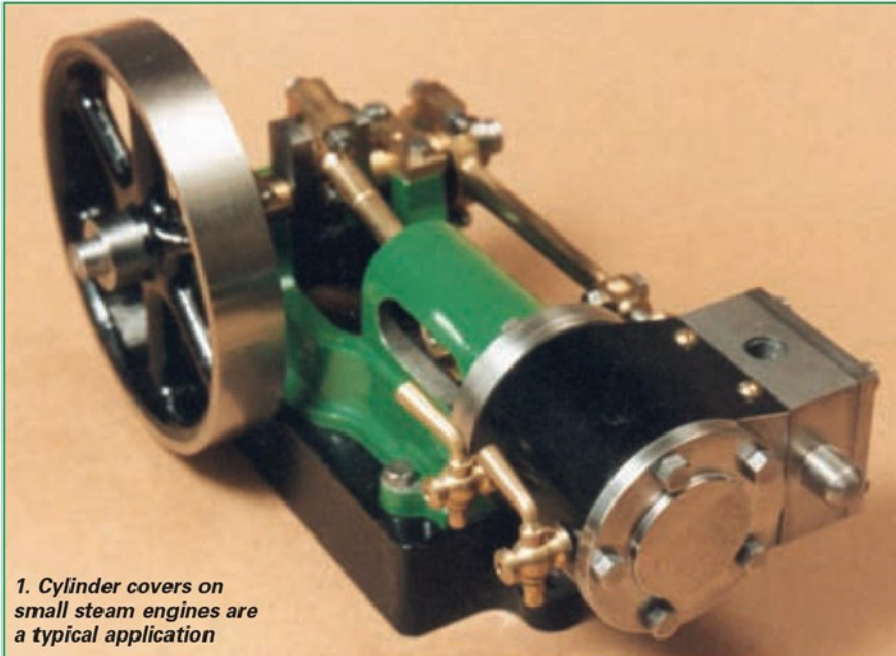
CPC plc, Component House, Faraday Dr, Preston, Lancs. PR2 9PP, tel 0870 20 25 30, email sales@cpco.co.uk

Air pumps/air stones: -
 Aquatic/aquarium shops

Epson Photo Quality Ink Jet Paper Part no S041126 :-
WH Smith/most photographic shops and www.7daysshop.com

HOLES ON A PCD

(The mathematical method)



1. Cylinder covers on small steam engines are a typical application

Background

The need to place holes on a pitch circle diameter can occur in many differing circumstances but most often only involving a small number of holes, typically 3 or 4 when drilling a back plate to take a chuck. In model engineering five or six holes to fix the cylinder cover on a stationary steam engine cylinder as seen in **Photo 1** is another example.

The obvious first choice for positioning the holes will be either a dividing head or rotary table. However, I suspect, many workshops will not be equipped with either of these and even if they are they may not adequately support the workpiece, either due to its size, weight or shape. Situations will therefore arise where an alternative method has to be found. One of the commonest alternatives will be when requiring six holes. An appropriate method may then be to set the dividers to the radius, scribe a circle and then with the scriber still at the same setting step round the scribed circle. If only three divisions are required it is simply a case of ignoring every other position. Many requirements will though be much more difficult than that and another method will be required.

One such method is to work out the position of each hole in terms of its X and Y co-ordinates and use the milling machine leadscrew dials to position each hole. The advantage of this method is that it achieves a fair degree of accuracy. In particular, if a centre hole is also drilled, then the possibility of eccentricity errors (easy to incur with inaccurate set up of a rotary table) are avoided. However, before this can be undertaken the positions of the holes need to be calculated, and this is the main purpose of this brief article. **SK. 1** shows a very simple example for which we require to position 5 holes on a given diameter.

If you enjoy the luxury of a digital read out, then life is made very much quicker and easier. Indeed, many industrial read outs incorporate a "bolt hole calculation" facility. Some of these though are limited to a relatively small number of holes, and it may be found useful to augment such a unit with one of the techniques noted below.

Hole generation

A variation is often used in the home workshop to enable large holes to be cut in a workpiece by drilling touching holes on a pitch circle as illustrated in **SK. 3**. Whilst this can be done using relatively inaccurate methods it almost certainly will result in the need for more manual activity, filing, sawing, etc.

In this case the pitch circle diameter is not of importance. We are more interested in the diameter on the outer edge of the drilled holes. Arranging this to be closer to the ultimate hole size required will considerably minimise the finishing work necessary. What is required is that with the chosen hole size and on the calculated PCD, that the outer edge is close to the hole size being made. This may seem

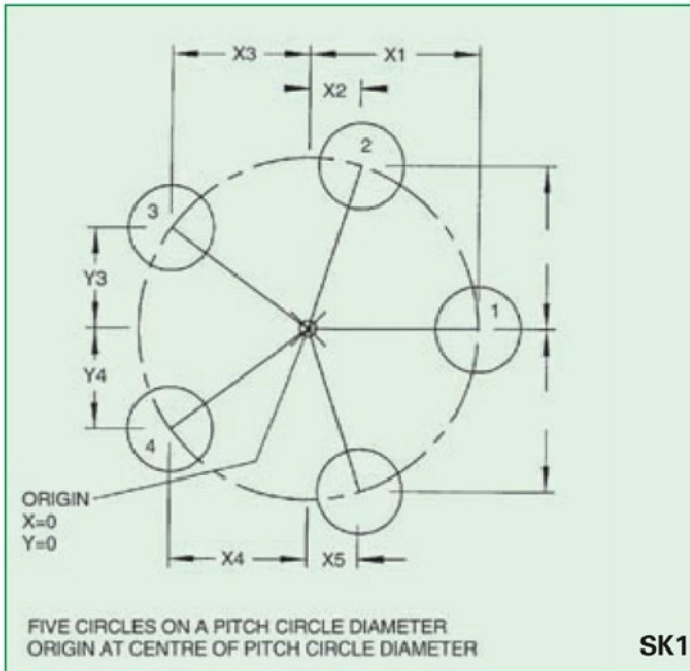
Harold Hall discusses two axis positioning

The Formula

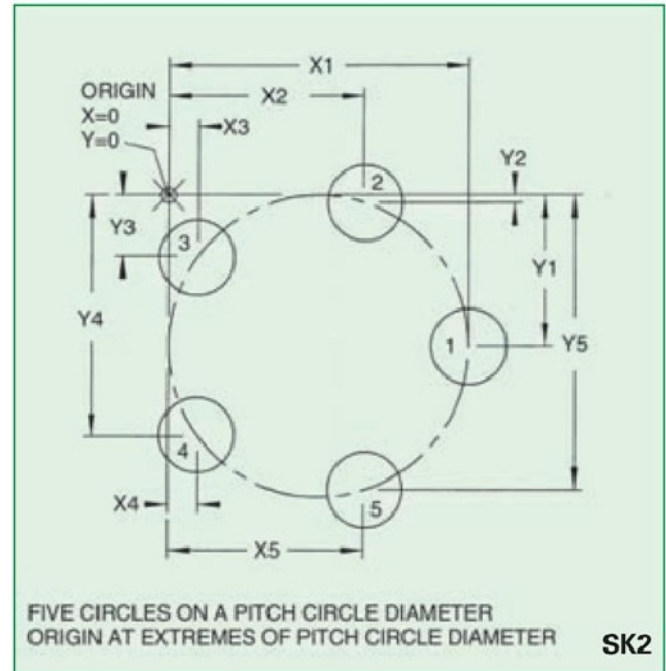
The formula for the X co-ordinates is $X = R \cos((P-1) \times 360/N)$ where R equals the radius (that is PCD/2), P equals the hole number, e.g. 1, 2, 3, 4 or 5 and N equals the number of holes, 5 in this case. Similarly for the Y co-ordinates $Y = R \sin((P-1) \times 360/N)$. Calculating these values, even when there are many more holes, will not be that arduous if you have a calculator having trigonometrical functions. Unlike printed tables that normally list values up to 90 degrees a calculator will deal easily with the angles above 90 degrees, giving the value and whether it is positive or negative. I would suggest therefore that, with simple scientific calculators being available quite cheaply, one should be a standard item in the home workshop.

A disadvantage of this method is that it involves both positive and negative co-ordinates making it somewhat difficult to equate the values to those to be read off the leadscrew dials. This can easily be overcome by changing the reference point from the centre of the circle to a point equal to the extreme upper and left positions as in **SK. 2** making all co-ordinates positive (according to the convention adopted here). The required co-ordinates are easily arrived for X by adding the radius of the PCD to each value; thus the formula for this reads $X = \{R \sin((P-1) \times 360/N)\} + R$ For Y however the value arrived at must be deducted from the radius of the PCD; the formula therefore reads $Y = R - \{R \cos((P-1) \times 360/N)\}$ Do take note that the value for $R \cos((P-1) \times 360/N)$ for some hole positions will be a negative value creating a minus minus situation, mathematically this equates to a plus situation. In simple terms for example: $5 - (-3) = 5 + 3 = 8$

Some may say that holes below the upper line should be negative if normal geometric conventions are applied. This is correct but if your milling machine behaves in the same way as mine, then the convention applied here leads to increasing values matching increasing readings on the leadscrew dials. A drill placed over the zero line will move towards the lower holes when the hand wheel is rotated clockwise and the reading on the dial increases. However, some milling machines are set up in "reverse standard" and for these, the datum point might well be moved to the bottom left. It will not though alter the calculated values, only how they are applied.



SK1



SK2

relatively straight forward but what will certainly be found is that the last hole does not meet with the first hole drilled. The drill size and PCD have to be chosen more carefully and involves some calculation. Having started on the project I had anticipated that this may prove quite complex but in fact it is not that difficult. All that is necessary is to roughly estimate the number of holes to be drilled. You may choose to make the number divisible by four as this will make the holes identically positioned in each 90 degree segment and as a result reduce appreciably the amount of calculation required.

Having decided on the number of holes work out the angle (A) between each adjacent hole, that is $360/N$ where N is the number of holes. Choose an outer diameter (D) just sufficient for final finishing. The drill diameter (d) can now be calculated using the formula in SK.3. If the drill works out too small, or too large, then reduce/increase the number of holes estimated and recalculate. The PCD on which the holes are to be drilled will be equal to $D - d$.

The co-ordinates can now be calculated as in the first example and then drilled. Having recently used the process to make a relatively large hole in a casting it was very gratifying when the centre just dropped away as the last hole was drilled. This made the care taken well worth the effort involved. It should be noted that while reference has been made to drilling holes, for situations where holes overlap, a slot drill will be the preferred tooling.

A curved slot

Another frequent requirement is for a curved slot and again the rotary table is an obvious first choice for the task. However, if one is not available, or the item is too large, then the much used method of drilling a series of holes and finishing the slot with a file is the immediate practical alternative. This will be rather like the last operation but this time the drill size will be dictated by the width of the slot required. Work out the angle between each adjacent hole and work out the co-ordinates. It is

unlikely that a given number of holes will accurately provide the length of slot required and one of three options will need to be chosen. Filing the slot to the length required or alternatively, if the design will permit, leave the slot a little on the short side or make it a little on the long side by drilling one additional hole.

Using a programmable calculator

Gadgets such as the Texas Instruments unit shown in **Photo 2** have the facility to execute simple programs and will deliver sets of coordinates for large numbers of holes. The TI 83 in the photo had been programmed on the basis of the formulae above and out of interest was tried on 151 holes on a 50 radius. Each press of the "enter" key displayed the location of the next hole to ten digit accuracy.

Using a computer

If you are an accomplished user of computer spreadsheets you will not need me to inform you of the advantages of using these for the repetitive type of calculations necessary for the above. If though you have a computer that you ably use for other applications may I encourage you to get to grips with "spread sheet" applications.

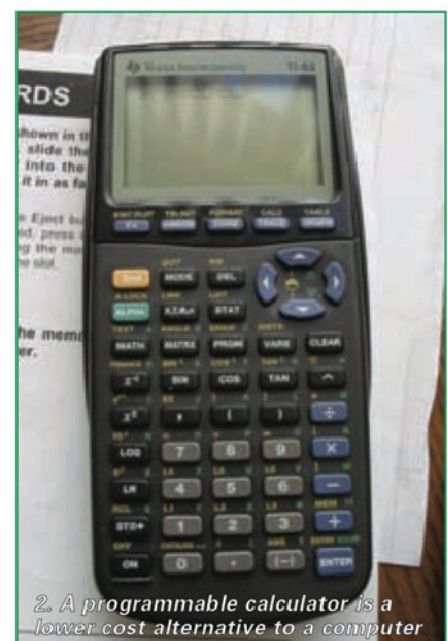
A spreadsheet is basically a form divided into columns and rows and at each point where they cross a block is created, called a cell. For my software, each cell is established for a single purpose being chosen from four available uses.

1. To carry text entered at the spreadsheet design stage and used for such purposes as a heading for the sheet as a whole or a heading for individual columns.
2. To carry text entered when the "spread sheet" is used. In a financial application this could be the description of an item purchased.

3. To receive numerical data as the sheet is being used. Again in a financial application this could be the value of an item purchased, in the above example it could be the number of holes or the value of the PCD.
4. To display numerical values calculated using the values entered as in 3 and using formula entered by the sheet designer at the spreadsheet design stage.

It is the values as calculated in 4 that make the spreadsheet so useful. In a financial sheet it may be a single calculation from a very large number of entered items, typically the total money spent on items purchased over a period of time, one month or one year maybe. On the other hand it may make a multitude of calculations from a small number of entered values. In this article, calculating all the X and Y co-ordinates from just two entered values, the number of holes and the diameter on which these are placed.

It is such a case as this that make the use of "spread sheets" so useful in the





3. A stainless cap produced by the method described.

home workshop. The speed at which this takes place can be a surprise to a new user of a personal computer, add new values for the number of holes and the PCD and the required values will appear almost instantly.

I made considerable use of spread sheets when producing the *Model Engineers' Data Book* and without the facility the task would have been enormous even impossible in practical terms. The inch/metric conversions (pages A1, etc.) The thread details with tapping size drills (pages C3 etc.) are just two examples from very many. The charts were calculated then printed out and these entered into the pages photographically eliminating any possibility of typing errors and a mass of checking.

The following is an example of a simple spreadsheet set up to calculate the volume of a cylinder where the user adds both its diameter and length.

	A	B	C
1	Diameter	Length	Volume
2			

Initially cells 2A and 2B will be left blank with cell 2C having the formula for the volume of a cylinder added. However, the formula will not normally appear in cell 2C so the sheet will initially appear as above. The formula $\text{Volume} = \frac{\pi}{4} \times D^2 \times L$ will though be set up in terms of cell references and will therefore be $\pi \times A^2 \times B2$. Most, if not all, computer programs use * as the multiplication sign so the formula will read $\pi/4 * A^2 * B2$. This is a very simple application but one that would be very well worth setting up to try out if you are a new comer to spread sheets. You will soon find the advantages of being able to enter new values for diameter and or length and for the volume to immediately appear.

If we now enter a diameter of 10 and a length of 2 the screen will read

	A	B	C
1	Diameter	Length	Volume
2	10	2	157.08

The program will calculate in the background the answers to very many decimal places but you can though format each column to display values with the number of decimal places as appropriate to the application. All columns can be

individually configured in terms of width, number of decimal places, etc. In a financial sheet the column for the value of the item purchased will be set up for numerical data and probably be 8 characters wide. 5 for whole pounds, 1 for the decimal point and 2 for the pence. The column to carry the item description will be set up for text and have a much larger width, say 30 characters.

I should explain that in addition to providing cells for inputting values and others containing formula, heading cells can also be included at the spreadsheet design stage. The Diameter, Length and Volume headings in the above are an example.

Multiple calculations

The spreadsheet really proves its worth where multiple calculations are involved and where there are many more columns and rows. The need to calculate X and Y co-ordinates at numerous angles is a good example. However, unless you are expert in setting out the formula it will be necessary to proceed systematically, and in some cases it may be helpful to introduce columns for interim results so that the calculations can be broken into more manageable pieces. Let us take the slightly more complex example of working out the touching holes on a PCD as illustrated in SK. 3.

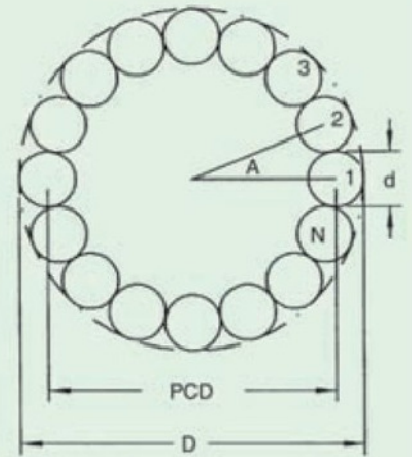
First the outside diameter must be determined based on the outer radius and then the number of holes chosen. In addition to headings, etc. set up at the design stage, four cells must be provided as follows 1. For the number of holes chosen. 2. For the outer diameter. and 3. The cell in which the program displays the calculated value for the angle between adjacent holes. and 4. The cell in which the program displays the calculated value for the drill diameter.

	A	B	C	D
1	Holes	OD	Angle	drill size
2				

Cells A2 and B2 should be set up for numerical entry. C2 then carries the formula for calculating the angle between holes and D2 that for the drill size. The formulae do not appear in the cells but elsewhere on the screen. I should add at this stage that as with all computer programs there will be subtle differences but the basic principles indicated in this article should apply.

Building up a formula for adding to a cell can be somewhat complex as the formula has to be entered as a single line and the correct uses of bracket observed to ensure that parts of the formula are calculated in the correct order. By far the best way is to build the formula in stages and observe that the correct value is arrived at at each stage. As noted above for more complex calculations it can be helpful to introduce added columns for calculated entities, which are then used in subsequent formulae.

Starting first with the easy one C2. The formula for angle A is given in SK. 3 and when placed in cell C2 would read $= 360/N$ where N is the number of holes. However,



A - ANGLE BETWEEN THE HOLES
N - NUMBER OF HOLES
D - OUTER DIA.
d - DRILL DIA.
PCD - PCD ON WHICH HOLES ARE TO BE DRILLED

$$A = \frac{360}{N}$$

$$d = \frac{D}{\frac{1}{2 \sin \frac{A}{2}} + 1}$$

$$PCD = D - d$$

SK3

the value for N will have been entered in cell A2 therefore the formula in C2 should read $= 360/A2$. Note that / is used for divide and * for multiply in spreadsheet programs.

The formula in D2 is though much more complex being that given for "d" in SK.3. Build this up in stages and it is necessary to start at the innermost expression, that is $A/2$. Now remembering that A is the value in cell C2 enter a formula of $= C2/2$ and observe that the result is half the angle in C2.

Enter the "edit mode" for the cell and change the formula to read $= \sin(C2/2)$ and check this against some trig tables or your scientific calculator. The brackets (and) are essential else the program will give you half the value of sine C2 that is quite different from the sine value of half of C2 being what is required. The brackets say do $C2/2$ prior to choosing the sine value.

Again enter "edit" and change the formula to read $= 2 * \sin(C2/2)$ and check the value has doubled. Continue going through the following sequence checking the value at each stage, next $= 1/(2 * \sin(C2/2))$ next $= (1/(2 * \sin(C2/2))) + 1$ finally $= D / ((1/(2 * \sin(C2/2))) + 1)$. This may seem a slow process but as the value appears immediately the formula has been edited it is no more that a couple of

NEW LATHES FOR OLD

From its first appearance in the late 1940s, the Myford Series 7 lathe has been popular with the owners of home workshops. The Company now operates a factory re-conditioning service and also offers re-worked machines for sale. Geoff Sheppard was given the freedom to tour the works with notebook and camera to see what was involved in restoring a particularly roughly used example to a state where it would meet new production acceptance standards. At the end of the article is an opportunity for one lucky Myford owner to win a bed/ saddle regrind.



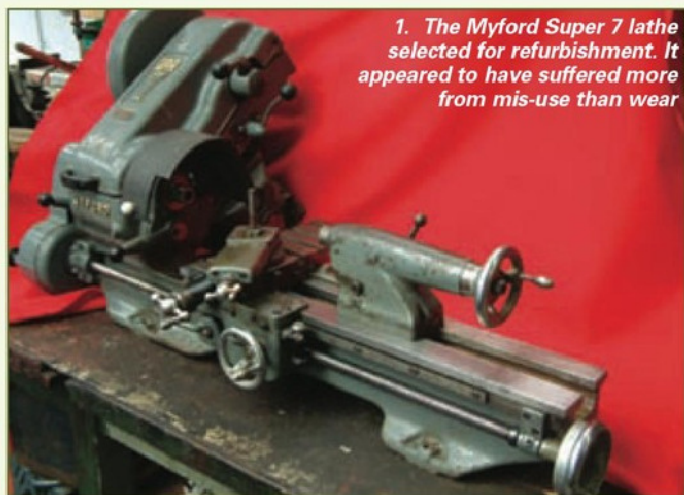
installed in private workshops are often cosseted as prized possessions, many having seen very little use. Indeed, one owner has volunteered the information that he has a very early model that has never been used. Conversely, others have had a very hard life, particularly when they have had to earn their keep in industry. A particularly harsh environment, where the machines often suffered more misuse than use, was the school workshop, where machines sometimes suffered damage as a result of practical 'jokes'. I have had recent personal experience of two lathes recovered from these latter environments, the condition of which made me wince when I envisaged the mis-treatment they must have received.

Myford Limited have always operated an excellent spares support service, with, in my experience, replacement components arriving within a few days of placing an order. They have also offered a bed re-grinding service, restoring worn slideways and the mating saddle surfaces to standards, which match those of the new machine. Over recent years this has been extended to the point where it is possible to have a well-used machine reworked so that it meets the acceptance standards required of a new production unit. The logical development has been to offer factory-reconditioned machines, supported by a warranty similar to that provided with a new lathe. Myford are now prepared to buy back lathes, restore them and then list them at prices which reflect the standard and age of the model and the level of equipment with which it is offered.

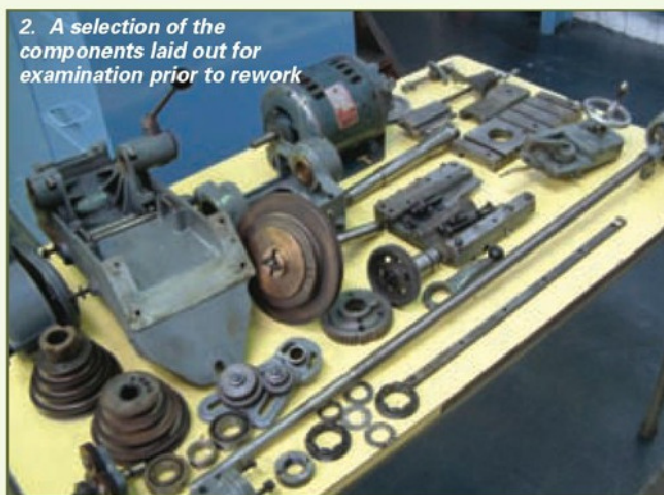
When the Myford ML7 lathe appeared, not long after the end of World War II, it set new standards for equipment for the model engineer's workshop. It also found a ready application in industry, particularly for instrument work and similar light engineering tasks. Over subsequent years, many thousands of them have been produced and there has

been a steady product development programme, with many refinements added, as well as the major upgrades introduced in the Super 7 and now the Connoisseur.

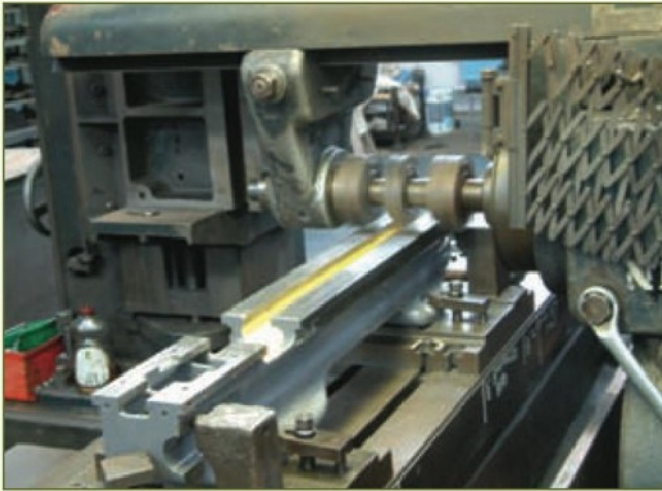
Indications are that, of all the Series 7 lathes produced, a very high proportion still exists, relatively few of them having been totally scrapped. The condition of these survivors varies immensely. Those



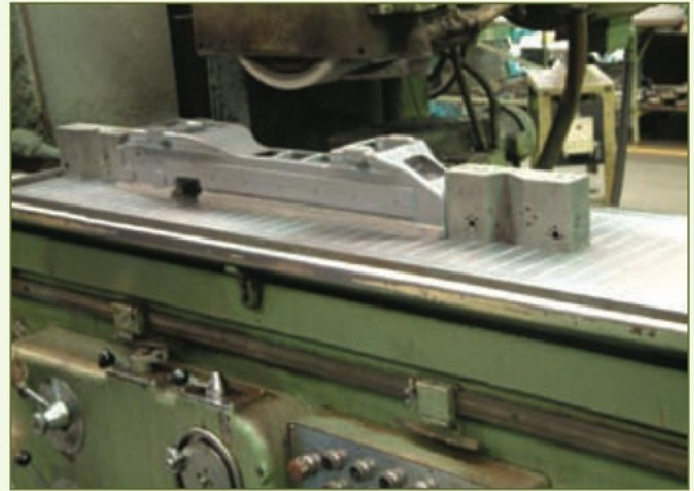
1. The Myford Super 7 lathe selected for refurbishment. It appeared to have suffered more from mis-use than wear



2. A selection of the components laid out for examination prior to rework



3. Milling the first bed shear side using a cutter with an inserted ceramic tip. (Note that the machine guard has been retracted temporarily to allow a clearer view)



4. Grinding the bed mounting feet faces



5. Inverting the bed on the same machine allowed the top surface to be ground.

As a Super 7 user for the best part of thirty years now, I was recently invited to visit the Myford factory in Nottingham to see this reconditioning activity in progress. Managing Director, Christopher Moore suggested that I should follow one particular machine through the workshops, observing

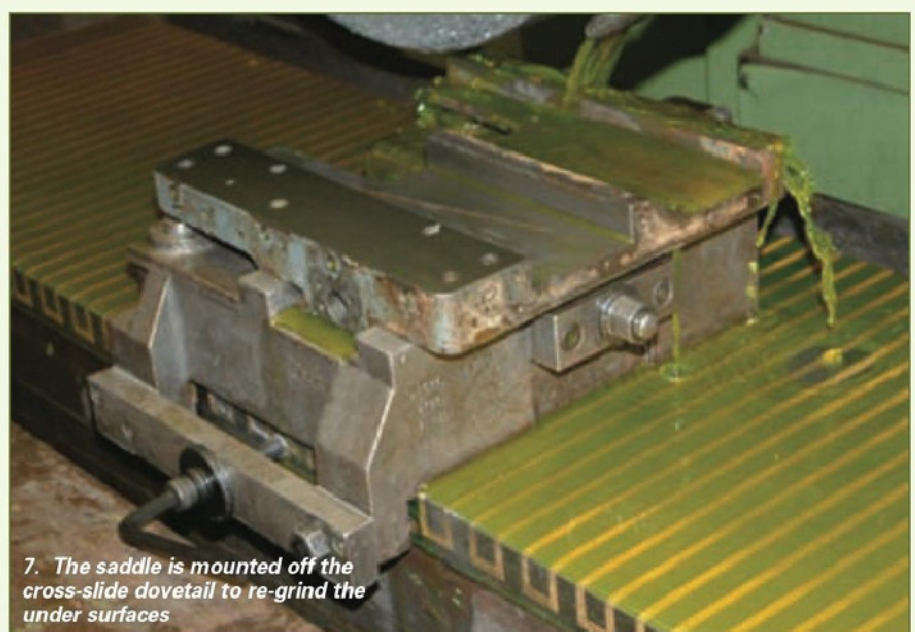
each operation, making notes and photographing as I wished. Having nominated and examined a particularly poor example (**Photo. 1**), I arranged to travel to Nottingham and call in at the works on a Monday afternoon, then to spend all of Tuesday and most of Wednesday following

the component parts through the re-working process and, hopefully see the machine re-assembled to working condition. As it happened, this did not prove quite to be possible due to the motor of a large sideway grinding machine deciding to expire at the crucial moment. Some time was lost while a second machine, currently set up for other work, was re-configured to carry out the task. I therefore had to leave for another appointment while the chosen lathe was in the final stages of re-assembly, but I had witnessed all the vital re-machining and hand fitting operations and the inspection checks, which determine the accuracy of the finished product.

On arrival at the factory on Wilmot Lane I was greeted by Christopher Moore and his Purchasing and Production Manager, David Wheat, who then introduced me to Brian McKechnie, the Works Inspector, who was to be my guide through the various stages of the operation. A long-standing and experienced member of the team, Brian was previously a fitter and would, on this occasion, carry out the majority of the hand fitting and assembly tasks involved in the refurbishment. Machines would normally go through the works in batches of eight, ten or twelve, but to meet the required timescale, this machine would be treated as a single unit.



6. Grinding the underside of the bed shear



7. The saddle is mounted off the cross-slide dovetail to re-grind the under surfaces



8. Brian McKechnie scrapes the underside of the saddle to produce a good bearing surface

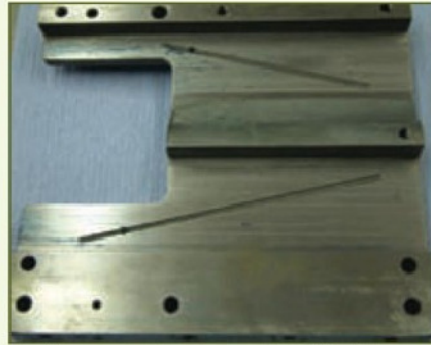
History

One of the first tasks was to check the history of the machine in question. Extensive records are kept in the Inspection Foreman's office, and it was possible to ascertain that it had been supplied new through an agent in Gloucester in March 1966, on a cabinet, complete with motor. The customer was the local Education Authority, the final destination being a comprehensive school. At some stage a quick-change gearbox had been fitted, but this had subsequently been removed.

Initial examination

Examination and initial dismantling of the machine revealed where reworking would be possible and where replacement parts would obviously be required (Photo. 2). Subsequent checks at the re-assembly stage could also result in the need for new components. The initial list of replacements was:-

- Bull wheel
- Back-gear cluster
- Rear spindle bearings
- Sleeve gear
- Feed nuts
- Feed screws
- Top slide base and gib strip
- Top slide tool clamp (stud)



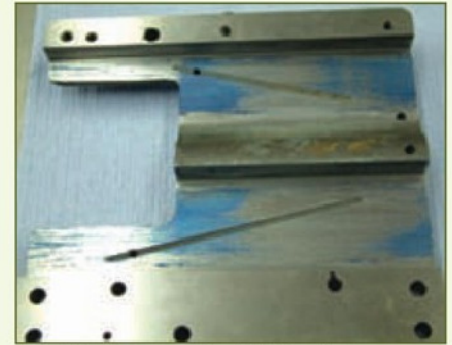
9. A worn and un-ground saddle has minimal contact with a newly ground bed

- Tailstock cam and eye bolt
- Drive belts
- Felt wiper for saddle
- Lubricating wick for spindle bearing

Re-machining

Prior to my arrival, a number of items had been sent for cleaning and re-painting, a process which is carried out on an 'on-condition' basis. These included the bed, tailstock body and belt guards. Painter Alec. Jaworski had matched the colour to the original grey, colours having been changed to green and blue for various models over the years. As soon as the paint on the bed was dry, machinist Chris. Musson set the bed up on a fixture on a large horizontal milling machine in order to re-face the sides of the shears. On a new bed, all four faces are gang-milled at one setting, using ceramic inserts in the cutters. When reconditioning, however, each face is treated individually, removing up to a maximum of 0.005in. from each. In this case, around 0.002 to 0.004in was sufficient to clean up, the ceramic cutters creating an excellent surface (Photo. 3).

In order for me to be able to see as many of the processes as possible in the time available, a number of the required operations were being carried out concurrently in different parts of the factory. I was given complete freedom to travel between the various locations, making notes and taking photographs as I wished. I was made most welcome wherever I went and detailed information was freely available. It made for a most pleasurable experience, and reminded me of my days in industry when I always



10. The re-ground saddle has been scraped to give a good bearing surface, the oilways allowing lubricating oil to reach the areas of contact. It is essential to keep these oilways clear

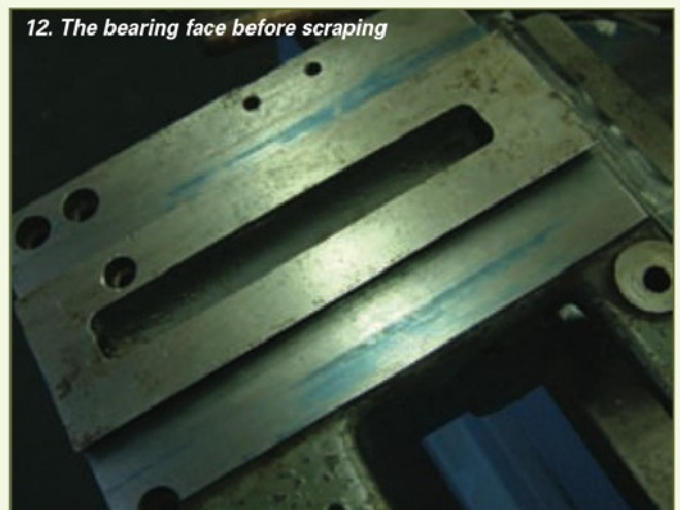
enjoyed the opportunity to visit the machine and fitting shops to discuss problems first-hand with skilled operators.

The next areas of the bed to be tackled were the top and bottom surfaces. The cleaned top face of the casting was mounted face-down on the table of a large Snow surface grinder in order to take about 0.003in. off the mounting feet (Photo. 4). After dressing the wheel, Chris. set the bed the right way up for grinding the top surface (Photo. 5). This is where one of the 'tricks of the trade' came in. Experience has shown that accuracy of the assembled machine can be improved by pulling down the centre of the casting just a few tenths of a thou. before grinding, various means being used depending upon the modification standard of the component. This is just one of the areas where the expertise of the original manufacturer results in a high quality refurbishment.

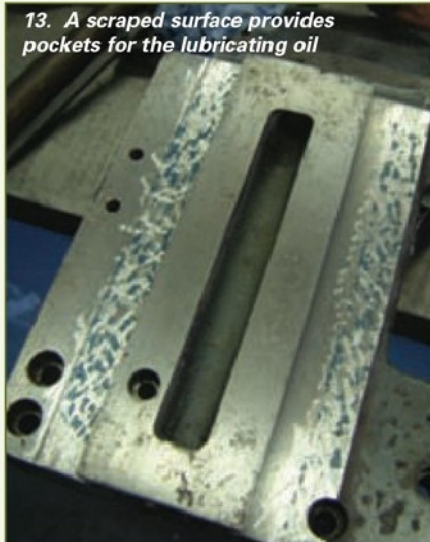
To complete the bed rework it was now passed to Garry Alton who would grind the under faces of the shears, using a slideway grinder equipped with a vertical spindle. At this point gremlins appeared, it being evident that the machine was not operating correctly. Returning from witnessing another operation, we found that the problem had been pinpointed to a main drive motor, the only solution being a complete re-wind. Garry therefore had to set up another machine (a Thompson/Matrix grinder) and prepare a grinding wheel to suit. The result can be seen in Photo. 6.



11. The dovetail on which the cross-slide runs is checked against a master gauge and scraped to fit as necessary



12. The bearing face before scraping

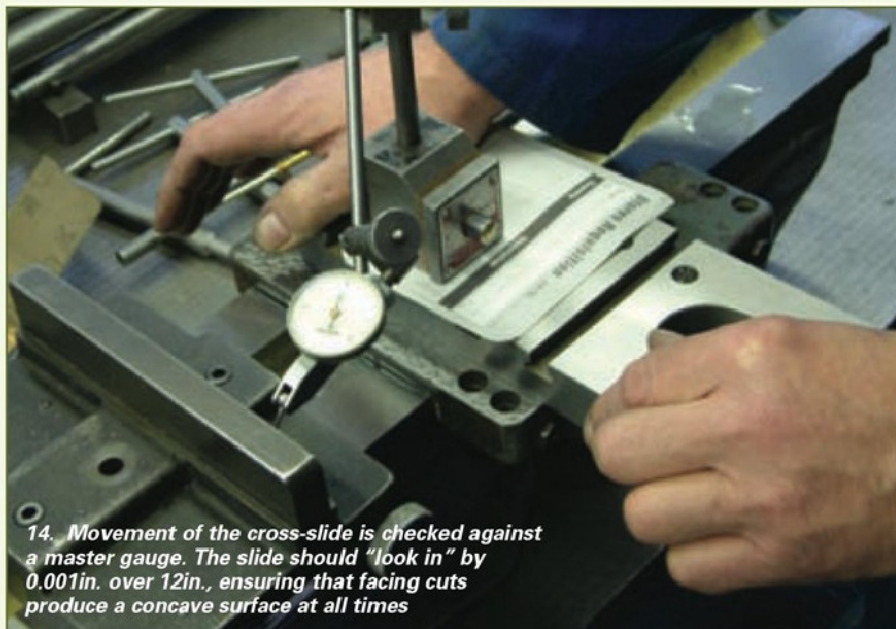


13. A scraped surface provides pockets for the lubricating oil

The saddle

The next component to be reworked was the saddle. The fixture mounted on a Magerle surface grinder locates the cross-slide dovetail (Photo. 7), allowing the faces which bear on the top and side surfaces of the bed shears to be restored, ready for scraping at the fitting stage (Photo. 8). This is, perhaps, an appropriate point to emphasize that Myford consider it essential that, if a bed re-grind is carried out, then the saddle must also be ground and scraped to fit. Although the problems with the slideway grinder had caused the saddle to be ground before finishing the bed, it was possible to illustrate this need by trying another worn saddle on the newly ground bed. The minimal contact can be clearly seen (Photo. 9) and it is not practical to improve this to the required level simply by scraping. The large area of contact achieved after grinding and scraping can be seen in Photo. 10.

To complete these grinding operations, the various gib strips were re-worked to remove the effects of wear and the front and rear saddle strips stepped to



14. Movement of the cross-slide is checked against a master gauge. The slide should "look in" by 0.001in. over 12in., ensuring that facing cuts produce a concave surface at all times

compensate for the reduction in thickness of the bed shears.

After grinding the top faces of the cross-slide and top slide, these items were fitted to their mating components by scraping (Photos. 11, 12 and 13). This now made it possible to fit the saddle to the bed. With a jig clamped to the bed and the saddle secured so that the 'fast' edge was located against its mating bed shear, the movement of the cross-slide could now be checked. (Photo. 14). The requirement is that the movement towards the headstock should be 0.001in. in 12in., ensuring that facing cuts will produce a slightly concave surface. This requirement was met by scraping the fast edge of the saddle to suit.

The final operation in fitting the saddle to the bed was to adjust the thickness of the shims between the saddle and its retaining strips. Each shim lamination measures 0.002in. and the aim is to achieve no more than a 1½thou. running clearance with a shim thickness of 0.008in.,

hence the need to grind the step in the saddle strips. Often all that is needed is to rub a shim on a file to achieve the required fit. A further consequence of the reduction in bed shear thickness is that the size of the saddle clamp may need to be adjusted.

With the saddle oilers and a new wiper fitted, the gib screws were adjusted to give a silky-smooth movement of the saddle on the bed. A new cross-slide nut and leadscrew completed the assembly, allowing the cross-slide to be fitted in a similar manner. Before fitting the apron, the rack was attached and tapped upward as far as possible. The rack is a hardened item and the pinion is left soft, but it had been judged that there was insufficient wear on the pinion to require a new one to be fitted. However, re-examination of the leadscrew nuts suggested that renewal was worthwhile. With the apron bolted in place, the rack was tapped back down to adjust the backlash on the pinion. With the leadscrew re-installed, this assembly was complete.



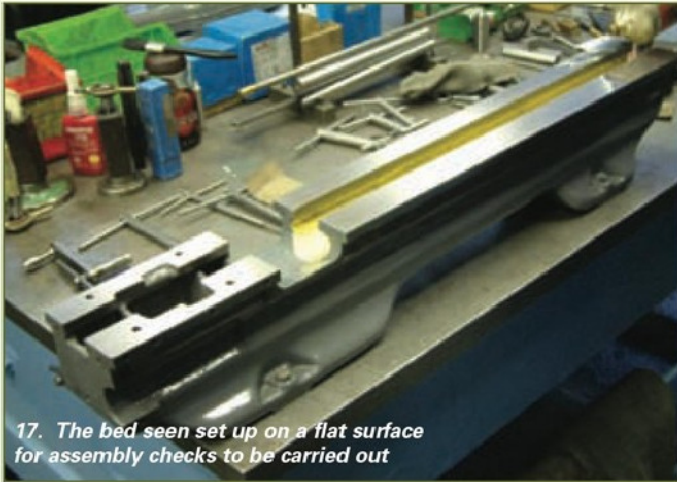
15. Brian McKechnie re-fits the front bronze taper bearing by scraping

Headstock

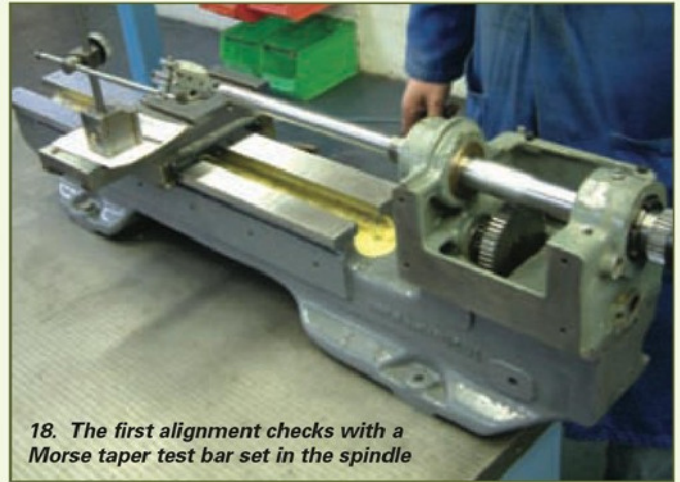
While other components were being re-machined, Brian McKechnie had made a start on the headstock. With a dummy rear bearing in place, the front bearing taper was scraped to the required fit (Photo. 15). Examination of the spindle indicated that both the nose thread and the Morse taper socket were in an acceptable condition. It is possible to correct minor imperfections



16. The old with the new. The back gear cluster had suffered badly, with no teeth left on the small pinion. The bull wheel was also short of its full complement, as can be seen in Photo. 2



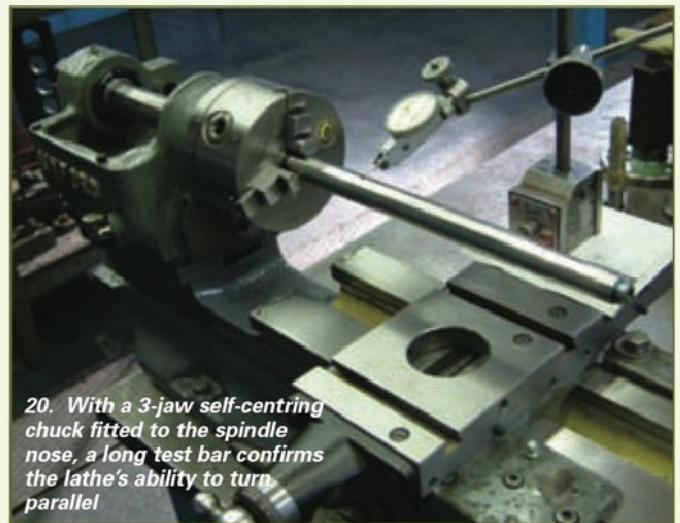
17. The bed seen set up on a flat surface for assembly checks to be carried out



18. The first alignment checks with a Morse taper test bar set in the spindle



19. A master dummy faceplate confirms cross-slide alignment



20. With a 3-jaw self-centring chuck fitted to the spindle nose, a long test bar confirms the lathe's ability to turn parallel

in both areas. The thread can be re-chased to bring it back to original tolerances and the taper can be lightly reamed to improve the surface. There was, however, some marking on the shaft in the area of the bull wheel location that gave cause for concern. As soon as the bed assembly was available, the headstock was fitted and checks carried out on the concentricity of the nose spigot and the bore of the taper and the swash on the location face. These proved to be unacceptable, indicating that the spindle was bent – a somewhat rare occurrence, I was assured. This resulted in the decision to fit a new spindle. This damage, coupled with the fact that there

were no teeth left on the smaller gear of the back-gear cluster (Photo. 16) and quite a few missing from the bull wheel, suggested to me that the back-gear had been engaged while the lathe was running – an old schoolboy prank!

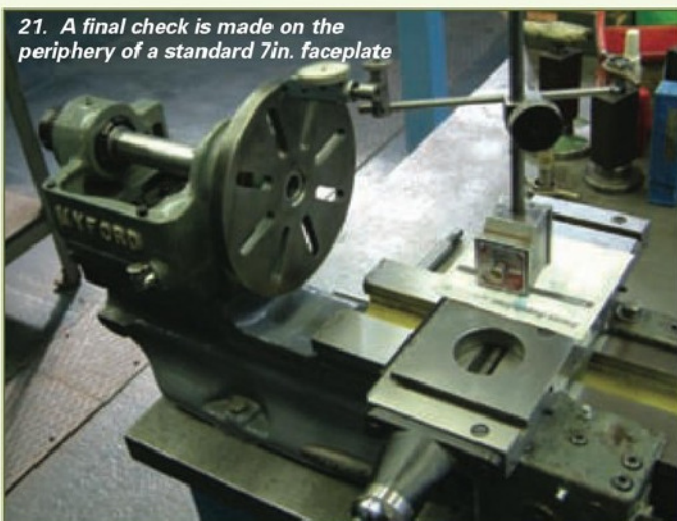
Once this problem had been eliminated and with the bed set level (Photo. 17), it was possible to carry out the remainder of the setting checks, using

- a. a test bar located in the headstock taper
- b. a dummy faceplate
- c. a test bar gripped in a 3-jaw chuck, and
- d. a standard 7in. faceplate (Photos. 18 to 21).

In each case the measurements were within, or close to, the errors permitted by the new-build Inspection Report. Where there were minor discrepancies, these were corrected by scraping the bottom face and/or tenon of the headstock casting.

Tailstock

Basic checks had been carried out on the tailstock at an early stage and it appeared to be generally good. Possible corrective action here includes reaming the Morse taper socket, but if wear between the body casting and the barrel is excessive, then there are two over-size versions available,



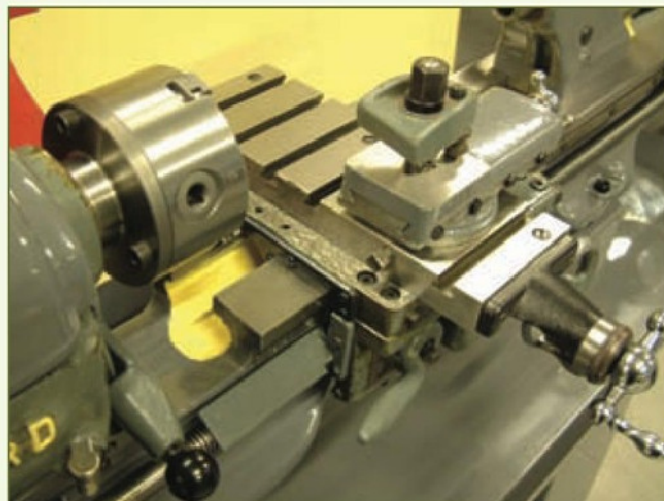
21. A final check is made on the periphery of a standard 7in. faceplate



22. With the re-worked tailstock fitted, a between-centres test bar checks the alignment between headstock and tailstock



23. Operation of the tailstock barrel clamp must cause the barrel to lift no more than 0.001in. at a distance of 3in. from the body. Further checks are carried out with a test bar located in the Morse taper socket



24. The refurbished saddle and slide assembly differs little in appearance from that of a new lathe

the bore being honed to suit. With the tailstock fitted to the bed, similar checks to those carried out on the headstock were undertaken, plus checks on a test bar located between centres (Photo. 22). Again, corrective action involved scraping the bottom face and tenon until satisfactory results were obtained. An additional check involved measuring barrel lift when the barrel lock was operated (Photo. 23). Excessive movement here would have necessitated the fitment of one of the over-size barrels mentioned above, but the lift was well within limits.

Top slide

With the top slide fitted to its new base (the old one having been run into the chuck on many occasions, it seems) one check was to set the movement parallel to the test bar between centres, then to mark a new fiducial line on the top surface of the cross-slide, the old one having been removed when the surface was re-ground. (Photo. 24)

Re-assembly

On completion of the checks, the remaining work consisted of straightforward re-assembly, fitting the motorising assembly and screwcutting

gear train components (Photo. 25). Re-fitted to its newly refurbished cabinet stand and with modern switchgear (Photo. 26), this rather sad example of this famous machine has been rejuvenated and is now ready for a new career in someone's workshop. Backed up by full factory guarantees, it will give many more years of good service.

Conclusion

I greatly enjoyed the opportunity to get to know the Myford works and its small but enthusiastic team. It has always been evident that the Company's products are of the highest quality and I have been able to see first-hand that this factory reconditioning service operates to the same standards. Anyone acquiring a machine that has been processed in this way can be confident that it will give good service and will be backed by the same support arrangements as a new machine. Myford 7 Series lathes are going to be producing first class work for a long time yet. It says much for the original design of the machine that, by the simplest of machining and hand fitting processes, even quite badly worn examples can be restored without the need to replace a large number of major components. Myford machines deserve their excellent reputation.



25. The re-assembled screwcutting gear train assembly



26. Back on its repainted cabinet stand, with new switchgear fitted, our reconditioned lathe awaits a new owner

GREAT OFFER FOR A MYFORD OWNER

As part of the MEW centenary celebrations, on behalf of Myford Ltd. Chris. Moore has very kindly offered a bed and saddle regrind on a Myford Seven series lathe, valued at around £355.00. If you wish to enter the draw for this most generous prize then answer the following questions from the above article:

1. Who matched the colour to the original grey?
2. What kind of inserts are fitted to the cutters used for milling the shears?

Send your answers with your own name and address, on a postcard to: **Myford Competition, Model Engineers' Workshop, Highbury Leisure Publishing Ltd., Berwick House, 8-10 Knoll Rise, Orpington, Kent, BR6 0PS.**

The winner will be the sender of the first correct card drawn on 10th September. Please note that the winner will have to arrange transport for his machine to and from the Myford factory, that the editor's decision is final, and no correspondence will be entered into.

Screen Print 1

	A	B	C	D	E
1	CALCULATES CO-ORDINATES OF HOLES ON A PCD				
2					
3		USER ENTERED ITEMS			
4	NO. OF HOLES		RADIUS AT		
5			HOLE CENTRE		
6	5		40		
7					
8		CALCULATED VALUES			
9		ANGLE BETWEEN HOLES			
10			72		
11					
12			RELATIVE TO CIRCLE CENTRE	RELATIVE TO EXTREME CO-ORDINATES	
13					
14	HOLE NO.	CO-ORDINATE X	CO-ORDINATE Y	X	Y
15					
16	1	40.000	0	80.000	40.000
17	2	12.361	38.042	52.361	1.958
18	3	-32.361	23.511	7.639	16.489
19	4	-32.361	-23.511	7.639	63.511
20	5	12.361	-38.042	52.361	78.042
21	0	0	0	0	0
B16/Formula: IF (A16, C6*COS(((2*PI)/360)*C11)),0)					

Screen Print 2

	A	B	C	D	E
1	CALCULATES CO-ORDINATES OF HOLES IN AN ENCLOSING OUTSIDE DIAMETER				
2					
3		USER ENTERED ITEMS			
4	NO. OF HOLES		OUTER RADIUS		
5					
6	5		0.650		
7					
8		PROGRAM CALCULATED ITEMS			
9		HOLE DIAMETER	RADIUS AT HOLE CENTRE	ANGLE BETWEEN HOLES	
10					
11		0.481	0.409	72.000	
12					
13			RELATIVE TO CIRCLE CENTRE	RELATIVE TO EXTREME CO-ORDINATES	
14					
15	HOLE NO.	CO-ORDINATE X	CO-ORDINATE Y	X	Y
16	1	0.409	0	0.819	0.409
17	2	0.127	0.389	0.536	0.020
18	3	-0.331	0.241	0.078	0.169
19	4	-0.331	-0.241	0.078	0.650
20	5	0.127	0.389	0.536	0.799
21	0	0	0	0	0
B16/Formula: IF (A16, C11*COS(((2*PI)/360)*D11)),0)					

minutes. Entering the formula at one go and say leaving out a crucial bracket could take much longer to solve. Of course if you are experienced and can do this and do not need advice.

Cell's A2 and B2 have been set up for numerical entry and could be 3 characters for A2 (up to 999 holes) and 7 characters for B2 (up to 999.999 for the outside

diameter). However, width of columns will often depend on the heading required at the top. For example column A may have to be 7 characters wide, that is five for the word "holes" and a space either side to separate it from its adjacent heading. Headings can take up more than one row. If in the case of the word "holes" "number of holes" was preferred then the heading

could span rows 1 and 2 with the value being allocated to row 3. The columns do not have to be wide enough to display the formula these are displayed separately and one at a time as the cell is selected. The two screen prints help to illustrate this, more later.

If carrying out the above was to be a one off calculation then you would be better off with a piece of paper and your calculator. If though you were to expecting to make the calculation frequently then save the sheet to a file and call it up next time you need it, all that will be needed would be to enter new values for number of holes and/or outer diameter and the calculated values would be there quicker than you could blink.

The real benefit of using a spreadsheet becomes apparent where multiple calculations are required the need for multiple X and Y co-ordinates being an excellent example. Five columns will be needed as follows. Column A. Hole Number. Column B. X co-ordinate relative to PCD centre. Column C. Y ditto. Column D. X co-ordinate relative to extreme co-ordinates. Column E. Y ditto. The formula for these will be those indicated above in the paragraph headed "The Formula" These having been written on a single line will have all the brackets in the required places, typically for the X co-ordinate relative to the PCD centre = $R \cos((P-1) \times 360/N)$ To make the formula work though R, P and N will have to be substituted by the cell numbers which contain the values.

If you set up your spreadsheet for up to 60 holes you may feel that typing in the formula sixty times and similarly for the other three columns is a task beyond what is acceptable. Fortunately, the facilities "copy" and "paste" limit the work involved considerably. Having typed the formula in and checked that it worked it could then be duplicated into the remaining 59 cells. However, after having duplicated say 4 individually the block of 5 could be duplicated and pasted in five at a time reducing the work significantly.

Unfortunately, this will not work though, for whilst the values for R and N are constant and will be picked from the cells at the top of the sheet (R is in C11 and N is in A6 in the screen print 2) the value for P (A16, A17, etc.) progresses by one on each row. All is not lost though as when the formula is pasted for the first time some programs will seek out each variable and ask if it is absolute (the same value each time) or Relative (changes each time relative to another cell). Having indicated that R and N are absolute and P relative it will not ask when the formula is pasted in further cells so the task is still an easy and quick one and can be done in blocks rather than one line at a time. Do though set up only a few lines and test your program thoroughly before pasting in the full number of lines.

Adding logic

Going back to column "A" which contains the hole position number. Say you are working to a maximum number of holes of 60 in which case you could just type in when designing the spreadsheet the numbers 1 to 60 down column A. This would work quite well but when say requesting co-ordinates for say 6 holes on

a PCD it would continue calculating through the 60 lines as though you were going round the circle 10 times. When on the screen the lines beyond 7 up could be ignored but if as is likely a print out is to be taken extra sheets would be printed out. If therefor the sheet could be made to stop at hole 6 an all round tidier situation would result.

We are now beginning to get into more complex programming and if you feel enough is enough then you could leave your spreadsheet as just described. I would though ask you to persevere now to the end of the article. I feel as we are now getting to the more complex features of spreadsheets that I should once more comment that there are bound to be differences between programs, but whilst they may not work as I indicate they will be able to achieve the results I am aiming at by some other means.

In simple terms, column A, carrying the number of each hole, needs to be set up with some simple logic that halts the calculations once the hole number has reached the number of holes required. Trying to express this verbally the logic would state, "IF the value in the previous cell in the column equals the number of holes required enter "0" IF NOT enter a value one higher than in that cell".

Whilst this would work for the first line after completing the number of holes required it would not work for the next line as the value above does not equal the

number of holes required, a double IF has therefore to be used which again states "IF the value in the above cell equals "0" then enter "0" IF NOT IF the value in the previous cell in the column equals the number of holes required enter "0" IF NOT enter a value one higher than in that cell

For my spreadsheet program the IF feature works as follows IF(b,x,y). This equates to IF b is non zero then x else y For the IF clause that establishes the hole number and stops at the number of hole required this reads IF(A6-A16,A16+1,0) to ensure that subsequent lines also have a zero once that point has been arrived at the complete expression should read IF(A16,IF(A6-A16,A16+1,0),0). The cell numbers refer to those in the screen prints.

To ensure that the X and Y values also display a value of zero the formula should include an IF clause as illustrated at the bottom of the screen prints if this were not done the co-ordinates would be worked out on basis of zero in column "A" giving irrelevant values.

I will finish with a few brief comments on the screen prints published. Screen 1 is for calculating holes on a PCD whilst Screen 2 calculates values for holes in an enclosing circle.

The only major differences are that in two the hole diameter (B11) has been calculated by the program as has the radius on which the holes are to be placed (C11).

It is not visible on the print but the cursor was at cell B16 when the screen print was taken and the formula for that cell is displayed at the bottom left of the screen. Moving the cursor to other cells would cause their formula to be shown. Note the IF command that basically states IF A16 is zero display zero in B16 IF NOT then calculate as per formula. One other important point is that spread sheets use radians to describe angles rather than degrees. Therefore, as there are 2 Pi radians in a circle then say for 70 degrees the number of radians is $70 \times 2\pi / 360$. This should be evident in the formula for B16.

Other uses for spread sheets include the calculation of different combinations of changewheels, as noted in the past by Mike Haughton. Once set up it becomes quick and easy to check screwcutting gear trains.

I realise that the article has now got into deep waters but do hope this will not deter you from experimenting with the use of spreadsheets. You do not need to get into logic expression, certainly not in the early stages. In the above, leaving out the IF command would just carry on calculating values through to the 60 holes as already explained. This is not a disaster. As an alternative if only 20 holes were required copy the sheet to another file and block delete cells for hole 21 onward, you then have a sheet for just 20 holes as required.

So what are you waiting for, go on, give spreadsheets a try.



IN OUR NEXT ISSUE

Coming up in Issue No. 101 will be

Refurbishing a Centec 2A Mill

Mike Haughton
breathes new life into
and old machine.



A Speed Inserter for a Mill

Dick Stephen's device
gives better finish
faster with small
cutters

Improving the Chester Champion Mill

Nic Ashmore
outlines his mods.



Spinning

Nothing to do with politics, Jack
Cox tells how



Issue on sale 10th September 2004

(Contents may be subject to change)

TIG WELDING: CONTROLLING THE CURRENT

1. View of device fitted to inverter welder.



David Hoskin describes a low cost, self build foot pedal current control.

Background and rationale

As a newcomer to TIG welding, I was delighted to find Trevor Marlow's excellent article in MEW No. 79, which contained a great deal of practical and interesting information. I was particularly taken with his method of controlling the current from the inverter during the welding process, and thought to myself, "That's just what I need!" Of course, no self-respecting model engineer can leave well alone, and I wondered if a few refinements might be made. Whether these count as "improvements" will depend upon your assessment of the trade off between simplicity and added features.

The original unit allowed for the current to be jogged upwards or downwards from a simple hand-held unit. It was an important design criterion that there should be no interference with the internal circuitry of the inverter so as not to invalidate any guarantee. These, too, were my objectives, but I wanted more. I had in mind:

Something which not only enabled the current to be increased and decreased, but which gave direct control of the current setting.

A means of limiting the maximum current to a level appropriate for the job in hand.

A pedal as an alternative to a hand-held control, simply as a matter of personal preference. It was also noted that foot pedal control is regularly specified on expensive industrial equipment. All of these have been achieved for a very modest financial outlay: electronic components are surprisingly cheap. The greater cost has been in time and effort, but it has been well worth it. The new features, standard on professional TIG welders well out of my price bracket, are now available to the humble owner of a basic inverter.

How it works

The key to the system is the use of two variable resistors or 'pots'. One is attached nose-to-nose with the current adjustment spindle on the inverter. This one I call the 'sensor' because it provides a means of sensing the position of the current control as that control is rotated by a motorised drive. The other is hand or foot-operated and is the 'master' control. A black box is required to compare the setting of the master (the current being requested) with the position of the sensor (the current being delivered). If the sensor is reading lower than the master, the motorised drive needs to turn the current control clockwise until the sensor reading matches that of the master. If it is higher, the motor should turn the other way. If it is about right, it should leave well alone... but more about that later.

The box of tricks doing the comparing is called, would you believe, a comparator. Specialised integrated circuit comparators can be bought cheaply enough, but in fact for our purposes a simple general purpose operational amplifier will do just as well. An op. amp. has two inputs, "positive" and "negative". If the positive is higher than the negative the output swings (almost) to the full supply voltage. If it is lower, the output goes (almost) to ground, or 0V. If the DC motor driving the current adjustment is connected between this

output and half the supply voltage, it is fairly obvious that it will reverse direction as the output changes. This is the circuit shown in Fig. 1. Unfortunately, for a whole host of reasons it is a circuit that will not work! — or at least, not without some complicating additions.

The practical circuit of Fig. 2 is essentially that of fig. 1 — appearances can be deceptive. I should say at this point that I am not a professional circuit designer, and what I know of electronics is self-taught. The circuit is, I believe, sound. It has been deliberately over-engineered to give large margins of component safety. And, most important of all, it works! No doubt those with greater knowledge than I have, could come up with something altogether more elegant or be able to suggest improvements to this circuit, and I should be happy to learn from their experience. On the other hand, I suggest that those who are not the slightest bit interested in the electronics skip the next few semi-technical paragraphs. After all, there are no exam questions at the end!

The circuit explained

VR2 is the master pot operated by hand or foot, and VR3 is the sensor attached to the current control spindle. These are

connected as potential dividers delivering voltages to the inputs of the operational amplifiers. VR1 limits the maximum setting of the master pot, so that the maximum to which the inverter current control can be driven is also limited.

Op. amp. inputs work over a wide range, but not quite as wide as the full supply voltage. R1, D1, VR4 and VR5 are therefore added to limit the possible range of op amp input voltages from something above ground potential up to something a little below the supply voltage. If a resistor were used instead of D1, different settings of VR1 would play havoc with the voltage provided by the lowest setting of VR2. The forward-biased diode means that this is always 0.65V. Pre-sets are used for VR4 and VR5 so that the range over which VR3 is driven by the motor can be fine-tuned, and, more importantly, a bit of leeway can be given so that there is no danger of VR3 and the current control spindle reaching the end of their travel whilst still under power. C1 and C2 get rid of the electrical noise at the op. amp. inputs which otherwise would probably be significant in proximity to the inverter.

If the voltages applied to the positive and negative inputs are significantly different, the outputs of the op. amps. will go high or go low together. If they go high, T1 will be switched off and T2 switched on. The motor is then effectively



2. Rear view of case reveals on/off switch and pedal connector.

connected between ground and +3V, and it leaps into life. If the op amp outputs go low, T1 will be switched on and T2 switched off. Now the motor is effectively connected between +6V and +3V, and it leaps into life in the opposite direction.

Two op. amps. acting in parallel as comparators are used rather than one in order to introduce a central 'dead' area where the motor is driven neither one way nor the other. Without this the motor would constantly hunt back and forth over the required position. D2, forward-biased, is used to give a fixed difference of 0.65V between the positive op amp inputs. This means that if the voltage supplied to the negative inputs by the sensor lies in this 0.65V band between the two positive input potentials, then both T1 and T2 will be switched off and no current will be supplied to the motor.

The IC used is the cheap and cheerful LM358N as I happened to have a slack handful of them in the spares box. It is a suitable candidate for the job because two separate op. amps. are conveniently packaged in the one chip and, importantly, those op. amps. are capable of tolerating input voltage differentials up to the full supply voltage.

T1 and T2 provide the necessary current to drive the motor; R3 and R4 limit the base current, R5 and R6 limit the emitter current, and D3 and D4 quell unwanted voltage spikes from the inductive load presented by the motor.

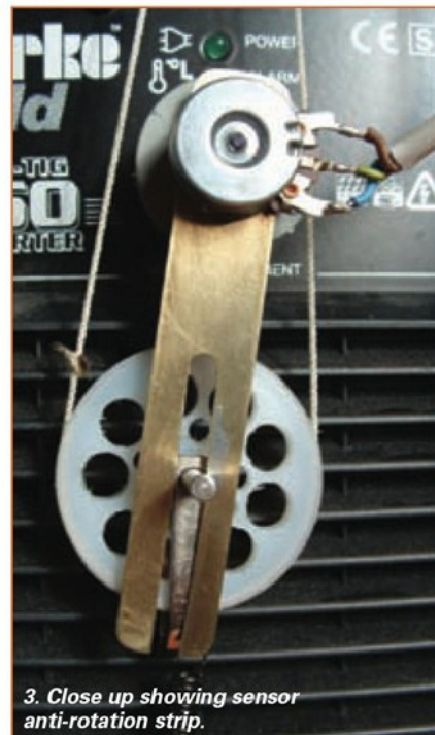
Motor matters

I have specified a 6 volt supply with the motor being connected to a 3 volt tap. This is easily arranged using a battery box designed for four AA cells. 6V may seem very low given that only half of it will be available to the motor but, somewhat to my astonishment, I found that the motor used (nominally 12V) gave ample torque to drive the gearbox even with old-ish batteries. This is more surprising as the voltage available is actually some way short of 3V due to the effect of T1 or T2 and R5 or R6. If you find your motor needs a bit more oomph (apologies for using a

technical term), there are two possible solutions. First check that that stall current of the motor is not much more than, say, 500mA (mine is 300mA) and then replace R5 and R6 with wire links. Theory says this should be perfectly OK as T1 and T2 cannot both be switched on at the same time. When one transistor is switched on the motor alone provides sufficient load to limit the current to a safe value. I have tried this with success. However, if you, like me, prefer belt and braces, then leave R5 and R6 alone and instead increase the supply voltage to 12V, feeding the motor from the 6V point. I am pretty confident that no component values will need to be changed.

The circuit was built on Vero board, and the layout used is shown in Fig. 3. I do not claim that this is the best possible layout, merely the best that I had come up with when patience ran out. For those with the necessary equipment and skills, a printed circuit board could be designed and made, but I did not think this worthwhile for a 'one off'. The two transistors are plenty powerful enough for the task without the need for heatsinks. The components are all readily available from, for example, Maplin. A list is given at the end of the article.

Mechanically, the arrangements are pretty straightforward. The drive mechanism on the inverter is very similar to Trevor Marlow's design. Not having a small geared DC motor to hand I used the gearbox from an old central heating motorised valve, replacing the mains motor with a small DC motor from a defunct computer printer (my 'make do and mend' credentials are impeccable!). The pulley attached to the current control spindle has a bush long enough to accommodate the sensor pot nose-to-nose. The belt (string) passes from the drive unit, once around this pulley, and on



3. Close up showing sensor anti-rotation strip.

to a third, spring-loaded, pulley that maintains tension and balances the forces on the current control spindle. It is important that this spindle is not loaded to any significant degree, so careful thought had to be given as to how the body of the sensor pot could be restrained, preventing it from rotating with the spindle. This is achieved by attaching the body of the pot to the end of a light metal strip, the other end of which has a longitudinal slot. The slot rides on the extended axle of the lower pulley.

The black box on top of the inverter contains the motor and gearbox, the circuitry, the battery unit, a battery on-off switch, and a 3-pin DIN socket into which the cable from the pedal control is plugged.

The pedal unit

This is an experimental 'lash-up' that works so well that I have no intention of replacing it until it falls apart. The design is, I believe, self-evident from the photo and certainly does not warrant the dignity of engineering drawings. Depressing the foot-board pulls a cord which passes once around a pulley which turns the master pot, then over the top pulley, and down to

Fig. 2 Control circuit

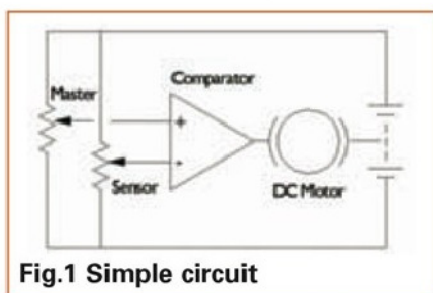
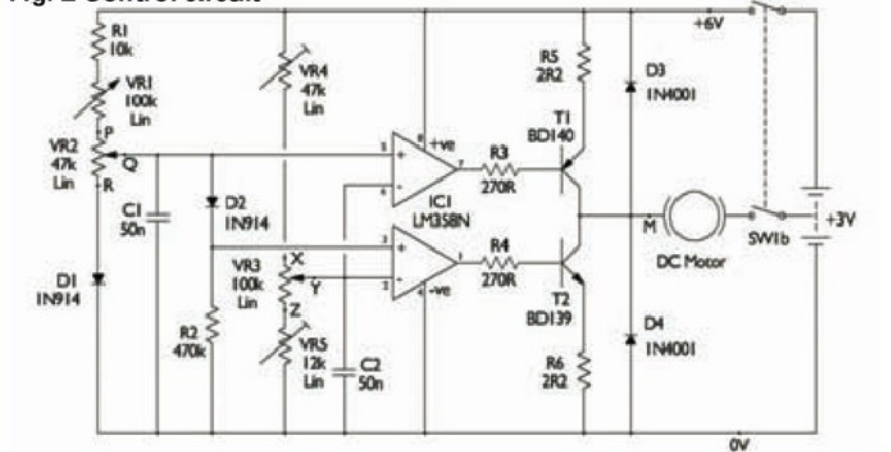
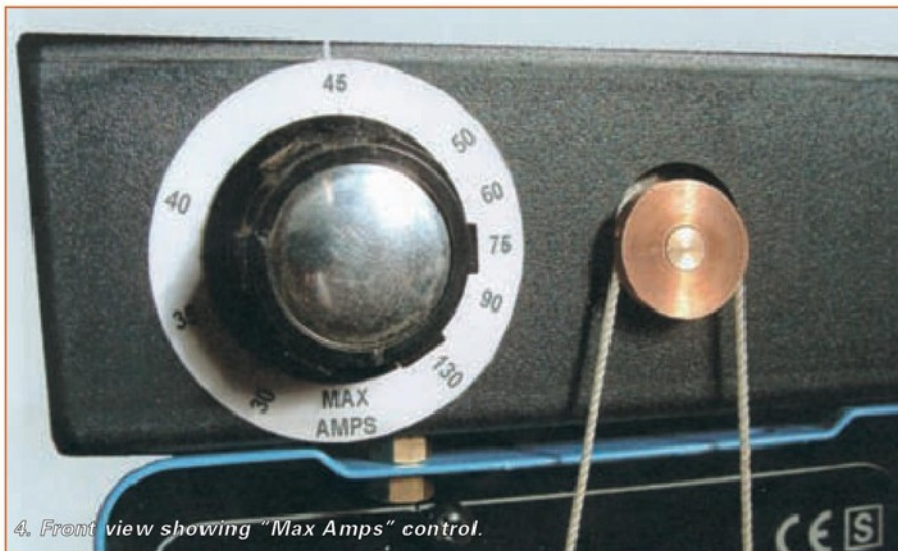


Fig.1 Simple circuit



4. Front view showing "Max Amps" control.

a spring which maintains tension over the full travel of the control.

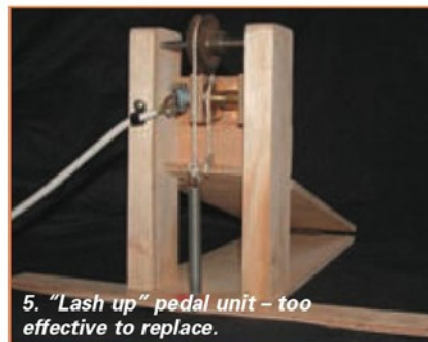
The travel of the foot-board is limited by the baseboard and by a cross-member which is added last in such a position that the master pot is not quite rotated through its maximum range. The pot itself is somewhat fragile, and again a means has to be found so that the spindle is not unduly loaded. This is achieved by mounting the pulley on a brass sleeve that runs in its own bearings (simple hardwood blocks suffice for this). The spindle of the pot is then inserted into the sleeve and held in place with a grub-screw. The body of the pot is constrained from rotating simply by the cable. This allows for a certain amount of give if things are not adjusted 'just so'. It would of course be possible to design the pedal unit with only one pulley, mounted at the top, and serving both purposes. However, a significant lateral force would then be applied to the brass sleeve, and this would need to be designed accordingly.

The pedal unit is not the only option. If you prefer a hand-held control I suggest that the pot is either operated by a thumb-wheel or replaced by the slider type of variable resistor.

Setting up

All setting up can be done with the inverter switched off. It is not necessarily obvious without deep thought which way round the motor should be wired, and given that there is a 50% chance of getting it right first time I decided to guess - and needless to say got it wrong! Quite clearly lifting the pedal should send the current control spinning towards zero, and depressing it should result in clockwise rotation. With the motor leads swapped over, everything worked first time.

The pre-set pots are quite easy to adjust. With the master pot at minimum (pedal released) adjust VR5 so that the motor drives the current control down



5. "Lash up" pedal unit - too effective to replace.

almost, but not quite, to zero. Now make sure VR1 is set to minimum resistance (for maximum current) and depress the pedal fully. The current control should spin up towards maximum. Its exact position, just short of maximum, can be set with VR4. As one pre-set affects the other, this procedure should be repeated two or three times.

The Maximum Current Control (VR1) can now be calibrated. Depress the pedal fully for maximum current and hold it in that position. With VR1 turned up halfway the current control might settle at, say, 50 amps. Mark '50' against this setting of VR1, and repeat for different settings as necessary. You will find that the scale is, unfortunately, not linear.

And finally...

All that remains is to put it to work. I have certainly found that as well as being interesting to design and make, the device has proved reliable and easy to use. I am not yet a competent TIG welder, and probably never will be, but that has more to do with operator error than with equipment failure!

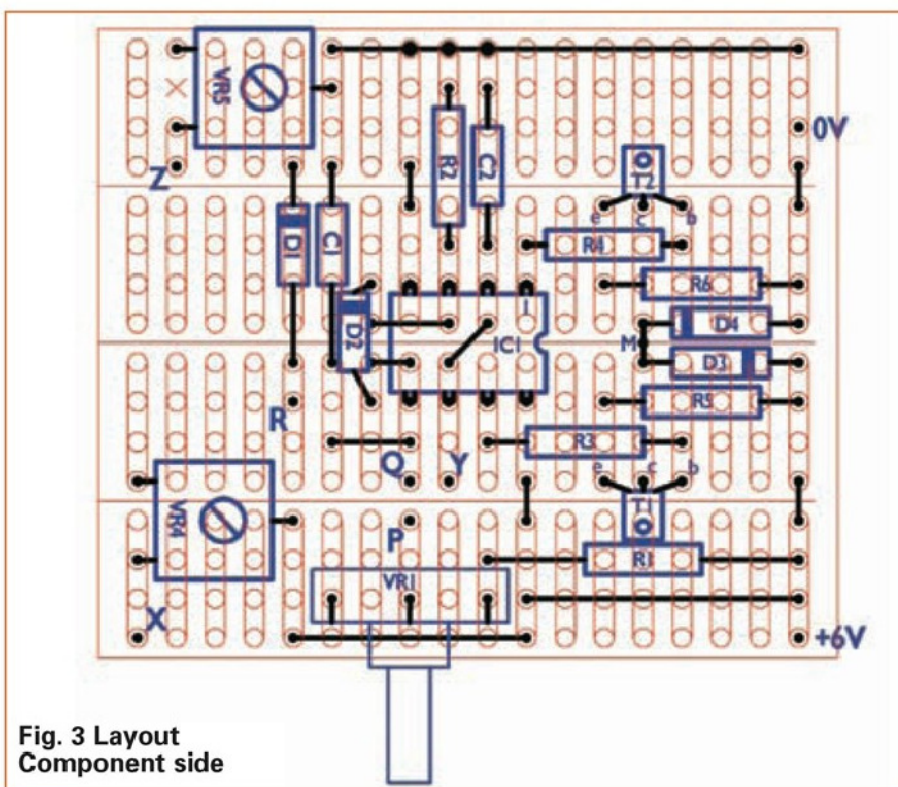


Fig. 3 Layout Component side

Components list

IC1
T1
T2
D1, D2
D3, D4
C1, C2
VR1, VR3
VR2
VR4
VR5 LM358N
BD140
BD139
1N914 (or any silicon signal diode)
IN4001
50n Mylar
100k Lin Standard Pot
47k Lin Standard Pot
47k Lin Horizontal Preset Pot
12k Lin Horizontal Preset Pot
R1
R2
R3, R4
R5, R6
Misc 10k 0.6W
470k 0.6W
270R 0.6W
2R2 2W
Stripboard (Veroboard). I used the 'Line of 4' type.
4x AA Battery Box
DPST Switch
Suitable Case and other hardware.

MILLING SUB- TABLES



1. Large sub-table used with long clamp bar

Background

This article describes two devices which I have termed "Sub - Tables", and makes brief mention of a tilting plate. The first and larger sub- table was prompted some years ago after I decided to build a 4-6-2 locomotive. (To my shame it was never completed and was sold at the running chassis stage.) But to continue, when I looked at the machining of the frames, it was realized that a problem was likely to be encountered, due to the length of the parts compared to the length of the milling table, further complicated by the necessity to slide the part along the table to be able to cut and drill all the holes and maintain the alignment.

This alignment could of course be carried out using a dial gauge on the edge of the plate, however being laid flat on the table made this very awkward. The other difficulty was the height they would have to be lifted above the table surface to miss the cast features at the ends of the mill table which are slightly higher than the diameter of the graduated dials on the ends of the lead screws. Now I normally use either plywood or more frequently nowadays, M.D.F. to pack up my parts so that the cutting tool will not damage the table and have found it to be very accurate in the consistency of its thickness, but I always use only one thickness, basically because I feel that more layers will increase any variation in the thickness.

Material dictates design

I therefore decided that a "Sub-table" (photo 1) would solve all the problems if fitted with a fence. This then allows the part that is being worked, on to be slid along the fence and re-clamped without the necessity of re-aligning. It would also lift the work piece above any obstructions on the table. At that time, I had a relatively large quantity of 150mm x 20mm bright steel bar in lengths of 300mm and this stock of material determined the leading

dimensions of the table. The drawings shown here have been modified slightly by increasing the length of the base. This will make for easier clamping down. My sizes may not suit your mill (or available material) so feel free to modify to suit your requirements.

I also have a pair of heavy steel blocks (photo 2) one mounted on each end of the table and these are used to allow the use of long clamp bars for sheet material, that is too wide to be able to be clamped in the middle. This would not be necessary if the table were longer but where do you stop. The sub-table is screwed together using

Peter Rawlinson describes two versions of a milling accessory

M8 cap head screws counterbored below the surface, and the base has two milled slots, one at each end to allow the part to be bolted down to the mill table "T" slots. My table uses the full height of the bar, but for rigidity I would suggest that the bar between the top and bottom plates be say 50mm high.

The top of the Sub - Table is peppered with M8 tapped holes as this is a simple and easy way of clamping the parts down, this can be done as required on a grid pattern designed to suit your own requirements. If you tend to work in smaller scales, then you might choose a smaller thread size such as M6 or even M5. My own table as built has no overhangs at the front and back, a feature I have always regretted as it will not allow the use of tool makers clamps along these edges. There is room at the ends to use the clamps, however. I shall one day modify it so that there is a 20mm overhang along these edges and would certainly recommend that it be built in this way when starting from scratch. To this end, my drawings have these modifications incorporated.

I have also incorporated a series of M10 tapped holes along the two long edges. The purpose of these is to either hold the fixed fence or to allow the fixing of long pieces of studding on which the fence can be fitted so that it is adjustable for those long jobs. It is this set up that I used to machine the Perspex sides and tops for both my model covers and the perspex tank for the spark and wire eroders.

The top surface should be machined all over (Mine is ground but a light cut on the milling machine will suffice), and the edges should also be machined to allow the fence to be fitted, and will then be truly parallel. Prior to machining the edges, you may wish to incorporate underside keys as described below.

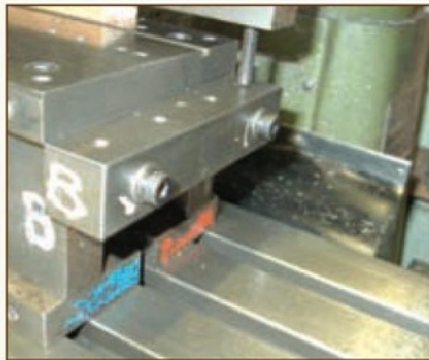
A brief diversion

Now for a couple of short "asides". First, many years ago (I could start "once upon a time") I was having trouble with rotating the vice on it's base as the bolts were too long and I decided to solve this once and for all. To this end I made a number of "Tee" nuts together with stud lengths as well as decent heavy washers these parts would cover all of my equipment, these nuts and studs were threaded $\frac{1}{2}$ in. U.N.F. as it is a thread that I like and is fine enough to tighten down without large effort. All these parts were then case hardened and they have proven the worth of making over and over again and are still being used some 10 years after they were

made with none being scrapped. And second, over the years I have fitted all my equipment (that mounts on the mill) with accurately fitting keys that align these items on the mill table such that no further alignment is required, I do however always fit these accessories (dividing head, sub-table, dividing fixture, machine vice, rotary table, and other parts.) the same way round and always push the accessory to the back of the slot in the table as they are tightened down. In this manner, life is made easier and work proceeds at a faster pace. The underside of the vice may be seen in **photo 3**, and that of the large sub-table in **photo 4**.

Mark II miniature version

The second sub-table (**photo 5**) came about because I believe in doing things in the easiest way possible and I was finding that the vice was being removed and the large sub-table was being fitted at regular intervals, often for smaller machining jobs. I therefore decided that a small sub-table that would fit into the vice would save much of the humping and grunting which invariably accompanied the removal and fitting of the sub-table which weighed in at some 27.8kg. and the vice, which was also no lightweight. As the second version would be for the smaller and more delicate parts, it could then be built to a smaller scale and would also be lighter. It consists of just two principal components and bears some similarity to the coordinate table described by Bill Brading in MEW issue 93. Indeed, it would not be difficult to add on the geometric reference features described in that article.



2. Detail view of end block



3. Underside of vice showing key



4. Key fitted to underside of sub-table



5. Small sub-table gripped in vice

The first part consists of a heavy piece of bright mild steel that fits between the Vice jaws (25mm thick x 50mm high. x 120mm long.) this piece is first put in the vice and a light skim taken off the top to make sure that it is parallel with the table. (I would recommend that this first part be marked in such a way that its orientation in the vice is known.) Let us call this part

the clamp block. It can be seen in the underside view **photo 6**.

The second part is a bright mild steel plate 120mm wide x 10mm thick and 250mm long. Make sure that this piece is flat and pack if required so that the plate is not twisted as it is clamped down.

This is clamped down to the milling machine table and a tight fitting groove

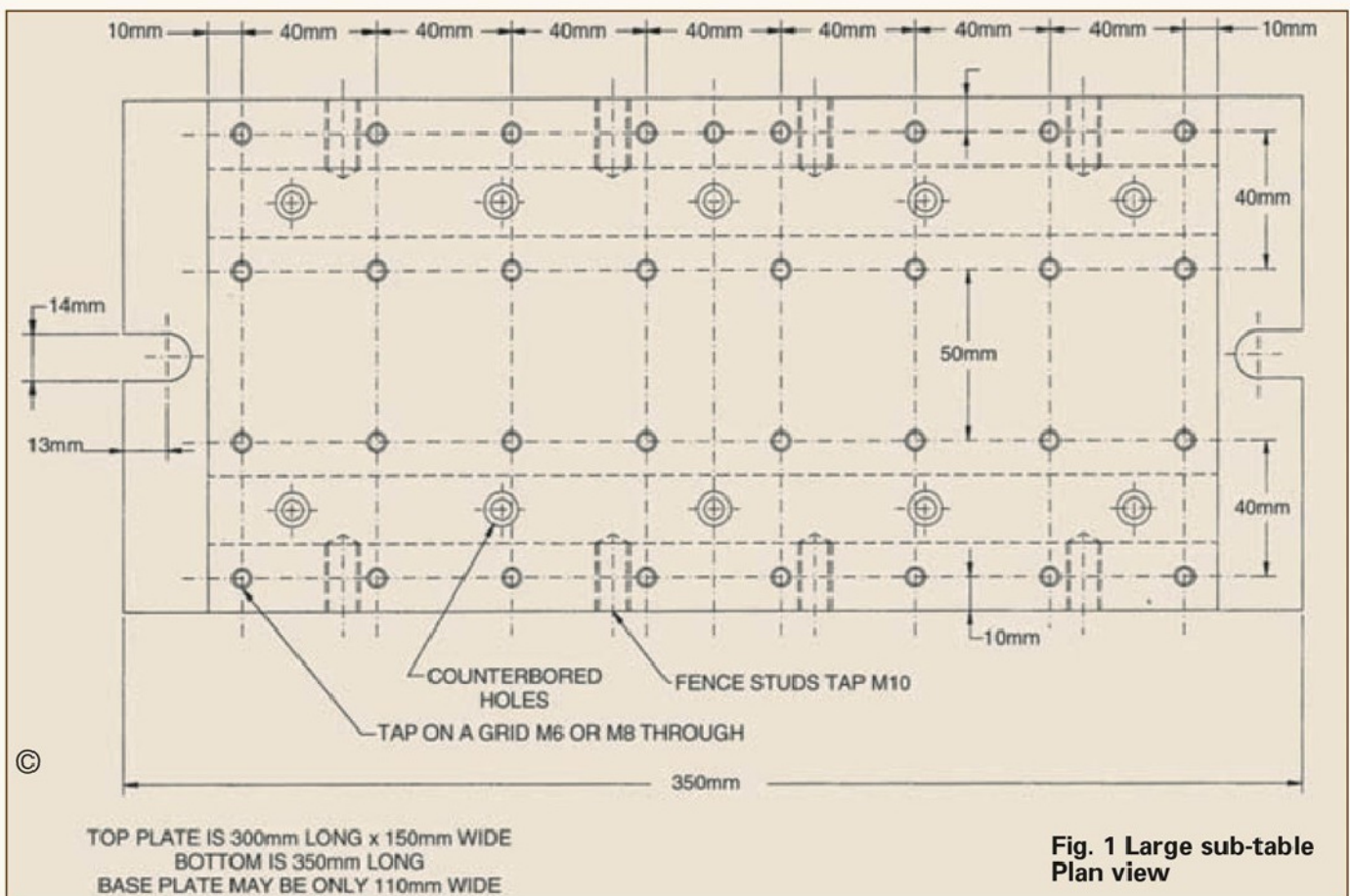
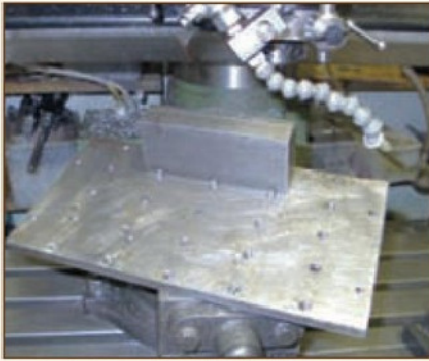


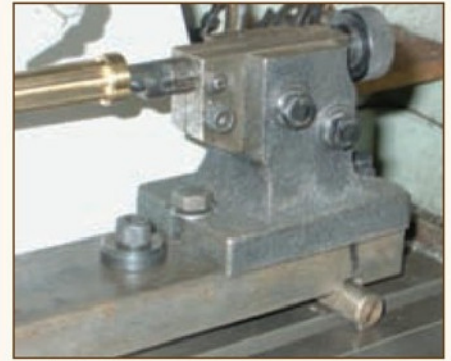
Fig. 1 Large sub-table Plan view



6. Underside of small sub-table showing clamp block



7. Roller and packing at dividing head end



8. Roller at tailstock end



9. Congrieve clock complete with Grecian columns.

machined down its length to suit the length of the clamp block and in the centre of its length. This will then accommodate the clamp block. If this is accurately machined then no dowels will be required between the parts for alignment. The position of this slot has been detailed on the drawing to suit my requirements, but

can of course be modified to suit your particular needs.

This top plate is bolted down to the clamp block with (I would suggest) a minimum of three M6 cap head screws counter bored to be slightly lower than flush. (The top surface will require skimming). The top surface is again "Peppered" with a grid pattern of tapped holes in M8 and M6 sizes. All four edges are then machined and a fence made to fit, this fence is machined in situ so that it is parallel to the main mill table and will require to be doweled to the sub-table.

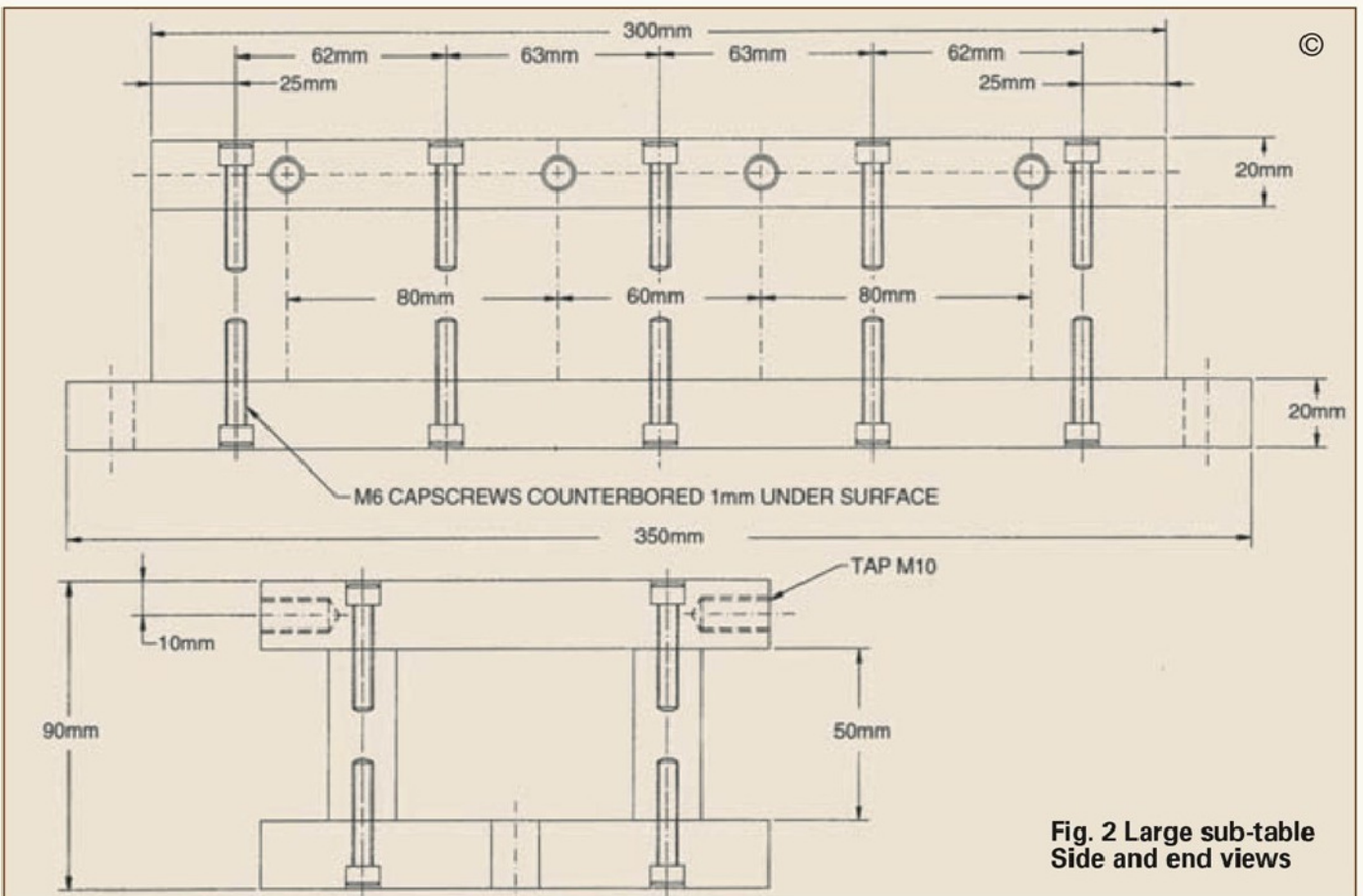
Individual users of the sub-tables will probably find that additional holes may be required for specific jobs and I am sure many and varied uses will be found. Personal experience has been that they are ideal for small finicky jobs that have to be bolted down, notably such items as clock faces and other such intricate parts. I have also used them to hold the front faces of my control cabinets for the C.N.C. mill projects etc. It will depend on the height

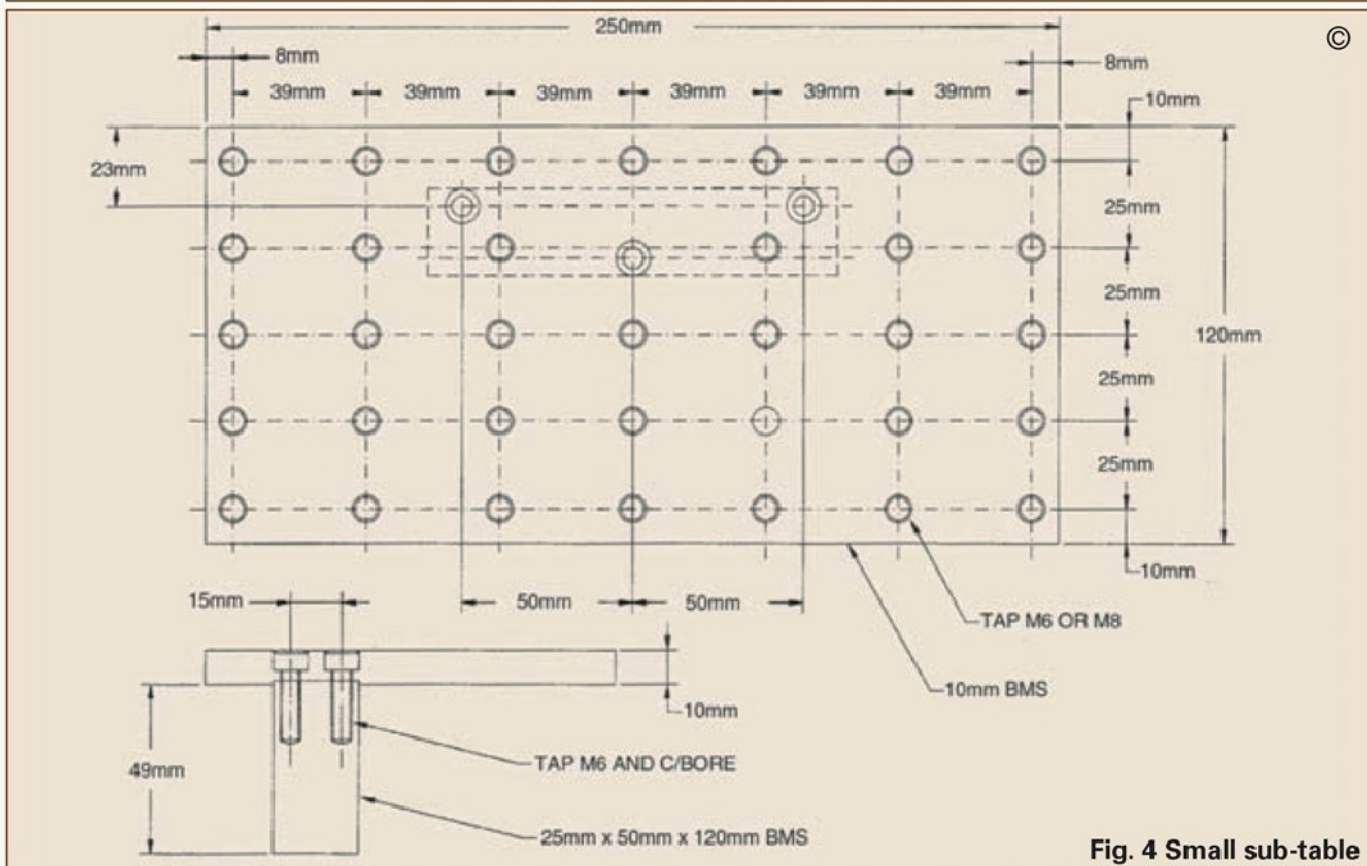
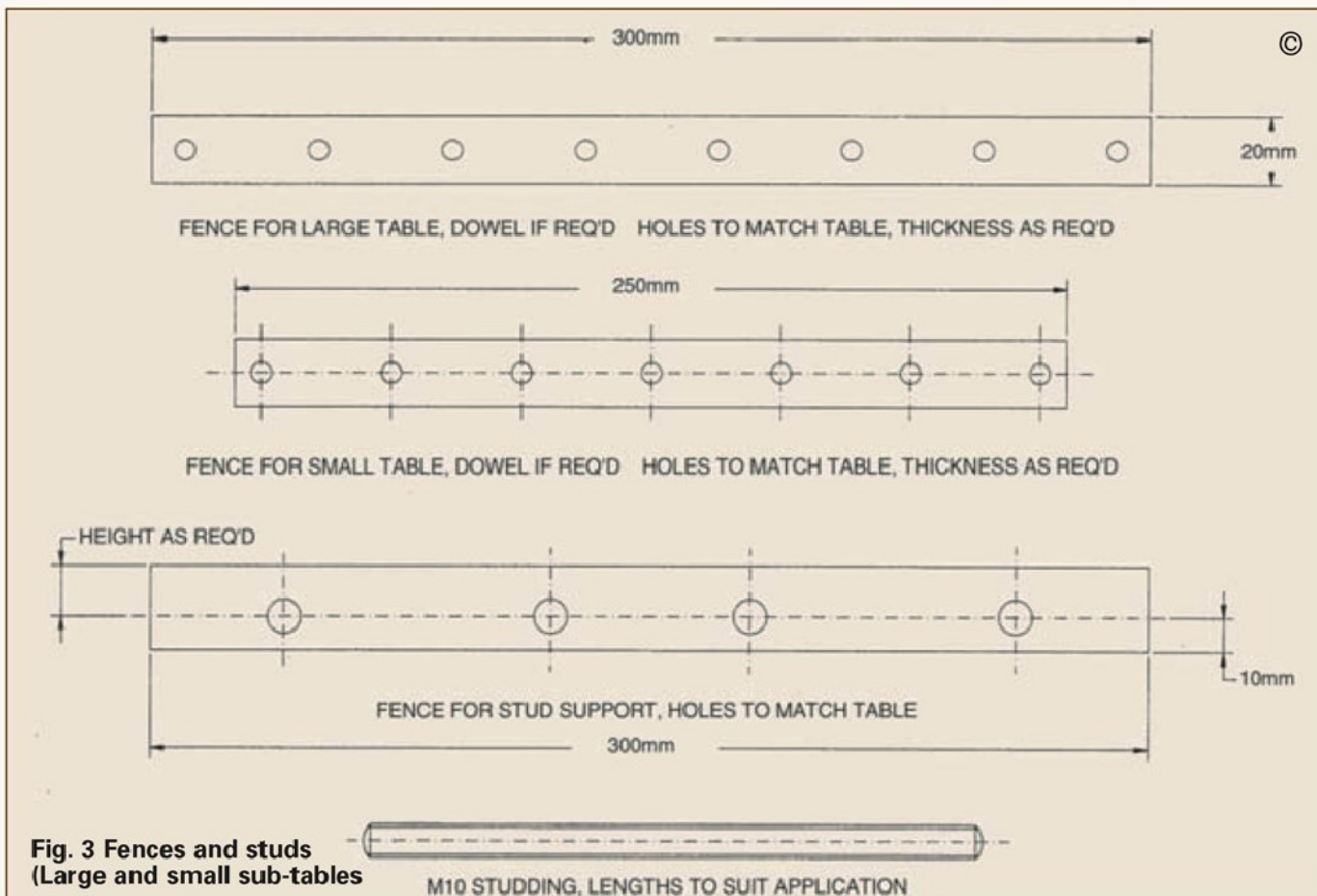
and shape of the main vice jaws, whether it is possible to use toolmakers clamps around all the edges.

Tilting variant

I have also for machining parts of the "Congrieve clock", obtained a piece of bright mild steel 75mm x 30mm x 600mm and this has two slots milled along the centre line from each end along its length (it would be better for long term use to have one slot the full length.) and these will allow me to position the dividing head at one end and its tailstock at the other. The underside has two shallow transverse grooves one at each end and these are for the location of rollers in a similar manner to those on a sine bar. This set up is fitted to the mill table and bolted down with packing under one roller to give an accurately controlled inclination.

The purpose; to machine the flutes that I have put in the four corner pillars. These are first turned to a taper on the lathe and then mounted in the gadget. It is then





necessary, to align the top face of the column to be parallel with the bed of the mill table by the use of packing under the rollers, the top surface being checked with a dial gauge. The whole unit is then clamped down firmly and the flutes

machined using a ball nosed end mill. There I have my Grecian columns. The two photos 7 and 8 of this set up are I think self-explanatory.

I hope that these parts will stimulate the brain and give some ideas to make the

hobby even more enjoyable. As in all my previous articles, I am happy to help in any way but as previously stated phone only please.

Peter Rawlinson, Charing, Kent.
01233 712158.



MY WORKSHOPS

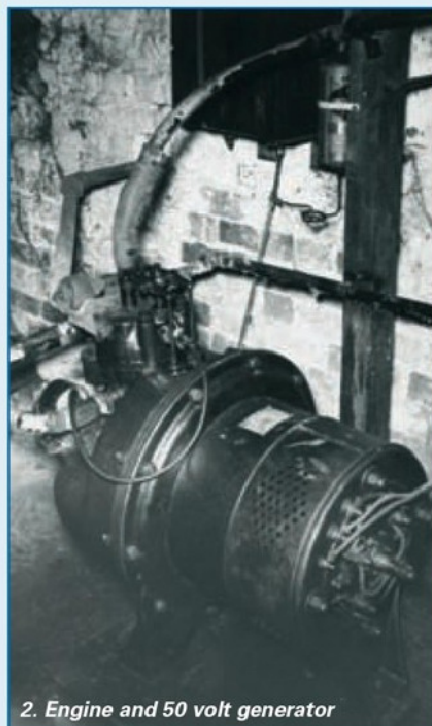
John Brittain offers reminiscences on workshop accommodation



1. Myford ML7 on stand/cupboard

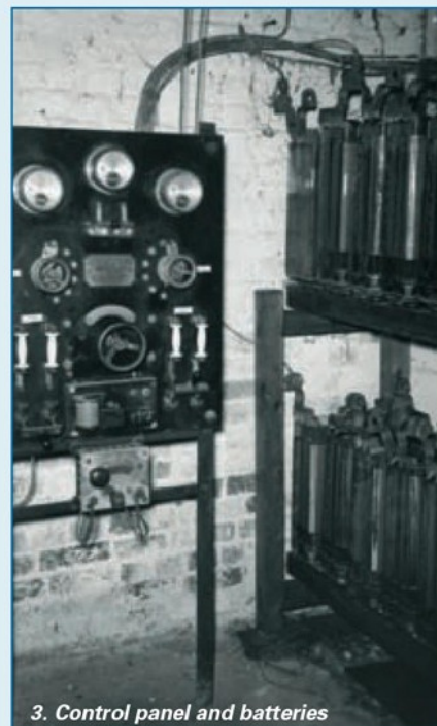
Early days

My first recollection of a workshop was of a large barn clad with feather-edge boarding and coated with a bituminous substance that gave it a sombre, somewhat forbidding appearance. My father, who was quite a fair handyman, had set up a bench in one corner of it on which he had mounted a hand-operated pillar drill, a four-inch metalworker's vice and a grindstone, also hand-operated. With this equipment, together with a modest selection of wood and metalworking hand tools, he accomplished a surprising number of projects, the manufacturing of which no doubt influenced my desire to imitate and create something. I remember his bringing home, on a number of occasions, a sack of planed softwood off-cuts, which he intended using for fire-lighting purposes,



2. Engine and 50 volt generator

but I had other ideas! To me, these 'goodies' were far too precious to burn and needed alternative treatment; I was soon beaver away making an assortment of 'weaponry' with this easily worked material. Since I was only allowed a spokeshave as my forming tool, the initial shape of each off-cut tended to dictate what the finished product would be, but I always had the same theme in mind. Using the afore-mentioned metalworker's vice as my holding device, such items as knives, swords and tomahawks began to appear with ever-increasing regularity, my mother aiding and abetting this activity by providing a nifty line in gun holsters made from old felt hats! When I was fully kitted out with



3. Control panel and batteries

these accoutrements, my appearance must have been truly side-splitting. I imagine that I must have resembled something crossed between a frontiersman from the Early West and a fugitive from the Spanish Maine!

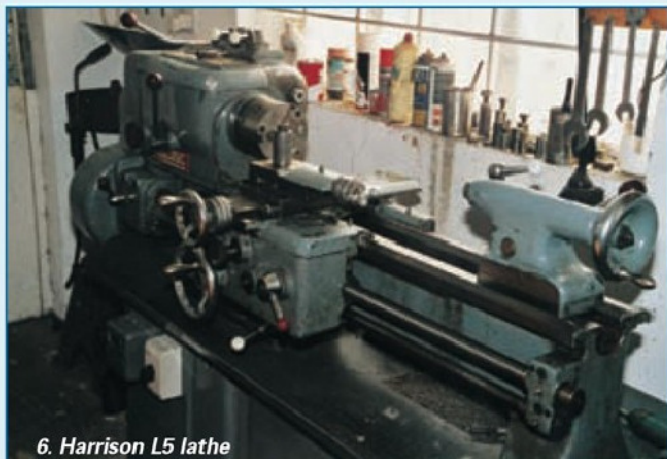
My tenth birthday saw us moving to another home and here the workshop situation took a definite turn for the worse. Dad was forced to set up his bench in a building that had been a stable and which didn't even possess the luxury of a door! Activities were therefore confined to the better weather periods and, as I recall, neither of us made very much during this period. Matters improved somewhat however when we decided to utilize a shed that had been originally built for the



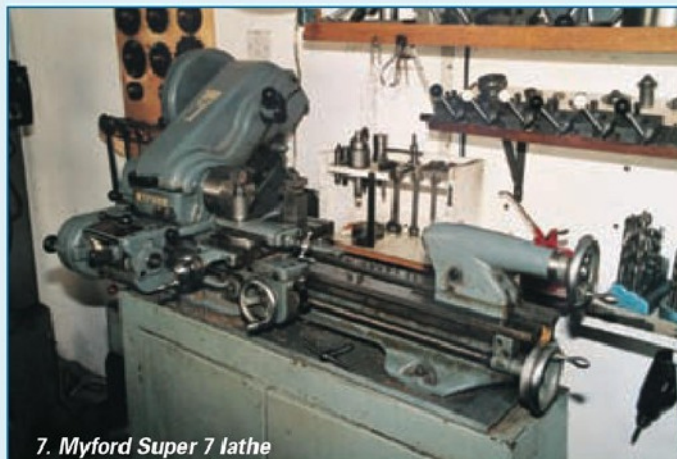
4. Feather-edge board shed (still in existence forty years on)



5. Present workshop



6. Harrison L5 lathe



7. Myford Super 7 lathe

purpose of hanging game birds after a shoot (our 'new' house had been a gamekeeper's cottage) and which presented a rather a macabre appearance inside with its rows and rows of hooks. The bench was shifted to this new location which, though far from perfect, provided a more suitable venue for our craftwork.

At around this period I was receiving some tuition in the form of metalwork lessons at school and these new skills greatly added to my craft repertoire. I remember discovering at this time the magazine 'Practical Mechanics' which I began to read regularly at the local library near my school. From time to time, it would publish plans for certain items to be made by the home craftsman and one in particular caught my eye. It was of an electro-magnetic clock that could be made fairly simply by utilizing part of an alarm clock wheel train, thus eliminating the obvious clockmaking problem. I duly sent for the plans and, with the aid of a few files and a soldering iron, began construction. To this day, I still remember the glow of satisfaction that I experienced when I first got it to tick - and found it still ticking the next morning! I'm afraid I never did make a case for it and scrapped it some years later, but the experience of actually getting something mechanical to actually work was obviously very encouraging and no doubt spurred me on to try more ambitious projects.

Insulated and well lit

It was several years after this that my father felt he needed a better garage and managed to obtain an ex-W.D. hut for this purpose. After laying down a concrete base, we erected this quite large structure on it and I was allocated half for a workshop. The building was covered with a tough bituminous felt, had an asbestos roof and was lined with plasterboard, so that, once I had added a ceiling and some doors, the room became quite snug. My half of the building already possessed two windows and thus, after a coat of white emulsion paint had been applied to walls and ceiling, the place was very well lit. At last I was about to experience the joy of working in a well-insulated space where (as it turned out) there was no need to be constantly wary of condensation and its associated rust problems.

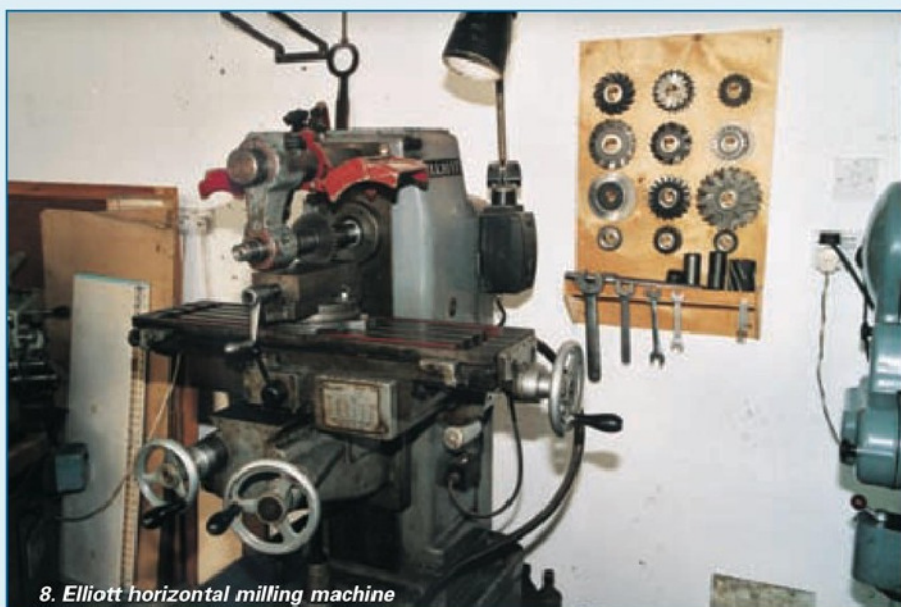
First lathe

Around this time, a colleague with whom I was working, began talking to me about his interest in metalwork and, in particular, his fascination with lathe work. The more I listened to him the more appealing these conversations became, resulting in every lunchtime being occupied (between sandwiches) by discussions on lathe practice and how such-and-such a method

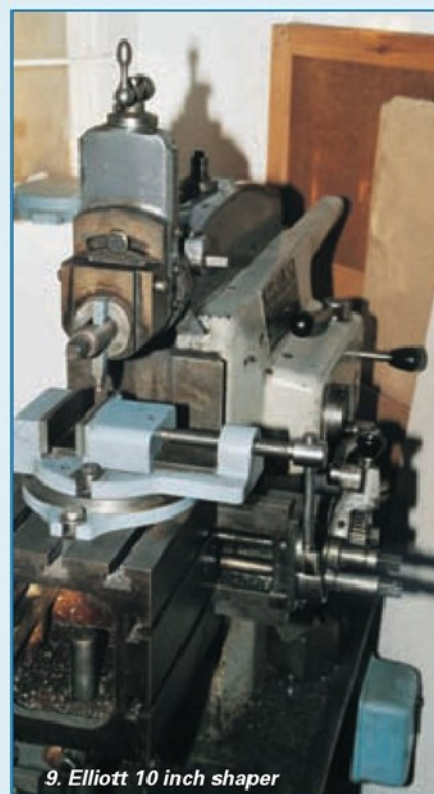
would need to be used to achieve a particular outcome.

I recall quizzing him over many aspects of lathe procedure and finding that he was only too willing to answer my questions, so pleased he was to have such a keen pupil! I remember, in particular, his cautioning me on what my approach should be. 'A slaphappy attitude is useless on a lathe,' he said - 'only care and patience will achieve anything worthwhile.' At the time, he was experiencing difficulty in putting this philosophy into practice since his lathe was a pretty ancient one which had long since given up on accuracy but, as he put it 'if you know where to lean on it you can still get quite a reasonable result!' Soon after this time he persuaded himself that he just had to 'update' and purchased a brand new Myford ML7 for, as he recently told me 'just fifty one pounds, seventeen shillings and sixpence (£51.87p), giving away his somewhat tired old machine.

Meantime, these continued conversations with my colleague, coupled with my reading of a recently published book 'The Amateur's Lathe' by Lawrence Sparey, further increased my curiosity until



8. Elliott horizontal milling machine



9. Elliott 10 inch shaper



10. Union tool and cutter grinder

I couldn't bear it any longer and decided that I, too, must have a lathe. The choice was obvious, and I purchased a new ML7, complete with the usual accessories, Dad and I bringing it home in the boot of the car. I constructed a sturdy stand/cupboard from well-seasoned red pine, fixed it to the concrete floor with rag bolts and mounted the lathe on it, using Mr. Sparey's method of ensuring that the lathe bed was not strained. I was on my way! (See **photo 1**)

Power source

My father's contribution to this whole saga became ever more significant, since he was ultimately responsible for providing the power to drive the lathe. Our house lay on the edge of a rather remote village that did not enjoy the benefit of electricity, so my ever-enterprising dad found a derelict fifty-volt lighting plant and bought it for ten pounds! He then proceeded to rig up the whole unit (**photo 2**), complete with its twenty seven huge glass accumulators and impressive control panel (**photo 3**), replace gallons of sulphuric acid and complete all the necessary wiring. This effort occupied him in his spare time for some weeks but finally, we prepared to see if the whole system worked! I remember the scene, as



11. Drilling machine (made whilst at Loughborough T.C.)

if it were yesterday, of Dad cranking the starting handle and the engine bursting into life - but with no sign of any electricity generation! An electrician friend who had come to oversee the house wiring was crouching beside the dynamo cleaning the commutator with rag and screwdriver when suddenly the engine took on a new and more strident note, the lamp above our heads beamed a beautiful light and the control panel dials sprang into life, registering charging voltage, charging amperage and state-of-battery voltage - a most memorable moment in my life and one which has stayed with me ever since. (Incidentally, the plant ran for a further fourteen years during which time it required one cylinder re-bore and replacement big-end bearing, one dynamo re-wind and several replacement plates for the batteries - not bad considering that it was manufactured in 1916 and we didn't acquire it until about 1948! What a tribute to the excellence of British engineering at that time!)

There was an immediate problem however as far as the new lathe was concerned. The lighting plant was fifty volt D.C. and so I needed a motor that was compatible. Fortunately, we heard of someone in the locality who had been

running a similar lighting plant but had subsequently acquired mains electricity. A visit to his farm revealed that he possessed a motor, which would indeed suit my purpose, and it was duly purchased, complete with start-up rheostat. Another bout of activity in the wiring department followed and I was ready to take my first plunge into the unknown. How well I recall those first faltering steps into the mysteries of turning. The many conversations with my workmate had ensured that, at least, my basic theory was all right but now I needed to put it into practice. Again, Mr. Sparey's book came to the rescue with his design for a tailstock dieholder and the first curls of swarf began to appear. I duly finished the job and celebrated the occasion by cutting my first diestock-generated thread in the lathe, accompanied by nods of approval from Dad. (I still have this tool and it is still giving good service).

The workshop proved a great success, its double 'skin' proving a most adequate defence against condensation and the dreaded rust, contrasting sharply with what I had hitherto been forced to tolerate.

I continued to use this workshop for some years until I married, and moved to a new home. Here I found myself back to 'square one' without a workshop and with a different set of priorities.

Starting afresh

Setting up home was obviously the immediate consideration and I couldn't, at that point in time, justify much expenditure on a workshop. All was not lost however, since the garden possessed a 10ft. x 8ft. barn constructed from 4in. x 2in. timbers and clad with 'featheredge' boarding (see **photo 4**). It had a corrugated iron roof, very much in need of replacement, a stout door but no windows. I reckoned however that it had the potential for conversion to a workshop and, over a period of some weeks, set about transforming it.

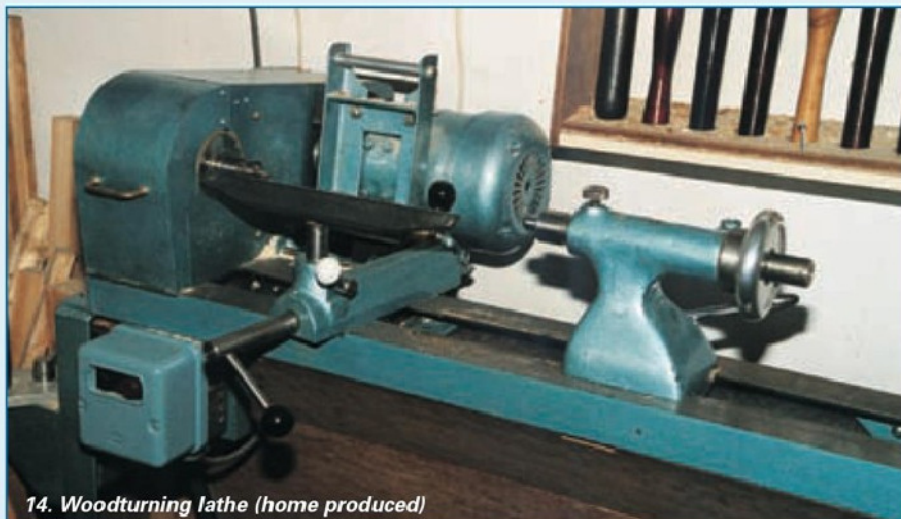
The roof was easily and cheaply replaced, after which I needed to consider what to do about the floor; since the building was raised up on two courses of bricks, I decided to use these to give me the level for it. The shed had obviously been employed as a coal store and the earth floor had sunk well below ground level, which presented another problem.



12. Coronet circular saw/planer



13. Bandsaw



14. Woodturning lathe (home produced)

How should I fill this huge hole in order to bring the floor up to the brickwork top?

The answer came unexpectedly. At the time, the road was being repaired right outside the house and quantities of bituminous-bound gravel were being piled up ready for removal. A word with the foreman resulted in the workmen wheeling in barrow loads of this material and tipping it into the void until the level was within about two inches from the top of the brickwork. All I then needed to do was to add a layer of concrete and the floor was complete - and waterproof!

Windows were the next obvious item and I was lucky in being given three ex. W.D. units, which were already glazed and ready for installation. After marking out their locations on the outside of the shed and cutting holes in the walls, I nailed 4in. x 2in. frames into these positions and was able to fix the windows into them with the minimum of trouble.

Insulation was the next priority and here I was somewhat at a loss, since any form of boarding - plywood, plasterboard, fibreboard etc. was outside my budget. My cheap alternative was to procure some large cardboard boxes from the local Co-Op. and open them out flat. I dampened their surfaces and, whilst they were in this state, clad the inside of the building (walls and rafters) with them, using clout nails. The resulting appearance next day was most satisfying, the cardboard having shrunk and stretched very tautly across the timbers. I covered the whole lot with cheap lining paper and gave it a coat of white emulsion paint, thus altering both the appearance and the comfort factor very considerably.

Electricity was provided by an overhead cable from the house and some second-hand electrical wire and fittings were used to complete the job. Over several years, this workshop was to prove most satisfactory and I derived much pleasure from its use before circumstances forced me to abandon it.

House move

Accepting another post in a different county necessitated moving house and the workshop problem manifested itself once more. The cottage, which was to be the new home, possessed a lean-to building at one end (in all probability the wash house at one time) and I was forced to take this structure over as my temporary workshop until I could organize something better. I absolutely hated that nasty little shack! It was too small, too cramped, the wrong shape and, worst of all, was damp!

Nevertheless, I just had to tolerate it and, in fact, it was several years before I could find either the time or the cash to take action against it! The right moment finally arrived however and I decided to remove all my tools and equipment to the garage and knock the offending building down - to be replaced by a purpose-built one.

First, the size of the proposed building was pegged out and shuttering boards fixed in position straight, square and level. The bricks from the old lean-to were broken up and used as hardcore and reinforcing mesh laid in position, after which concrete was poured and levelled off so as to form a 'raft' for the new

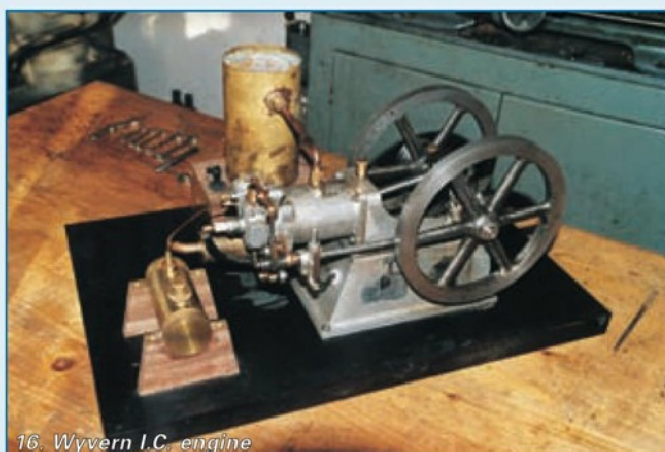


15. Viceroy toolgrinder

workshop base. I opted to use 18in. x 9in. x 9in. hollow concrete blocks as a speedy means of providing a form of cavity wall and, in the event, these proved eminently satisfactory.

The flat roof was covered with $\frac{3}{4}$ inch waterproof plywood and three layers of roofing felt, glass wool installed between the joists and a plasterboard ceiling fixed. The inside walls and ceiling were then plastered and skimmed. Three metal-framed windows allowed for plenty of natural light and adequate provision was made for all the electrical power and lighting.

Because the workshop was designed from scratch, I was able to build it exactly as I wanted it and what a pleasure it was to move in and find that I had plenty of elbow room and that everything was fitted to a predetermined plan. Unlike the lean-to shack, dampness and rust never featured in this new environment, low wattage, tubular heaters providing a stable atmosphere in the colder months and a fan heater supplying any auxiliary heat that I needed. This was a lovely workshop and one that I much regretted leaving some fifteen years later.



16. Wyvern I.C. engine



17. Wheel for spinning wheel



18. Hot air engine components

Current accommodation

I built my present workshop (photo 5) nearly twenty years ago and this time I wanted it to match the house, so I constructed it of brick and provided the 'cavity' by adding the usual breezeblock interior wall.

The building began life as a 20ft. x 12ft. structure, but later I extended it so as to provide a separate room for my woodworking activities. Thus the final size became 32ft. x 12ft. with a door at either end and five windows. Internally it was, as with the previous one, plastered, skimmed and finished with white emulsion paint.

Again, I fitted it with low wattage tubular heaters controlled by a thermostat (the same equipment as was used in the previous workshop) and provided electrical sockets at suitable intervals round the walls for all my machinery. Main lighting was originally from 4 foot

fluorescent fittings but I have since updated these to 5 foot with consequent improvement in illumination.

I have, over the intervening years, fitted individual lights to most of the machines, these being plugged into the existing sockets (with a minimum of dangling wires!)

Security-wise, I have fixed bars at all the windows (which are metal-framed anyway) and fitted two mortise locks to each door. I have reinforced these locks with galvanised steel plates fixed to both sides of the doors by bolts passing right through them. The 'keep' side is also protected by a hefty strip of steel screwed securely to the frame, thus making it extremely difficult for any would-be thief to kick in or 'jemmy' either door. In addition, my house alarm is also connected to the workshop and I have installed two security lights on the roof! (What precautions we need to take in order to protect ourselves from those 'delightful' people who appear to be largely immune from anything that our society chooses to do - or am I beginning to sound politically incorrect?)

- and equipment

This workshop is by far the best-equipped one I have possessed and, unless something very drastic happens to my life, the last one I ever hope to build! Its only disadvantage is that it is not attached to the house (imagine the luxury of stepping straight into the workshop without going outside) and I enjoy working in it immensely.

The metalworking area houses a Harrison L5 lathe, (photo 6), a Myford Super 7 (photo 7), a horizontal miller, (photo 8), 10 inch shaper (photo 9), tool and cutter grinder, (photo 10) drilling machine, (photo 11), power hacksaw,

double-ended grinder, propane equipment, arc welder, grinder and buffer, plus three workbenches and sundry hand tools.

The woodwork room houses a Coronet combination circular saw and planer (photo 12), a bandsaw (photo 13) a woodturning lathe (photo 14), and, most importantly, a Viceroy horizontal grinder (photo 15) designed specifically for woodworking tools. Together with a large collection of woodworking tools, this lot provides me with all I am ever likely to need for my amusement and my beautiful pastime.

Correction! I am in the process of looking for a suitable aluminium furnace, which I intend setting up near the greenhouse when the wife isn't looking! This then, together with a moulding bench already in position within the garage, will provide an extra string to my bow, and I hope to be casting (again) before the year is out!

Projects

Finally, like most model engineers, I have a whole heap of ideas and projects lined up - either in my head or roughly sketched or even partly experimented on. e.g. I have long since cherished the notion of building a more efficient type of drill/mill, driven by overhead gear but with power to tackle the milling of steel components. To this end, I have made several patterns and have decided on a final design - but I advise no-one to hold their breath!

The project photographs show:

My particular version of Westbury's 'Wyvern' I.C. engine - finished and run last year but still awaiting painting.

A partly constructed wheel for a spinning wheel.

Components for a hot air engine - made many years ago but resurrected to experiment with burners.



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WANTED

Wanted: Due difficulties in South Africa I have not been supplied with issues 88 & 90 of MEW Does any one have these for sale or copy? I will be happy to pay all costs to get them to South Africa. Please e-mail cunning@mweb.co.za with the good news .

Wanted: Information on 5in. x 36in. Atlas lathe. I have no manual and am missing a number of changewheels. Any info/photocopies on the machine and sources of spares would be most welcome. Please phone Mr B C Spick on 01476 566 234.

Wanted - for my 1947 Myford "M" series lathe; has any reader a manual to sell or be willing to provide photocopies. The cost will be reimbursed and any help greatly appreciated. Please phone Mr N Taylor on 01270 258 489.

Wanted - to purchase - Owners manual (or photocopy) for Boxford 8in. Shaper. Please contact Gordon Johnstone, R. R. 1 Legal AB. Canada, TOG 1LO

Wanted - Canadian supplier information - Having recently moved to Canada from the UK, I am having difficulty finding Canadian suppliers for tools and materials. I can find many USA suppliers but shipping and

customs make this an expensive operation. Would any Canadian readers who can help please email me at - rondaviesuk@shaw.ca Many thanks Ron Davies

Wanted - MEW issues 78 and 91 to complete the set for aged modeller. Your price paid. Please phone Mr A Blackbourn on 01509 890 818 (Loughborough)

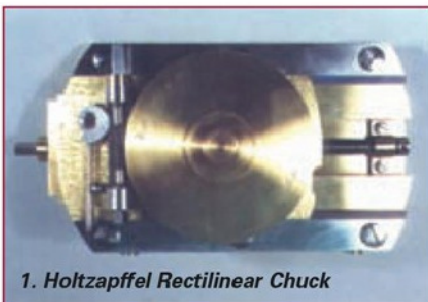
QUICK TIP

From Doug. Ball

When tapping holes of around M5 size, it may be found useful to employ a cordless pistol drill with a spiral point or spiral flute tap, rather than the traditional tap wrench, and hand tap. It is easier to align, and can be simply driven in forwards, and then reversed out.

ORNAMENTAL TURNING FOR MODEL ENGINEERS

③



1. Holtzapffel Rectilinear Chuck

In my last article (MEW issue 98) I described both the conventional and the modern versions of the Eccentric Chuck with some notes on the construction of the latter. This time I examine the construction of the conventional type. Readers who are skilled machinists and have the time and the inclination, should be able to make the various parts of the chuck from the drawings by using their own tried and tested methods. As an ex-banker, my knowledge of engineering has been acquired haphazardly and is rather limited; so the notes on construction that follow are provided only in the hope that they may prove helpful to those who haven't done this sort of work before.

Construction - conventional type of Eccentric Chuck

The design I would recommend is based on an amalgam of the basic Holtzapffel model with later improvements by J.H.Evans, John Bower, William Goyen, George Plant and myself. It has a foundation plate made to fit onto the lathe spindle. Next, it has a sliding eccentric plate with a central hole to accept the spigot of a nosewheel and with dovetail edges cut along its long sides. The plate slides between two parallel dovetail bars, one having provision for slide adjustment, which are screwed on to the long edges of the foundation plate. A tapered locking pin passes through the slide and into the foundation plate so that it may be locked in its central or neutral position. Most Eccentric Chucks have a leadscrew mounted on one end of the foundation plate, extending almost to the centre of the chuck and passing through a nut fixed to

John Edwards describes the conventional Eccentric Chuck

the sliding plate thus allowing the sliding plate to be extended eccentrically in one direction only. However, I prefer the arrangement of the larger Rectilinear Chuck (photo 1), which has a full length leadscrew so that the sliding plate may be extended in either direction. Supposing one wished to cover the surface of a workpiece with rows of similar cuts. The chuck would be fixed vertically by the index and division plate and the first row of cuts may be made across the face of the work by a cutting frame fixed at equidistant intervals controlled by movements of the slide-rest (cross-slide). After the central row of cuts has been completed, the slide of the chuck may be set eccentric by the same interval as allowed between the cuts and then another row may be cut. With the conventional chuck the cuts could be made at progressively greater eccentricities until one half of the surface is completed; i.e. the half opposite to where the eccentricity of the chuck is available. In order to ornament the other half it is necessary to rotate the nosewheel by 180° and, if the cuts are other than circles the angle of the cutter would also need to be re-set.

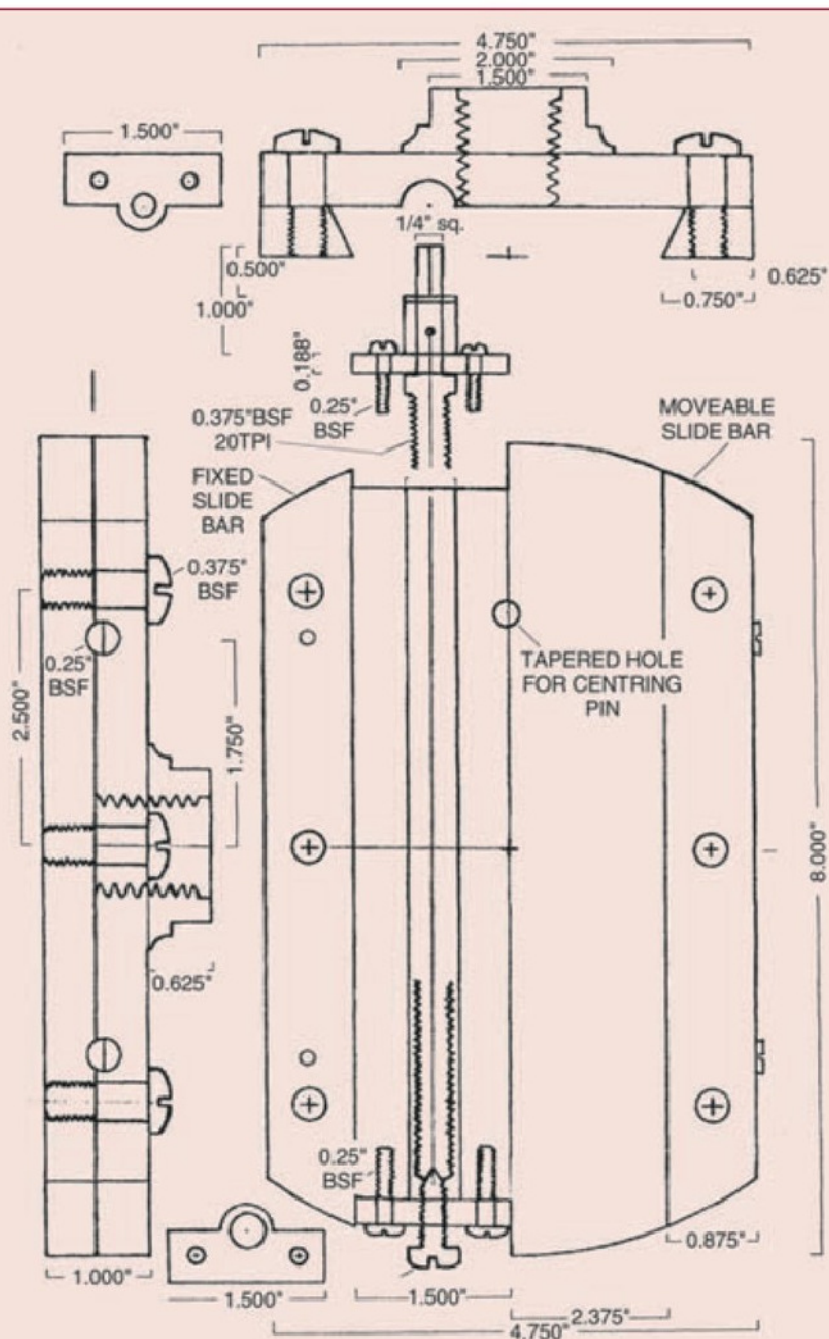
However, with the full length leadscrew it is possible to ornament on two opposing eccentricities at one setting of the nosewheel, i.e. the rows may be cut both above and below the centre line, thus decreasing the possibility of inaccuracy. I hope this example illustrates clearly the advantages of the conventional type over the modern version previously described.

A full length leadscrew crossing the centre of the chuck necessitates a thicker sliding plate to accommodate the nosewheel holding screw. However, this is avoided by placing the leadscrew to one side of the centre line where a full length groove can be cut in both the foundation plate and the sliding plate.

Eccentric Chucks do not have a counterbalance mechanism because they are not generally run at high speed. In normal use they are only run when locked in the central (or neutral) position when they are in balance; in this state they are run at sufficient speed merely to skim the workpiece true all over before applying any ornamental cuts. The larger Rectilinear Chucks, contrary to appearances, are also in balance when in the neutral position but they are not intended to be run at anything



2. Eccentric Cutting Frame made by Tony Brooks



Drawing 1 Foundation plate

more than a very slow speed (say, up to 50 r.p.m.). However, if one is to be used for multi-centre turning at speed, such as in making a spiral-staircase pattern or a model crankshaft, there is no reason why a counterbalance mechanism cannot be added. It could take the form of an extension to the foundation plate on which could be mounted a series of weights that



3. Eccentric Cutting Frame made by Holtzapffel

may be increased or decreased with progressive changes in the eccentricity and the weight of the workpiece.

First, a **foundation plate** is made (**drawing 1**); bronze is the preferred metal but brass, mild steel or cast iron will suffice. In choosing the metals, it is as well to consider that less wear occurs between moving parts of disparate materials; such as brass or bronze against steel or iron. The foundation plate may be made (as in photo 3 of the previous article in issue 98) from a casting with a central boss, or fabricated from a plate and a cylinder, (the parts being joined by welding or by silver solder and steel pins), or with a separate backplate as in photo 6 of the previous article, bolted on to the plate. If made in two parts the cylindrical piece should be made to fit accurately on the lathe spindle; i.e. by a screw thread with accurately

turned register or a Morse taper, whichever fits your lathe. Then, whilst fitted tight to the spindle the end of the cylinder should be turned to a true spigot to fit into a hole bored in the centre of the plate. Before joining the two components together, it is worth considering the orientation of the chuck in relation to the division plate. Ideally, the chuck should be capable of being set horizontal when the index is in the highest numbered hole in any row on the division plate. This is because, for some operations, it is necessary to set the chuck exactly horizontal (or vertical) to take the first of a series of ornamental cuts. If neither of these positions allows the index to be put into the highest numbered hole in the division plate there is a greater risk of errors in counting divisions for the pattern. The cylindrical section should be screwed firmly on to the lathe spindle with the index in the middle of its range of adjustment and the two components should then be joined together temporarily with the foundation plate horizontal and the index in a highest numbered hole. The pieces should be marked lightly so that after being removed from the lathe they may be joined permanently in the marked position. Next, the surface of the foundation plate should be turned truly perpendicular to the lathe axis.

If made from a single casting the piece is chucked by the boss and the ends and face turned flat; then it is chucked flat side down on a faceplate, the boss turned true and the screw thread (or Morse taper) is cut; then the piece is reversed again and mounted directly onto the lathe spindle so that the foundation surface may be turned absolutely true and perpendicular to the lathe axis. If possible, the thread should be cut so that the foundation plate may be orientated to the division plate as described above. I can only suggest that this be done by trial and error by re-chucking the plate and skimming the register surface until it can be orientated correctly. I should be glad to hear from any reader who knows of a more effective method of achieving this. A small pilot hole, say, 0.125in. dia. is drilled and reamed through the centre of the plate and a temporary pin fitted upon which the sliding plate may be mounted centrally.

The **sliding plate** (**drawing 2**) is a bronze (or brass) rectangular plate, turned true on both faces so it is perfectly flat, but with a boss or spigot on one side to receive the nosewheel, and a pilot hole is drilled in the centre and reamed so it will fit over the locating pin in the centre of the foundation plate. Like the foundation plate the sliding plate may be made from two pieces silver-soldered together and joined by steel pins for added strength. The sliding plate is then mounted on a milling or shaping machine and its long sides are chamfered at 60°, accurately parallel and equidistant from the centre hole. The two plates are pinned together temporarily so that all the long sides are parallel and they are clamped together in this position.

Two steel **slide bars** are each chamfered along one side at an angle of 60°, drilled to receive three holding screws; the fixed bar (on the left in drawing 1) is drilled to receive two fixing pins (pins of about 0.125in. diameter will suffice) and both bars are then clamped on to the long

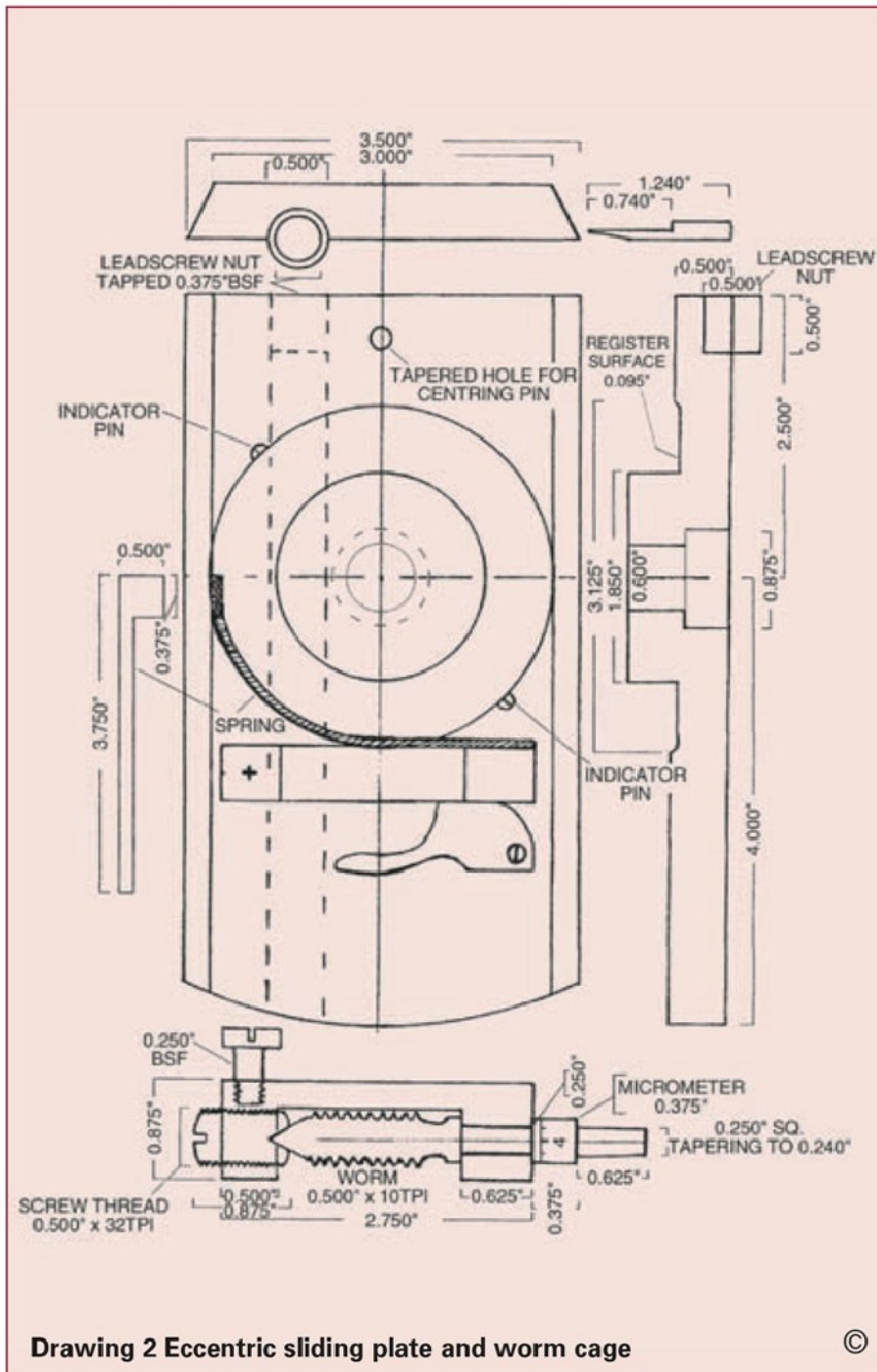
edges of the foundation plate so that the sliding plate fits snugly between the bars. The holes in the bars are then drilled through into the foundation plate, the bars removed and tapped (0.375in. BSF or similar), the screw-holes in the foundation plate are enlarged to clearance size and the screws and pins fitted. (In chucks made by Holtzapffel and others these screws were fitted in reverse; i.e. they were made to pass through the bars and screw into the foundation plate but that meant that at any one time at least two of the screw-heads were overlapped by the edge of the nosewheel and therefore inaccessible to a screwdriver, thus making it inconvenient to adjust or dismantle the chuck.)

The central pilot pin is removed and discarded so that the slide can move stiffly between the bars and it should be lapped with a non-invasive abrasive until it slides smoothly and freely. The moving bar (on the right in **drawing 1**) is unscrewed and the three screw-holes are then elongated slightly by filing so that the bar may be tightened or loosened against the sliding plate by means of the large heads of two set-screws screwed into the corresponding edge of the foundation plate (these screws may be seen at the bottom of photo 1). Their holes are drilled and tapped as close as possible to the top edge of the foundation plate and the bar is made wide enough to overhang that edge by a small amount. The large heads of these screws bear upon the bar and when tightened they squeeze the bar against the sliding plate, thus removing any play. The holes for the tapered central locating pin are drilled and reamed only after the sliding plate has been fitted.

With the whole assembly fitted on the lathe spindle the boss on the sliding plate is turned true and a hole is bored centrally into which will be fitted the central spigot of the nosewheel. The slide is then removed and chucked by its top surface so that its central hole runs true and a recess is cut in the centre of the underside of the slide to receive the **washer** and **holding screw**.

The **nosewheel** (**drawing 3**) is a 96-tooth (or, alternatively, a 120 tooth) wormwheel with a screw-threaded nose on which work-holding chucks may be mounted. It is best made from a single casting in bronze but, alternatively, may be fabricated in two parts like the foundation plate. The whole should be rough-turned all over then turned accurately to fit, on the underside, the boss of the slide, and on the top side, a screw-nose is cut to fit your work-holding chucks. For a wormwheel of 96 teeth at 10 t.p.i. the wheel section should be turned to 3.4in. diameter, (or for 120 teeth the diameter should be 4.25in.). The teeth (or grooves) should be cut to the left of centre (i.e. near the edge that fits over the boss of the slide) so that sufficient space remains along the right hand end for each cut to be marked by an engraved line. Every division should be indicated by a fine engraved line, and then following "ornamental turning" convention, every third division by a dot, every sixth division by a diamond and every twelfth division should be numbered: 12, 24, etc.

Then the **washer** and **holding screw** are made and the nosewheel is fitted to the sliding plate. Note that the square hole in the washer fits over the matching feature



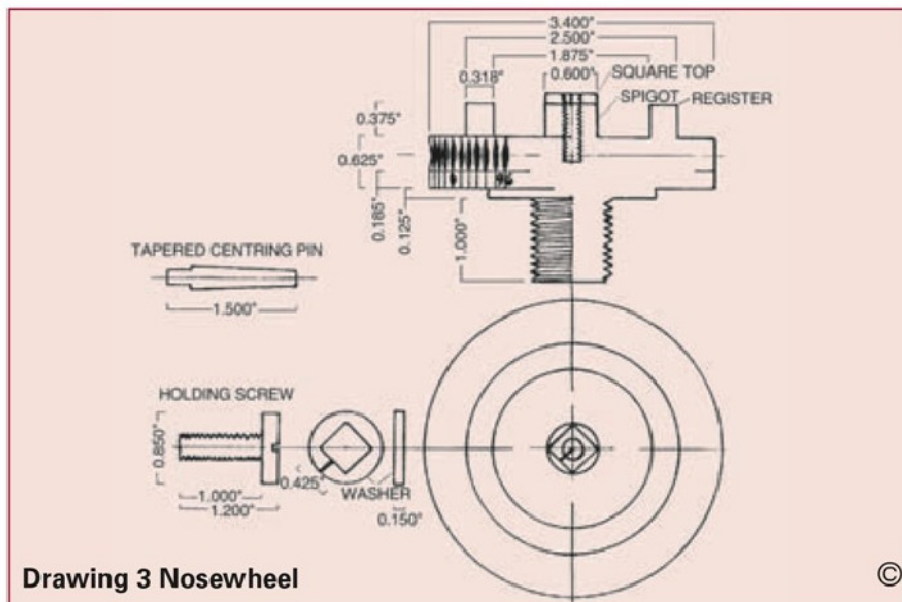
Drawing 2 Eccentric sliding plate and worm cage

on the nosewheel and thus both retains the wheel and obviates the tendency for rotation to undo the holding screw. The worm and tap (or hobbing spindle), if not having been made already, are made next and they may both be cut 10 t.p.i. at the same setting on the lathe. To make the worm fit in its cage it may be necessary to cut it slightly undersize, say, to about 0.450in. OD; then it will fit into the hole in the cage, which should be tapped, with a finer thread to take the end screw. It may be necessary to vary the dimensions in the drawings to suit the taps and dies you have available. The Horizontal Cutting Frame (HCF) (described in MEW Issue 94) will be suitable to cut the wormwheel; it is set to the helix angle of the wormwheel which, in this case is (near enough) 11.5deg. and, using the spindle with the single cutter, each groove is slashed roughly while the lathe is fixed at each of

the 96 positions by the index and division plate. Care should be taken to advance the cutter to exactly the same depth for each groove.

Next, the spindle with the single cutter is replaced by the hobbing spindle and the wormwheel is hobbled all around by engaging the spindle in the slashed grooves and rotating it by hand until it will run freely all around without either jamming or disengaging. Then it is driven by the overhead; slowly at first (I use a ½ HP 3-phase motor with inverter for variable speed) then it is run at increased speed until all the grooves are cut evenly to full depth and the worm will fit and turn smoothly.

The **worm cage** (**drawing 2**) is made from a piece of hardenable flat steel bar 3.0in. long, bored 0.460in. diameter for 2.5in. of its length and the remaining 0.5in. is bored 0.312in. The centre of these holes



Drawing 3 Nosewheel

must coincide with the centre of the cuts in the wormwheel which, if the measurements on the drawing are followed accurately, should be 0.500in. (i.e. half the width of the part of the nosewheel in which the teeth are cut, $[0.625\text{in.} - 0.185\text{in.} \div 2] = 0.220\text{in.}$ plus the depth of the register on the nosewheel 0.375in. less the depth of the register on the sliding plate, 0.095in. A screw of 0.250in. BSF is made to fit tightly in the underside of the pivot end and that screw will hold the cage down firmly onto the sliding plate so that it can be swung from side to side without rocking. The wide bored end of the cage is then screw-cut 0.500in. x 32 t.p.i.

The centre section of the top side of the cage is milled out and the end screw with a female bearing centre is made to fit tightly in the 0.500in. threaded hole. These screws are all tailor-made to fit tightly so as to avoid the need for lock-nuts to prevent them unscrewing in use. The **worm**, is now fitted into its cage so it runs smoothly and without play; then the parts may be hardened (or case-hardened). The cage is placed firmly alongside the nosewheel to determine the positions of the holes required to fix the cage to the sliding plate. A pilot hole is drilled for the pivot screw and the full-sized hole is bored through from the underside of the sliding plate where it is counter-bored to receive the head of the pivot screw that will hold the cage down on the sliding plate. The cage may now be positioned so that the worm meshes perfectly with the nosewheel and the **cam-lock** and **spring** (drawing 2) may next be made and fitted. The spring is filed and bent to shape then hardened and tempered. A rectangular slot is drilled and filed carefully in the sliding plate so that the tang of the spring may be pressed in so tightly as not to move. The camlock is filed to shape and, with the worm pressed firmly against the wheel, its position is marked and the screw-hole drilled and tapped into the sliding plate. This is another screw that should have a very tight thread so that it will not work loose. Some light filing may be required to adjust the shape of the cam to allow the cage to move smoothly from the closed to the open position (as seen in

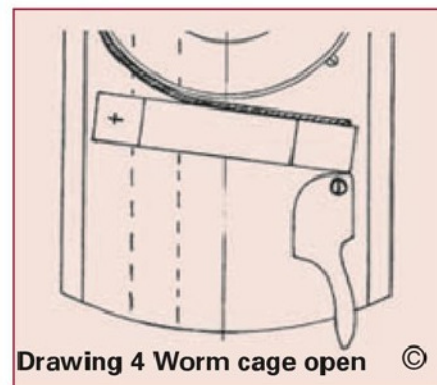
drawing 4). Then the positions for the **indicator pins** may be marked; these must be diametrically opposed so that, for example, when one pin indicates the 96 division the other will indicate 48 (or 120 and 60). The nosewheel must then be removed for the holes to be drilled and the indicator pins driven tightly into them.

The **end-plates** may be made from steel, bronze or brass; the central (leadscrew) holes fall exactly between the foundation plate and the sliding plate and the outer (screw-fixing) holes fall on the centre of the edge of the sliding plate.

The **leadscrew** (drawing 1) is made from a 0.500in. diameter silver steel rod screw-cut to 10 t.p.i., double start or 20 t.p.i., single start. I prefer the latter as being easier to make and easier to set accurately to the desired eccentricity. It is convenient to make it 0.375in. BSF which is 20 t.p.i. The adjusting end is turned down to 0.250in. diameter to pass through the end plate. The **nut** is made from a brass rod 0.500in. diameter and 0.500in. long and threaded to be a snug fit to the leadscrew. The nut is soldered into a recess cut into the half-round groove on the underside of the sliding plate.

The **leadscrew micrometer** is turned from 0.500in. diameter brass rod, bored 0.250in. and engraved 0, 1, 2, 3, 4, with intermediate lines for half-divisions. The chuck should be assembled, the leadscrew fitted and the end-plates screwed on; the plates should be aligned and the taper pin inserted to lock the chuck in the neutral position and the micrometer should be fitted so that the leadscrew can turn freely without end-play. Then a hole is drilled through both the micrometer and leadscrew, a locking pin fitted and the first, or zero, position should be marked on the micrometer.

It is most convenient at this stage to make also a similar micrometer for the worm. Whilst it is usual to broach this out to a square hole 0.250in. across flats, this seems to me an un-necessary complication and it can be just as effective if drilled and pinned like the leadscrew micrometer. The zero division of this micrometer should also be marked when the worm is engaged and the nosewheel indicator pins are exactly



Drawing 4 Worm cage open

in line with the 96 and 48 divisions (or 120 and 60 if applicable).

Engraving is a whole new subject and, to be perfect, needs considerable skill. However, reasonable results can be achieved with a scriber and scribing block, the index and division plate and a set of number punches. Each micrometer may be chucked on the lathe and the spindle rotated so that the scriber may score two lines around the circumference; then, using the 120 row of divisions, five equally spaced full length and five intermediate half-length horizontal lines may be scribed. The nosewheel may then be chucked and the spindle rotated so that the scriber may score a line from the end of one cut groove to the edge of the nosewheel; then, by indexing around, lines may be scored for every groove. Then, using punches the numbers, diamonds and dots may be added. For the punching operations the nosewheel and micrometers may be held in the vice by soft jaws. This must be done carefully as the punches need to be placed accurately so the numbers appear well-aligned and they should not be struck too hard. It is important that the nosewheel should not be distorted; but even so, the punches will cause the brass to bulge a little and the bulges may be removed by light filing then finished on the lathe by gentle use of abrasive paper. The ends of the leadscrew and worm are milled and filed into a square section, very slightly tapered, so they may be adjusted by a winch handle or key (like a clock key).

It only remains for screws to be made for the endplates, the steel parts to be burnished and the brass or bronze parts to be finished and lacquered. A soft abrasive may be used to cloud the surface of the brass/bronze then a curling pattern may be applied with a piece of slate or Stone of Ayr. The pieces should then be thoroughly cleaned in a dust-free environment, heated to about 70° C., brushed with shellac lacquer and allowed to harden.

My next article will feature the **Eccentric Cutting Frame (ECF)**, a more versatile instrument than the simple fly-cutter previously described, and capable of cutting circles, flutes, shallow circular recesses or grooves for inlaying and also may be used for planing facets; all accurate to a few thousandths of an inch. Sorry, I still can't think in metric!

Once again I will describe both a modern version and the conventional type; the modern one (photo 2) was designed and made by Tony Brooks on the lines of a boring head used on a milling machine. It is simpler to make but not quite so versatile in use as the conventional type (photo 3).

TRADE COUNTER

The format of Trade Counter has been changed for this 100th issue and includes comment and information from suppliers together with opportunities for readers to win vouchers or products. The winner of each item will be the sender of the first postcard drawn on 10th September 2004, from the relevant sack carrying the correct answers to the questions. A separate card should be sent for each of the six competitions. The editor's decision is final and no correspondence will be entered into.

Arc Euro Trade

Ketan Swali tells us:

"Established in 1986, by my father Ashwin Swali and me, Arc Euro Trade specialised in the procurement and supply of ball, roller and needle roller bearings for industrial applications. Over the years, we have built up a good relationship with the major U.S., British, European, Japanese and Chinese bearing manufacturers and have supplied bearings for applications ranging from miniature instruments, through to large scale applications in Steel Rolling Mills. We now carry in stock a good range of bearings for the Model Engineer."

Company management has now passed to me and my wife Sheetal, and in addition to bearings, in recent years, we have used our knowledge of procurement from China to expand our product range to include engineering products for the Model Engineer, at a competitive price. In addition to a considerable variety of consumable

cutting tools, we also carry a wide diversity of workholding and measurement products. Our range of machine tools extends from the mains powered Mini drill at just £15.00 up to the X3 Mill at a little under a thousand pounds. Having for some time supplied the low cost digital scales, a logical extension is the Digital Handwheels fitted to the C3 Mini Lathe. First shown at Sandown, these are essentially rotary encoders directly fitted to the feedscrews. As such they do not eliminate backlash calculations, but do make a very "easy read" alternative to the usual dial.

Whereas some suppliers maintain an inspection presence in the source factory, our policy is (apart from the smallest machines), to dismantle, inspect, and reassemble at our works. This activity is supervised by David Westgate, and his experience of electronics and CNC matters is allowing a further extension of activities into the supply of stepper motors and drivers.

Please call us for our latest catalogue. We will also be posting updates in the ME & MEW and launching our new website very soon.

The team at Arc Euro Trade take this opportunity to wish MEW a happy 100th Anniversary, and are pleased to offer a voucher for £150.00, which may be redeemed for products from our catalogue, by the lucky winner."

PRIZE DRAW ENTRY

To enter the draw for this voucher, which will be made on 10th September 2004, please answer the following questions.

1. In what year was Arc Euro Trade established?
2. Who is supervising the inspection of machines?

Send your answers on a postcard with your own name and address to "Arc Euro Trade Competition, Model Engineers' Workshop, Berwick House, 8-10 Knoll Rise, Orpington, Kent, BR6 0PS."

PRIZE DRAW
£150
PRODUCTS
VOUCHER



Low cost digital scales from Arc Euro Trade.

Folkestone Engineering Supplies

From John and Laura Bridges:

"Folkestone Engineering Supplies (FES) are pleased to support Model Engineer's Workshop in its 100th edition celebrations. FES was founded in 2001 to provide engineering materials to model engineers."

We keep a wide range of material types including Brass, Copper, Stainless Steel, Aluminium, Mild Steel in round, square, hex flat, angle and sheet. As an added service to customers, the addition of an Edwards Trucut guillotine allows the firm to offer a "Cut to size" facility. To complement our range of spring steel we can offer a hardening and tempering service, using a digital controlled muffle furnace. Not all customers are dyed in the wool model engineers. One gentleman recently purchased a quantity of stainless steel sheet. He later phoned to confirm the satisfactory completion of the ultimate in zero maintenance bathroom panelling.

This year Chinese demand has been significantly influencing the supply and price of material, however FES value means we continue to offer not only competitive prices but also good material in good condition and normally ex-stock for immediate delivery.

We also offer a range of fasteners in metric and some imperial threads and have recently added a range of quality taps and dies to our catalogue. Our free catalogues are available by phoning 01303 894611 or by visiting our web site at www.metal2models.btinternet.co.uk

In celebration of Model Engineers' Workshop's one hundredth edition we are pleased to offer readers a cased set of ME taps and dies with a retail value of over £100 as a prize."

PRIZE DRAW
£100+
ME TAPS
& DIES



Spring steel strip from Folkestone.

PRIZE DRAW ENTRY

To enter the 10th September draw for this prize, please answer the following questions.

1. What make of machine has been installed to give a "Cut to size" facility?
2. What equipment is used to give a hardening and tempering service?

Send your answers on a postcard with your own name and address to "Folkestone Engineering Supplies Competition, Model Engineers' Workshop, Berwick House, 8-10 Knoll Rise, Orpington, Kent, BR6 0PS."

Camden Miniature Steam Services

From Adam Harris:

"However you look at it, a Centenary is a significant occasion, and congratulations are certainly due to the publishers and the editors of Model Engineers Workshop on reaching the 100th issue. Equally significant is the fact that this success has been achieved against a background of ever increasing de-industrialisation, if there is such a word, in the western economies, and the U.K. in particular, and it suggests both that those who have been employed in engineering wish to retain their skills, and especially that there are still plenty of people who wish to acquire these skills, even if they have to teach themselves. Our own experience as one of the biggest suppliers of engineering books for hobbyists bears this out, as we receive frequent telephone calls from people seeking "an idiot's guide to the lathe", who turn out to have just bought, or often inherited, a lathe at which they are proudly looking, wondering where to start.

In fact, whilst one should bemoan the rundown in British manufacturing industries, if anything it has worked to the overall benefit of model engineering, in that it initially released a flood of machine tools onto the market

and, whilst this has now diminished, a visit to any model exhibition today will offer a bewildering choice of tools and other equipment at bargain basement prices.

Whilst I haven't the figures to absolutely prove it, I rather suspect that the cost of creating a workshop has never been cheaper when related to income. So, in my opinion, the outlook for model engineering is bright, even if it is gradually moving from the club/steam basis of many years standing. Clubs will no doubt continue to be a focal point for many years to come, but again we are noticing a trend away from steam propelled projects which, whilst they remain popular, are increasingly being replaced by Stirling and IC engines, and the making of workshop tools.

As it covers both the using and making of tools of all descriptions Model Engineers' Workshop is well placed for the future, and I look forward with interest to the next one hundred issues and to seeing it evolve and change as our hobby undoubtedly will."

Adam has very kindly offered a £150.00 Voucher for books/videos from Camden.

PRIZE DRAW
£150
BOOK
VOUCHER



PRIZE DRAW ENTRY

To enter the draw for this, which will take place on 10th September 2004, answer the question

What three topics, in Adam's view, are increasingly replacing steam propelled projects?

Send your answer on a postcard with your own name and address to "Camden Competition, Model Engineers' Workshop, Berwick House, 8-10 Knoll Rise, Orpington, Kent, BR6 0PS."

Warren Machine Tools

Roger Warren comments:

"Warren Machine Tools established their Warco brand 28 years ago. The original family engineering business traded as Engineering Services, working mainly for Dennis, the lawn mower and fire engine manufacturer in Guildford.

When the company replaced their machinery they were astonished by the demand for redundant lathes and milling machines. The entrepreneurial spirit dictated that there must be a market for used machine tools. Gradually the company changed from sub contract engineering to machine tool trading, thus Warren Machine Tools was established.

The bulk of the machines tool sales were exported to the Middle and Far East by container. In addition to the export sales there was a strong demand from the home market, especially model engineers who required small bench top mills and lathes. The model engineer demand was almost impossible to fulfil, there were very few small machines available on the market. Again an opportunity was recognised and in 1976 the first container of milling drilling machines arrived from Taiwan.

Demand from model engineers strengthened to the point that the company decided to cease trade in used machines and concentrate their efforts in building the Warco brand. Regular trips were made to Taiwan to check quality, which in the early days was necessary. These inspection visits also served as an opportunity to find new products to add to the expanding range.

Gradually the Taiwanese economy expanded to a point where their production costs increased to an uncompetitive level. Warco took the decision to source their range from China. The experience gained in Taiwan served as an excellent foundation in dealing with the Chinese factories. Again independent inspection is necessary, this time however there are too many machines in production for one person to inspect. Warco work with a team of three inspectors who remain in the factory throughout the build process, supervising assembly. Inspecting a finished product is not always sufficient.

The strong engineering background of the company has always been a bonus in their selection of products, there is no substitute for hands on experience. It is undoubtedly this knowledge which has helped the company to grow into the leading supplier of machine tools to model engineers."

To celebrate this one hundredth issue, Roger has put up a voucher to the value of £150.00 which can be used for the purchase of items from the Warco product range.



Warco's tooling range includes the ER series collets and chuck.

PRIZE DRAW ENTRY

If you would like to enter the draw for this, which will be on 10th September 2004, then please answer the following questions.

1. In what year did Warco's first container of machines arrive from Taiwan?
2. How many people are in the inspection team in China?

Send your answers on a postcard with your own name and address to "Warco Competition, Model Engineers' Workshop, Berwick House, 8-10 Knoll Rise, Orpington, Kent, BR6 0PS."

**PRIZE DRAW
£150
PRODUCTS
VOUCHER**

Hemingway Kits

Kirk Burwell writes:

"Trading since 1976, the Hemingway business was originated by Neil Hemingway, who built up a well respected range of kits. The business passed to John Corlyon who continued the tradition for some years until I and my wife, Sandra, bought it over last year. Our aim is to build on the excellent basis established earlier and continue to grow the range of over 60 unique tooling projects. Developments are in hand along a number of avenues.

Gear Cutting for Clockmakers

The Trent Pinion Mill, which debuted at Harrogate, will be available in kit form from late July, priced without motor at £154.60. The Trent products are based on the original designs of the late Elliot Isaacs, a friend and colleague of clockmaker, Alan Timmins. Mr. Isaacs' robust designs have been reviewed and developed by Alan to include dedicated castings and dovetailed work slides to both ease manufacture and improve accuracy. The Trent range will be joined shortly by a wheel engine, depthing tool and a continuous form relieving accessory for making 12 tooth cycloidal gear cutters.

The Quick Step Mill

Praised by all who have ever used one and envied by all who have ever seen one, Hemingway is proud to announce an agreement with John Payne to assume responsibility for both distribution and manufacture of the Quick Step Mill. We are looking forward to promoting this unique tool to a new generation of small workshop owners.

Rear Tool Post for the Larger Lathe

Suitable for lathes up to 5 1/2 in. centre height, Hemingway's new kit includes the casting and all material to complete a substantial Rear Tool Post for your Boxford, South Bend, Atlas, Chester, Harrison, Myford 254, Colchester, Warco, Grizzly.... plus many more. Based on George Thomas' Super 7 design, this tool attaches to a single T slot in the rear of your cross slide and is available now for £40.23.

2 Jaw Chuck

A 2 Jaw chuck.... are you mad? No; these are still very popular in the world of brass fittings, enabling awkward shapes to be held and the set-up repeated whenever required. Developed by Mark Figes, whose original version was featured in MEW issue No 32, Hemingway's 5in. kit version is on offer for £29.35.

Hemingway's Workshop Accessory Catalogue can be downloaded from www.hemingwaykits.com or by sending £2 to Hemingway Kits at 126 Dunval Road, Bridgnorth, Shropshire, WV16 4LZ.

We are delighted to continue the association with Model Engineers' Workshop, and are pleased to underscore this 100th issue by offering readers a voucher for £150.00 for Hemingway products."



Hemingway drawings are prepared by CAD and include 3D rendered views.

PRIZE DRAW ENTRY

The draw for this voucher will take place on 10th September 2004. To enter, please answer the following questions.

1. Who has undertaken development work on the Trent Pinion Mill
2. Who described the two jaw chuck in MEW issue 32.

Send your answers on a postcard with your own name and address to "Hemingway Kits Competition, Model Engineers' Workshop, Berwick House, 8-10 Knoll Rise, Orpington, Kent, BR6 0PS.

Newton Tesla (Electric Drives) Limited

George Newton tells us:

"Established in 1987, Newton Tesla (Electric Drives) Ltd are well known to industry for their supply of variable speed drive systems for electric motors of up to 900KW (1,200HP) for such diverse applications as stone crushers in quarries, water and waste treatment, newspaper printing and food manufacturing.

George Newton, the managing director of the company and a model engineer, was fed up with the unreliable and noisy single-phase motor on his home lathe, not to mention the irksome belt changing to find the speed that best matched the job in hand. He installed an inverter and quickly realised what a transformation it made to the machine. As time passed, inverters became smaller more advanced and less expensive such that he decided to design a purpose built system that could be bolted straight on to any Myford ML7 or Super7 lathe in a matter of minutes. A new three-phase motor is included in the price of the set-up. The response from the model engineering fraternity was staggering!

Over 1,000 units have been made so far and users are always amazed at how smooth their machine becomes; for most cutting operations it is possible to leave the lathe in it's highest belt speed as the motor can be varied over a 10:1 ratio with no loss of motor torque

A Newton Tesla CL750 package set up for bench test.



The electrical efficiency of an inverter is about 98% and utilizes "sensor-less flux vector" technology that can develop up to 300% motor torque at 3HZ. Motor cooling at low speeds is not a problem and due to the complete protection afforded by the inverter, it is virtually impossible to damage the motor. The inverters are set to give 60HZ maximum frequency, giving a useful 20% speed increase in lathe speed.

George and his team are planning to expand the range of drives available to the home machinist in the future to include Colchester, Harrison and all Bridgeport milling machines. The team congratulate the MEW team on the first 100, and are celebrating the milestone by offering a voucher to the value of £150.00 against the purchase of a Newton Tesla drive."

PRIZE DRAW ENTRY

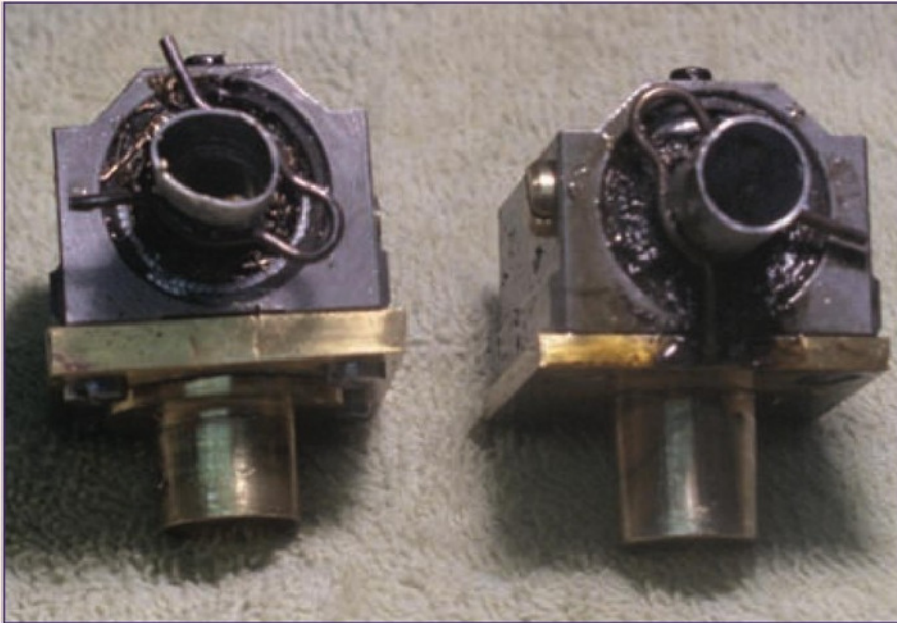
If you wish to enter the draw for this prize, (which will take place on 10th September 2004), answer the following questions.

1. What is the efficiency of a typical variable frequency inverter?
2. What is the maximum percentage motor torque that can be developed with a system from Newton Tesla?

Send your answers on a postcard with your own name and address to "Newton Tesla Competition, Model Engineers' Workshop, Berwick House, 8-10 Knoll Rise, Orpington, Kent, BR6 0PS.

**PRIZE DRAW
£150
NEWTON TESLA
DRIVE
VOUCHER**

CLEANING BALL SCREW ASSEMBLIES



1. The brushes caked with "grot"

Readers may recall that about two years ago I described the fitting of ball screws to my Wabeco mill. I replaced the original Acme screws because after a couple of years of heavy usage (several hours every day) the X and Y screws were showing a small amount of wear over the central portion. The screws were still essentially perfectly OK and would have given years more service. Being somewhat of a perfectionist and also fascinated by the concept of ball screws I decided to make the change. Two years on what has been my experience of ball screws and was the exercise worth all the effort? In general, the answer is a qualified yes.

The problem

Ball screws, in spite of what readers may have read, do have a problem. Acme

screws are not seriously affected by the dust and swarf present in all workshops. Conversely, ball nuts are very sensitive to the ingress of fine particles of swarf. The Wabeco mill is fitted with excellent bellows to stop swarf reaching the screws. However, much of my work involves machining engraving brass and hence the swarf produced varies between small chips and fine dust and in spite of strenuous efforts to keep everything clean, the fine brass dust seems to penetrate every space in the machine and sticks to the oil covering the screws. Ball nuts are fitted with wiper brushes to prevent dirt entering the nut but after a time brass dust and oil accumulates on these brushes and soon thereafter enters the nut and impedes the free rolling of the balls. **Photo 1** shows the brushes on the nuts from my mill caked with grot! In contrast to what one might expect, the result was that the backlash

Dick Stephen describes the maintenance procedure for these precision items.

increased to intolerable levels. The only solution was to remove each nut, strip it down, wash out all the muck in a paraffin bath, reassemble and refit it in the mill.

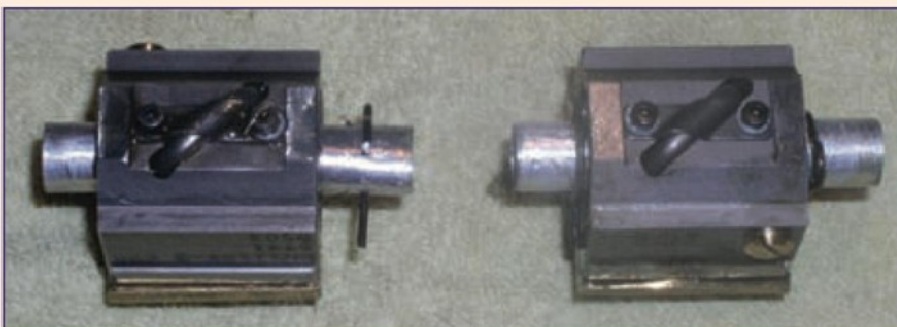
Dismantling procedure

This sounds all very simple, however a few words of warning are appropriate. If you don't know what you are doing and you remove the screw out of a ball nut you will end up with a large number of small ball bearings spread all over the workshop floor which you will have great difficulty finding! **Photo 2** shows a top view of my ball nuts each with a keeper to retain the balls in place. These keepers are tubes with an outside diameter slightly less than the core diameter of the screw. **Photo 3** shows one of the nuts on a length of screw, the keeper tube and a spigot fitted into the end of the screw. When I fitted my ball screws, a short length of screw was left. Fortunately, I kept the off cut as it has been invaluable for re-assembling the nuts. To remove the nut the keeper tube is fitted over the spigot and pressed firmly against the end of the screw. The screw is then withdrawn from the nut leaving the keeper in its place. The spring clips on the keeper prevent it falling out. To replace the nut this procedure is carried out in reverse.

The next job was to dismantle the nut. All the work of cleaning the nuts is best carried out on an old towel spread over the bench. The reason for this is to prevent any dropped balls vanishing. The towel effectively holds any dropped balls. Begin by removing the two screws that hold the ball return tube in place. Do this in a plastic tub in which the nut will be washed. Remove the keeper tube and cover the nut with clean paraffin. Wash the balls and the housing particularly the brushes. **Photo 4** shows the amount of swarf that had accumulated in one of the nuts. It was not surprising that with this amount in the nut it didn't work all that well! Dry off all the excess paraffin.

Reassembly

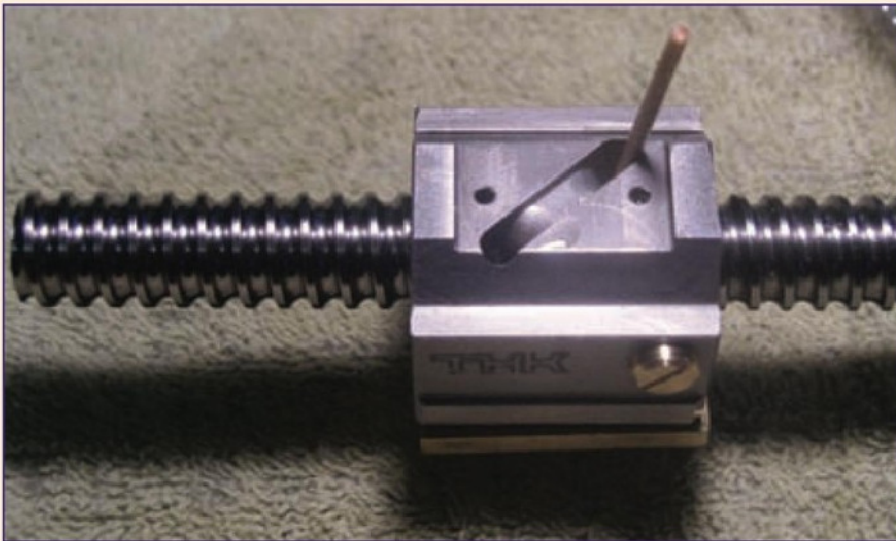
The next task is to replace the balls. Insert the screw into the nut housing. Using a wooden toothpick as a probe, line up the



2. Ball nuts with keepers and clips in place.



3. Ballscrew assembly and keeper.



5. Using a wooden toothpick to line up.



6. Ready for refitting, the oil pipes are clearly visible.

recycling holes with the screw thread (see **Photo 5**). Place one ball in the right hand hole and using the end of the toothpick push the ball firmly down. You should feel the ball engage with the screw thread. Continue pressing the balls in place with the toothpick until about ten balls have been inserted. The balls can now be inserted one at a time and picked up by advancing the screw a bit each time. Periodically compact the balls using the toothpick. When a ball becomes visible in the left hand recycling hole, stop adding further balls. The remaining balls are

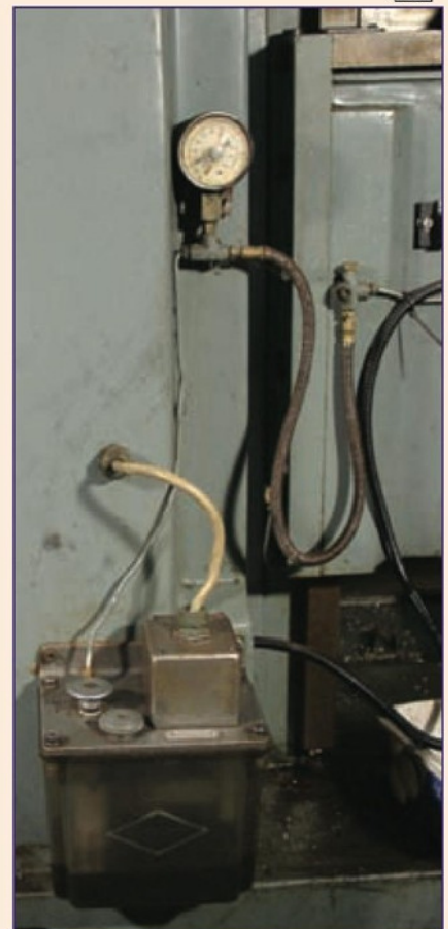
placed in the return tube. Block one end of the return tube with a small amount of grease. Add the remaining ball to the tube and the block the remaining hole with a bit more grease. The grease will stop the balls falling out of the tube. Replace the return tube in the housing and keeping it in place with one finger turn the screw to check it runs smoothly. Secure the return tube with the two screws. Ball nuts are fitted with an oil port for continuous lubrication. The advantage of continuous lubrication is that it washes out any swarf before it can cause a problem. This is not practical in most



4. Brass swarf clearly visible.

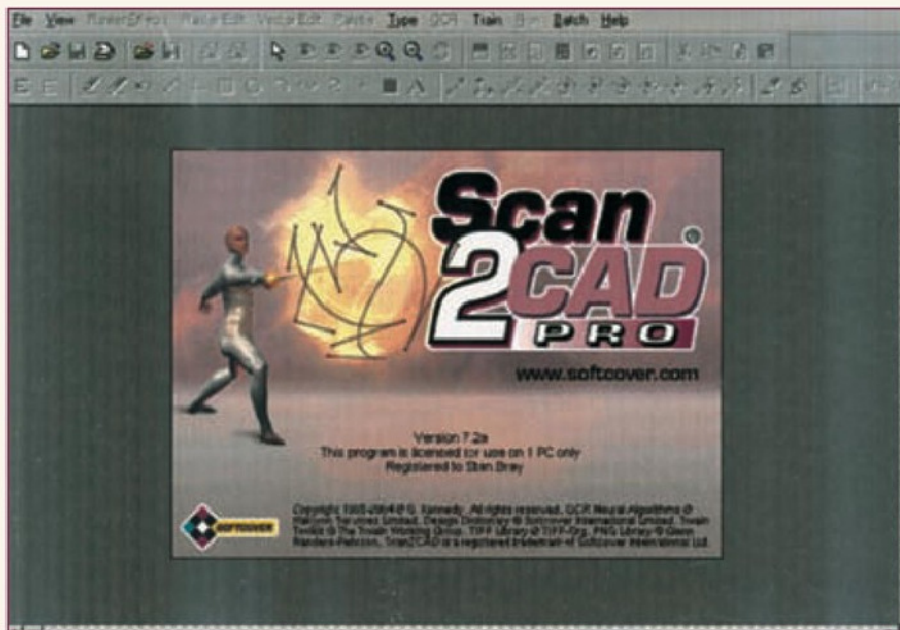
hobby mills. To improve the lubrication of my nuts I have fitted oil pipes to the nuts (see **Photo 6**). This allows me to squirt oil into the nut at frequent intervals hopefully removing some of the swarf that may have entered. At the larger industrial scale, lubrication is often via a centralised lubricator, which may be either manual or fully automatic in operation, similar to that shown in **photo 7**. With the screws re-fitted to the mill, the backlash had returned to 0.015 mm, a very acceptable value.

If your machine has factory fitted ball screws it is worth contacting the supplier of the machine and requesting precise information on how the ball nuts can be removed for cleaning. In my opinion it is quite impossible to prevent ball nuts from eventually becoming contaminated with swarf. All equipment requires regular maintenance if it is to perform well. Ball nuts are no exception to this rule.



7. This automatic lubricator delivers oil to ballscrews and table slides every 30 minutes.

SCAN 2 CAD V7.2



1. Scan 2 CAD opening screen

Purpose

Some time back we reviewed Scan2CAD V6 for the benefit of interested readers, if anyone missed it then it should be explained that Scan2CAD is a computer programme that enables raster drawings to be converted to vectors. Why should we want to do this and what does this mean? Well, explained in simple terms, if we want to scan a drawing into a computer this cannot be done in vector form, the image will be a raster and although a drawing programme such as Corel Draw, or one of the many others available will recognise the format, CAD programmes cannot, they use a vector image. Therefore while it is quite possible to alter a drawing in the basic drawing programme this is not usually suitable for engineering purposes as such programmes are not suitable for producing engineering drawings.

Rasters and vectors

It will help if the difference between the two types is explained, a raster image is made up of many minute squares, called pixels, the vector image consists of a series of lines, (Fig 1) and therefore is a format that will be more familiar to most readers. The Scan2CAD programmes therefore convert it from raster to vector and vector to raster if that should be required. While it might be thought that the latter idea has no place in engineering, that is not strictly true, one may wish to make a drawing and put it in a neat folder, or give it a fancy heading. In that case the original can be done in normal engineering format and converted to a more decorative form by changing it to raster and embellishing it in that form. The original article referred to above, demonstrated how the programme was used to change a very old and badly worn blue print into a well detailed engineering drawing, in a matter of an hour or so, where as redrawing or tracing would have taken very much longer. The new version, Scan2CAD 7 makes such an exercise both quicker and easier, with a number of updated tools to assist in this.

Instructions and procedures

The instruction book that comes with the programme is very comprehensive and unlike many, lays out very clearly how to use the programme and the new handbook now contains 304 pages as against 232 in the last version. A nice touch is the fact that if for some reason a scanned drawing cannot be improved, the book has a no nonsense approach and states quite clearly that such and such cannot be improved. This can save a lot of time trying to do the impossible, thus saving a great deal of time and frustration. This considerable increase in size reflects the many improvements that have been made in the update. It is impossible in a magazine article to explain in full what can be done, using Scan2CAD 7 as it would literally mean printing most of those 304 pages, however let us start by having a look at the basics.

All scanned drawings will be in raster format, this means that everything is drawn in a series of pixels and pixels are tiny squares, the definition of the drawing can be improved by increasing the number of pixels and it is possible to

Stan Bray examines the latest version of this software.

obtain a reasonable reproduction in this format. There are a considerable number of tools available in Scan2CAD 7 to allow the scanned image (Fig 2) to be edited and if these alone were used the programme would be as good if not better than a drawing programme costing considerably more. For example all raster drawings contain small holes in the lines, which give them an uneven look, there is a tool to remove these and if the lines look ragged it is possible to increase the number of pixels and cure that also. These two tools are particularly useful when a scanned drawing has lines that faded away, they can usually be brought back to their original form.

It is best if some limited editing is done in raster form prior to conversion to vector form, once again having converted to vector there are tools to enable further editing to be carried out and finally there is the choice to either print the finished drawing or save it as a DXF file. DXF is the drawing exchange file format and most CAD programmes recognise it. Readers who have tried converting CAD files from one format to another will know that it does not always work out quite as intended as different programmes use different systems to create lines, particularly when it comes to curves. They are invariably broken into sections and if greatly magnified it can be seen that in fact they are a series of straight lines put together to represent a curve. All Bezier curves are now exported as splines rather than polylines as they were originally, giving them a far better appearance.

The converted file when in vector format will have a series of grab points, (see Fig 3) some at the ends of lines and some possibly placed intermediately, movement of the points will allow the lines to be adjusted so that they can be shortened or lengthened and made into curves as one wishes, giving an added dimension to any editing that may be necessary. The distance between grab points can be adjusted as one wishes and

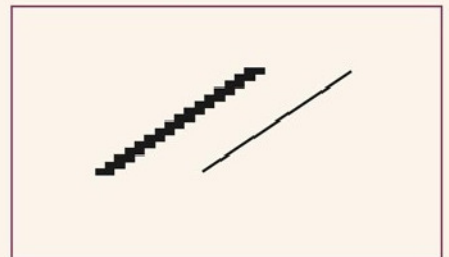


Fig 1 On the left is a typical raster line consisting of a series of squares known as pixels. This is the type of line obtained by scanning. On the right is a vector line produced by using CAD.

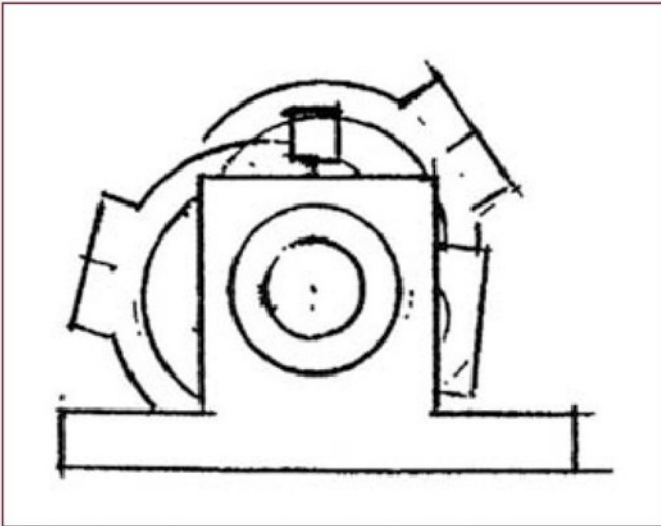


Fig 2 This drawing shows a raster type image as produced by a direct scan. The image is part of a larger drawing and although in the publication from which it was scanned, it appeared to be perfectly good, in fact as can be seen, it is really very rough.

this allows even greater flexibility. Many hand made drawings consist of a series of short lines; this applies particularly if the person doing the drawing is at all uncertain of himself or herself. Removal of a grab point results in sections joining up, thus making final editing far quicker than the more normal system of drawing a single line and then removing all the unwanted sections. It is also possible to set the points as control points, which allows one to alter the shape of the lines with which they are associated. (Fig 4) The Pro version of the programme works with colour as well as black and white, giving it yet another dimension.

Another plus is the ability of the conversion to close up lines, such as at intersections and corners, where all too often the person working with pen and paper either slightly overruns the join or leave a gap. Likewise, frequently crossed

lines will not meet accurately, but be somewhat staggered, the programme ensures them meeting correctly.

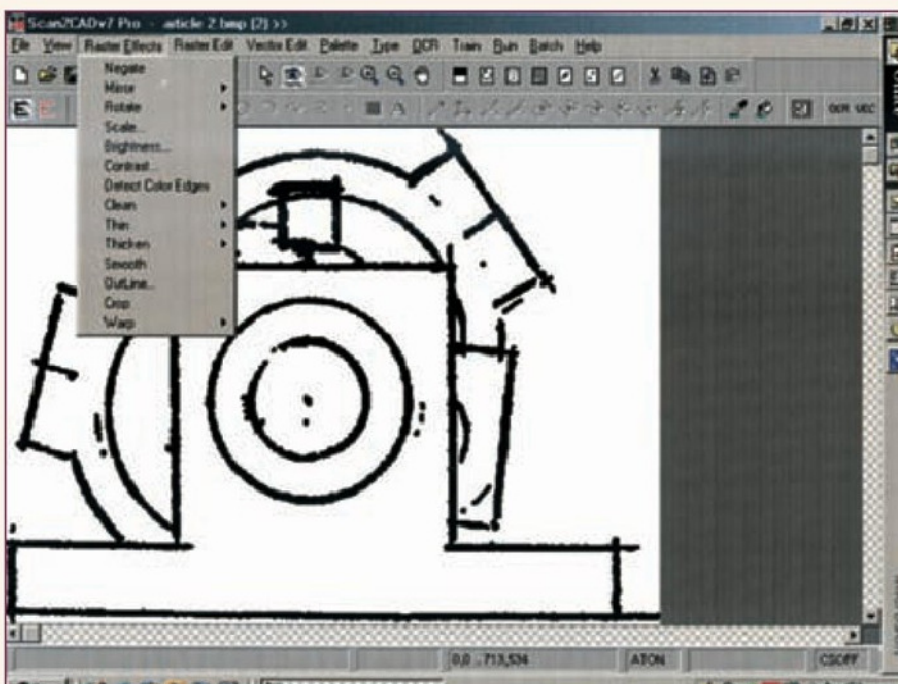
OCR facility

Both the earlier and this version of Scan2CAD include an Optical Character Recognition (OCR) facility and while it was very good in the original version it now is even better and is good enough to stand alone just for the purpose of copying documents. All OCR programmes are to some extent limited by the number of fonts they can recognise, in Scan2CAD a facility allows the user to actually train the programme to recognise an unusual font, this may not seem to be all that necessary but in fact it is very useful. Most engineering drawings made before the advent of CAD had hand written lettering. The draughtsman may well

have used a stencil but even so the end result was hardly a regular font as one sees on a typewriter or computer. Within reason, by using this facility not only can the text be read it can also be reproduced so that any additions to the drawing will match the originals.

Conclusion

Scan2CAD7 is a programme where it is very easy to learn the basics and having done that, moving to more advanced work is also comparatively easy and it is highly recommended for anyone who wishes to convert scanned drawings to CAD format, for example if one wishes to use a works drawing to build a locomotive, it can easily be converted and scaled far more quickly than by other methods such as tracing, or heaven forbid, actually copying the original. There is of course also less chance of errors creeping in. It is available from Softcover International Ltd, 364 Milton Road, Cambridge, CB4 1LW and a trial version can be downloaded from the web site at www.softcover.com.



2. Screen shot of Fig 2 with a pull down edit menu.

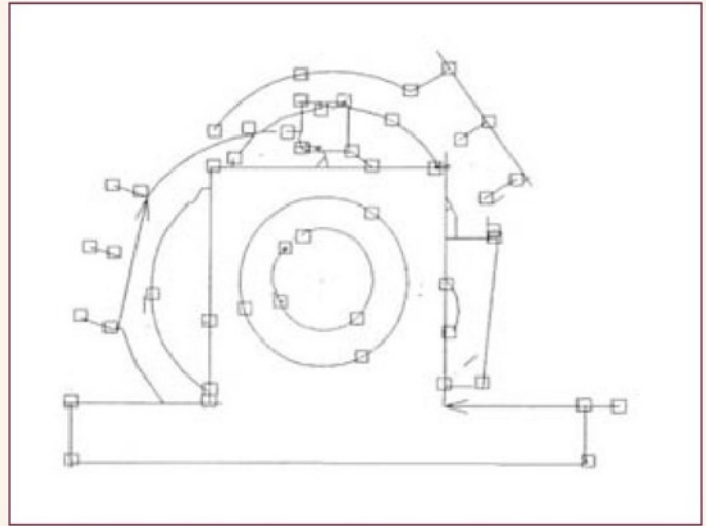


Fig 3 The original vectorised image. The grab points can be clearly seen and although the drawing is still far from good, a little work using the grab points either as markers or handles will soon sort matters out.

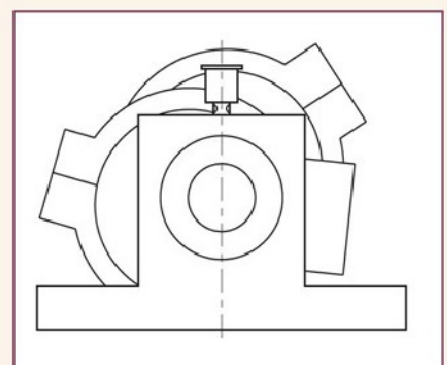


Fig 4 The finished image in vector form. Scan 2 CAD 7 saves the item as a DXF file. From there it can be saved in the correct format for the CAD programme in use.

NEW LATHES FOR OLD

From its first appearance in the late 1940s, the Myford Series 7 lathe has been popular with the owners of home workshops. The Company now operates a factory re-conditioning service and also offers re-worked machines for sale. Geoff Sheppard was given the freedom to tour the works with notebook and camera to see what was involved in restoring a particularly roughly used example to a state where it would meet new production acceptance standards. At the end of the article is an opportunity for one lucky Myford owner to win a bed/ saddle regrind.



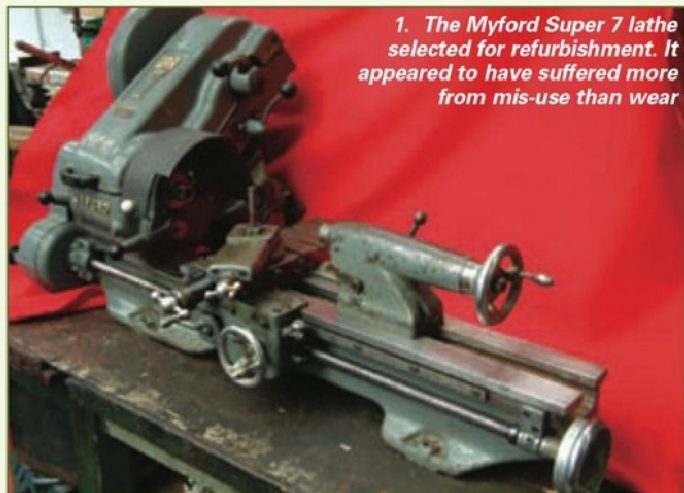
installed in private workshops are often cosseted as prized possessions, many having seen very little use. Indeed, one owner has volunteered the information that he has a very early model that has never been used. Conversely, others have had a very hard life, particularly when they have had to earn their keep in industry. A particularly harsh environment, where the machines often suffered more misuse than use, was the school workshop, where machines sometimes suffered damage as a result of practical 'jokes'. I have had recent personal experience of two lathes recovered from these latter environments, the condition of which made me wince when I envisaged the mis-treatment they must have received.

Myford Limited have always operated an excellent spares support service, with, in my experience, replacement components arriving within a few days of placing an order. They have also offered a bed re-grinding service, restoring worn slideways and the mating saddle surfaces to standards, which match those of the new machine. Over recent years this has been extended to the point where it is possible to have a well-used machine reworked so that it meets the acceptance standards required of a new production unit. The logical development has been to offer factory-reconditioned machines, supported by a warranty similar to that provided with a new lathe. Myford are now prepared to buy back lathes, restore them and then list them at prices which reflect the standard and age of the model and the level of equipment with which it is offered.

When the Myford ML7 lathe appeared, not long after the end of World War II, it set new standards for equipment for the model engineer's workshop. It also found a ready application in industry, particularly for instrument work and similar light engineering tasks. Over subsequent years, many thousands of them have been produced and there has

been a steady product development programme, with many refinements added, as well as the major upgrades introduced in the Super 7 and now the Connoisseur.

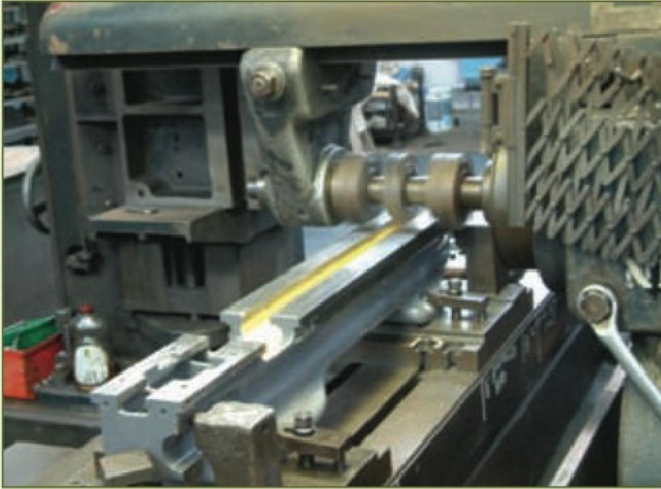
Indications are that, of all the Series 7 lathes produced, a very high proportion still exists, relatively few of them having been totally scrapped. The condition of these survivors varies immensely. Those



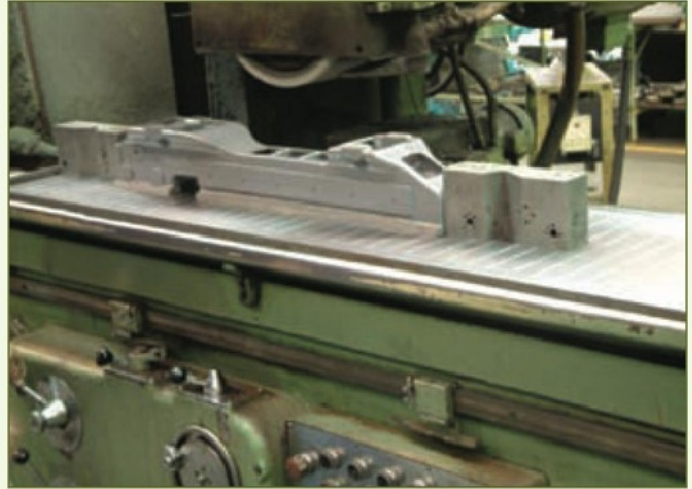
1. The Myford Super 7 lathe selected for refurbishment. It appeared to have suffered more from mis-use than wear



2. A selection of the components laid out for examination prior to rework



3. Milling the first bed shear side using a cutter with an inserted ceramic tip. (Note that the machine guard has been retracted temporarily to allow a clearer view)



4. Grinding the bed mounting feet faces



5. Inverting the bed on the same machine allowed the top surface to be ground.

As a Super 7 user for the best part of thirty years now, I was recently invited to visit the Myford factory in Nottingham to see this reconditioning activity in progress. Managing Director, Christopher Moore suggested that I should follow one particular machine through the workshops, observing

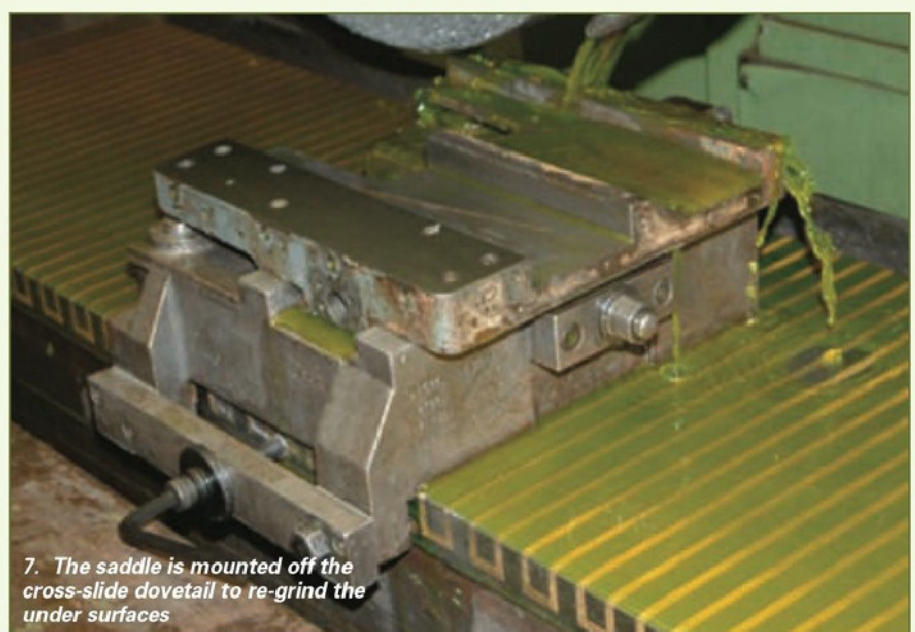
each operation, making notes and photographing as I wished. Having nominated and examined a particularly poor example (**Photo. 1**), I arranged to travel to Nottingham and call in at the works on a Monday afternoon, then to spend all of Tuesday and most of Wednesday following

the component parts through the re-working process and, hopefully see the machine re-assembled to working condition. As it happened, this did not prove quite to be possible due to the motor of a large sideway grinding machine deciding to expire at the crucial moment. Some time was lost while a second machine, currently set up for other work, was re-configured to carry out the task. I therefore had to leave for another appointment while the chosen lathe was in the final stages of re-assembly, but I had witnessed all the vital re-machining and hand fitting operations and the inspection checks, which determine the accuracy of the finished product.

On arrival at the factory on Wilmot Lane I was greeted by Christopher Moore and his Purchasing and Production Manager, David Wheat, who then introduced me to Brian McKechnie, the Works Inspector, who was to be my guide through the various stages of the operation. A long-standing and experienced member of the team, Brian was previously a fitter and would, on this occasion, carry out the majority of the hand fitting and assembly tasks involved in the refurbishment. Machines would normally go through the works in batches of eight, ten or twelve, but to meet the required timescale, this machine would be treated as a single unit.



6. Grinding the underside of the bed shear



7. The saddle is mounted off the cross-slide dovetail to re-grind the under surfaces



8. Brian McKechnie scrapes the underside of the saddle to produce a good bearing surface

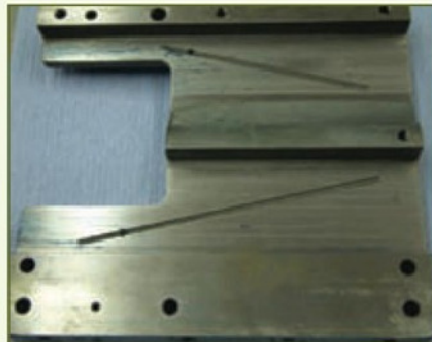
History

One of the first tasks was to check the history of the machine in question. Extensive records are kept in the Inspection Foreman's office, and it was possible to ascertain that it had been supplied new through an agent in Gloucester in March 1966, on a cabinet, complete with motor. The customer was the local Education Authority, the final destination being a comprehensive school. At some stage a quick-change gearbox had been fitted, but this had subsequently been removed.

Initial examination

Examination and initial dismantling of the machine revealed where reworking would be possible and where replacement parts would obviously be required (Photo. 2). Subsequent checks at the re-assembly stage could also result in the need for new components. The initial list of replacements was:-

- Bull wheel
- Back-gear cluster
- Rear spindle bearings
- Sleeve gear
- Feed nuts
- Feed screws
- Top slide base and gib strip
- Top slide tool clamp (stud)



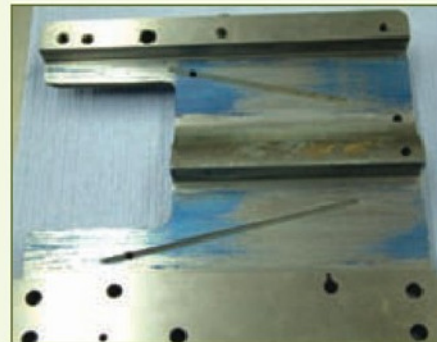
9. A worn and un-ground saddle has minimal contact with a newly ground bed

- Tailstock cam and eye bolt
- Drive belts
- Felt wiper for saddle
- Lubricating wick for spindle bearing

Re-machining

Prior to my arrival, a number of items had been sent for cleaning and re-painting, a process which is carried out on an 'on-condition' basis. These included the bed, tailstock body and belt guards. Painter Alec. Jaworski had matched the colour to the original grey, colours having been changed to green and blue for various models over the years. As soon as the paint on the bed was dry, machinist Chris. Musson set the bed up on a fixture on a large horizontal milling machine in order to re-face the sides of the shears. On a new bed, all four faces are gang-milled at one setting, using ceramic inserts in the cutters. When reconditioning, however, each face is treated individually, removing up to a maximum of 0.005in. from each. In this case, around 0.002 to 0.004in was sufficient to clean up, the ceramic cutters creating an excellent surface (Photo. 3).

In order for me to be able to see as many of the processes as possible in the time available, a number of the required operations were being carried out concurrently in different parts of the factory. I was given complete freedom to travel between the various locations, making notes and taking photographs as I wished. I was made most welcome wherever I went and detailed information was freely available. It made for a most pleasurable experience, and reminded me of my days in industry when I always



10. The re-ground saddle has been scraped to give a good bearing surface, the oilways allowing lubricating oil to reach the areas of contact. It is essential to keep these oilways clear

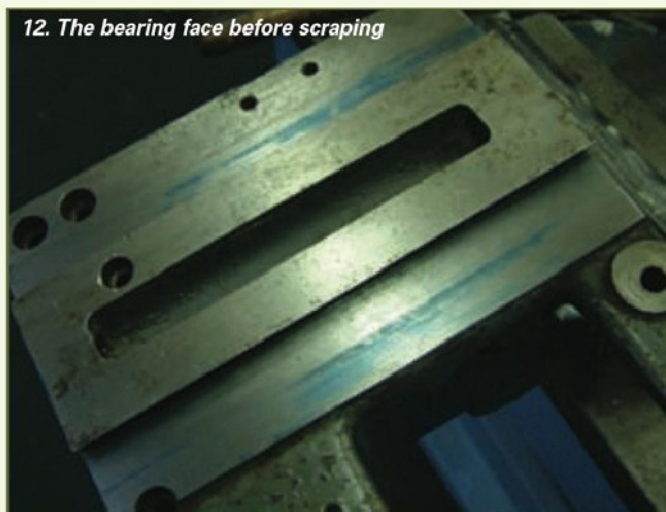
enjoyed the opportunity to visit the machine and fitting shops to discuss problems first-hand with skilled operators.

The next areas of the bed to be tackled were the top and bottom surfaces. The cleaned top face of the casting was mounted face-down on the table of a large Snow surface grinder in order to take about 0.003in. off the mounting feet (Photo. 4). After dressing the wheel, Chris. set the bed the right way up for grinding the top surface (Photo. 5). This is where one of the 'tricks of the trade' came in. Experience has shown that accuracy of the assembled machine can be improved by pulling down the centre of the casting just a few tenths of a thou. before grinding, various means being used depending upon the modification standard of the component. This is just one of the areas where the expertise of the original manufacturer results in a high quality refurbishment.

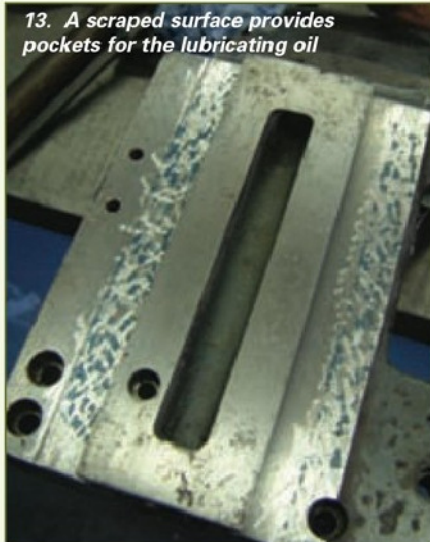
To complete the bed rework it was now passed to Garry Alton who would grind the under faces of the shears, using a slideway grinder equipped with a vertical spindle. At this point gremlins appeared, it being evident that the machine was not operating correctly. Returning from witnessing another operation, we found that the problem had been pinpointed to a main drive motor, the only solution being a complete re-wind. Garry therefore had to set up another machine (a Thompson/Matrix grinder) and prepare a grinding wheel to suit. The result can be seen in Photo. 6.



11. The dovetail on which the cross-slide runs is checked against a master gauge and scraped to fit as necessary



12. The bearing face before scraping

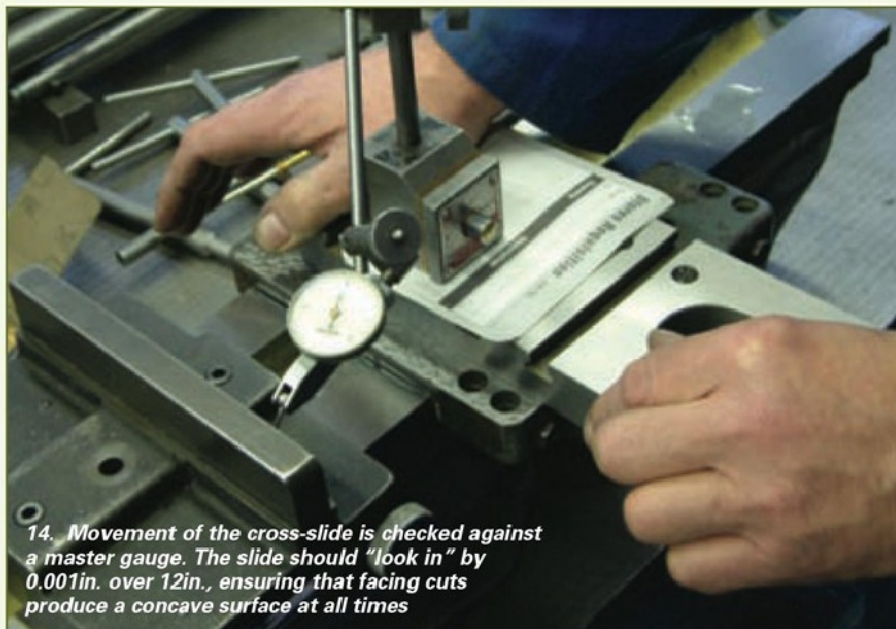


13. A scraped surface provides pockets for the lubricating oil

The saddle

The next component to be reworked was the saddle. The fixture mounted on a Magerle surface grinder locates the cross-slide dovetail (Photo. 7), allowing the faces which bear on the top and side surfaces of the bed shears to be restored, ready for scraping at the fitting stage (Photo. 8). This is, perhaps, an appropriate point to emphasize that Myford consider it essential that, if a bed re-grind is carried out, then the saddle must also be ground and scraped to fit. Although the problems with the slideway grinder had caused the saddle to be ground before finishing the bed, it was possible to illustrate this need by trying another worn saddle on the newly ground bed. The minimal contact can be clearly seen (Photo. 9) and it is not practical to improve this to the required level simply by scraping. The large area of contact achieved after grinding and scraping can be seen in Photo. 10.

To complete these grinding operations, the various gib strips were re-worked to remove the effects of wear and the front and rear saddle strips stepped to



14. Movement of the cross-slide is checked against a master gauge. The slide should "look in" by 0.001in. over 12in., ensuring that facing cuts produce a concave surface at all times

compensate for the reduction in thickness of the bed shears.

After grinding the top faces of the cross-slide and top slide, these items were fitted to their mating components by scraping (Photos. 11, 12 and 13). This now made it possible to fit the saddle to the bed. With a jig clamped to the bed and the saddle secured so that the 'fast' edge was located against its mating bed shear, the movement of the cross-slide could now be checked. (Photo. 14). The requirement is that the movement towards the headstock should be 0.001in. in 12in., ensuring that facing cuts will produce a slightly concave surface. This requirement was met by scraping the fast edge of the saddle to suit.

The final operation in fitting the saddle to the bed was to adjust the thickness of the shims between the saddle and its retaining strips. Each shim lamination measures 0.002in. and the aim is to achieve no more than a 1½thou. running clearance with a shim thickness of 0.008in.,

hence the need to grind the step in the saddle strips. Often all that is needed is to rub a shim on a file to achieve the required fit. A further consequence of the reduction in bed shear thickness is that the size of the saddle clamp may need to be adjusted.

With the saddle oilers and a new wiper fitted, the gib screws were adjusted to give a silky-smooth movement of the saddle on the bed. A new cross-slide nut and leadscrew completed the assembly, allowing the cross-slide to be fitted in a similar manner. Before fitting the apron, the rack was attached and tapped upward as far as possible. The rack is a hardened item and the pinion is left soft, but it had been judged that there was insufficient wear on the pinion to require a new one to be fitted. However, re-examination of the leadscrew nuts suggested that renewal was worthwhile. With the apron bolted in place, the rack was tapped back down to adjust the backlash on the pinion. With the leadscrew re-installed, this assembly was complete.



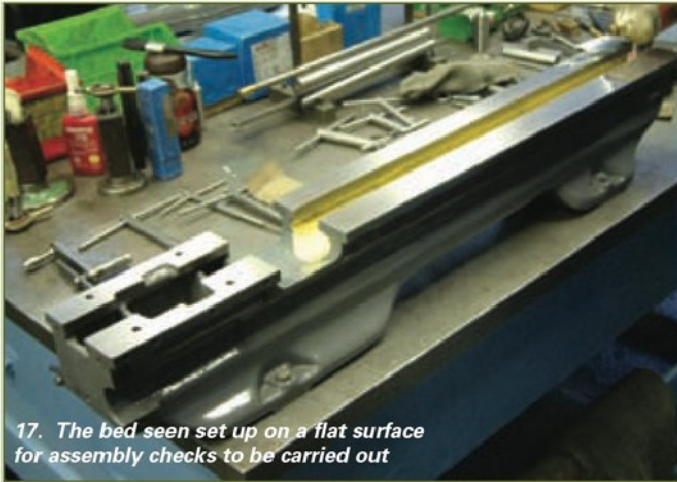
15. Brian McKechnie re-fits the front bronze taper bearing by scraping

Headstock

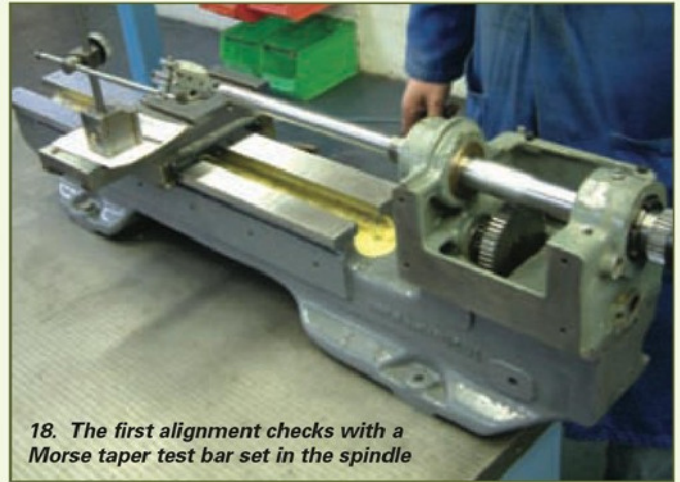
While other components were being re-machined, Brian McKechnie had made a start on the headstock. With a dummy rear bearing in place, the front bearing taper was scraped to the required fit (Photo. 15). Examination of the spindle indicated that both the nose thread and the Morse taper socket were in an acceptable condition. It is possible to correct minor imperfections



16. The old with the new. The back gear cluster had suffered badly, with no teeth left on the small pinion. The bull wheel was also short of its full complement, as can be seen in Photo. 2



17. The bed seen set up on a flat surface for assembly checks to be carried out



18. The first alignment checks with a Morse taper test bar set in the spindle



19. A master dummy faceplate confirms cross-slide alignment



20. With a 3-jaw self-centring chuck fitted to the spindle nose, a long test bar confirms the lathe's ability to turn parallel

in both areas. The thread can be re-chased to bring it back to original tolerances and the taper can be lightly reamed to improve the surface. There was, however, some marking on the shaft in the area of the bull wheel location that gave cause for concern. As soon as the bed assembly was available, the headstock was fitted and checks carried out on the concentricity of the nose spigot and the bore of the taper and the swash on the location face. These proved to be unacceptable, indicating that the spindle was bent – a somewhat rare occurrence, I was assured. This resulted in the decision to fit a new spindle. This damage, coupled with the fact that there

were no teeth left on the smaller gear of the back-gear cluster (Photo. 16) and quite a few missing from the bull wheel, suggested to me that the back-gear had been engaged while the lathe was running – an old schoolboy prank!

Once this problem had been eliminated and with the bed set level (Photo. 17), it was possible to carry out the remainder of the setting checks, using

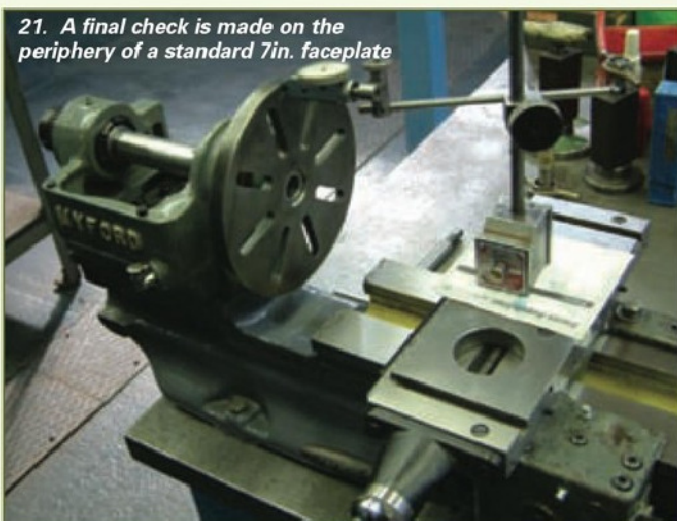
- a. a test bar located in the headstock taper
- b. a dummy faceplate
- c. a test bar gripped in a 3-jaw chuck, and
- d. a standard 7in. faceplate

(Photos. 18 to 21).

In each case the measurements were within, or close to, the errors permitted by the new-build Inspection Report. Where there were minor discrepancies, these were corrected by scraping the bottom face and/or tenon of the headstock casting.

Tailstock

Basic checks had been carried out on the tailstock at an early stage and it appeared to be generally good. Possible corrective action here includes reaming the Morse taper socket, but if wear between the body casting and the barrel is excessive, then there are two over-size versions available,



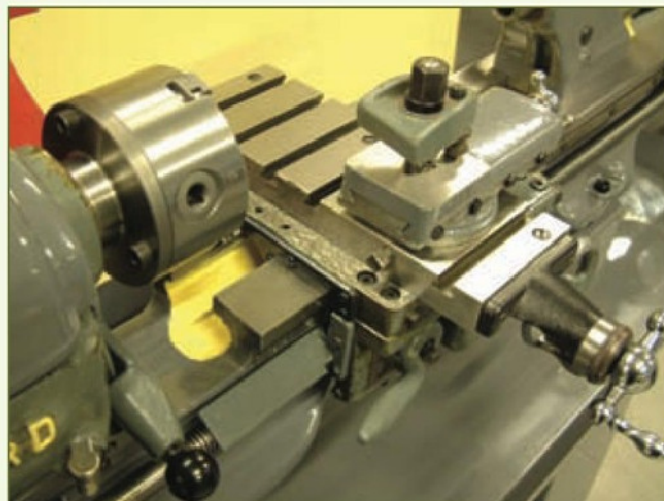
21. A final check is made on the periphery of a standard 7in. faceplate



22. With the re-worked tailstock fitted, a between-centres test bar checks the alignment between headstock and tailstock



23. Operation of the tailstock barrel clamp must cause the barrel to lift no more than 0.001in. at a distance of 3in. from the body. Further checks are carried out with a test bar located in the Morse taper socket



24. The refurbished saddle and slide assembly differs little in appearance from that of a new lathe

the bore being honed to suit. With the tailstock fitted to the bed, similar checks to those carried out on the headstock were undertaken, plus checks on a test bar located between centres (Photo. 22). Again, corrective action involved scraping the bottom face and tenon until satisfactory results were obtained. An additional check involved measuring barrel lift when the barrel lock was operated (Photo. 23). Excessive movement here would have necessitated the fitment of one of the over-size barrels mentioned above, but the lift was well within limits.

Top slide

With the top slide fitted to its new base (the old one having been run into the chuck on many occasions, it seems) one check was to set the movement parallel to the test bar between centres, then to mark a new fiducial line on the top surface of the cross-slide, the old one having been removed when the surface was re-ground. (Photo. 24)

Re-assembly

On completion of the checks, the remaining work consisted of straightforward re-assembly, fitting the motorising assembly and screwcutting

gear train components (Photo. 25). Re-fitted to its newly refurbished cabinet stand and with modern switchgear (Photo. 26), this rather sad example of this famous machine has been rejuvenated and is now ready for a new career in someone's workshop. Backed up by full factory guarantees, it will give many more years of good service.

Conclusion

I greatly enjoyed the opportunity to get to know the Myford works and its small but enthusiastic team. It has always been evident that the Company's products are of the highest quality and I have been able to see first-hand that this factory reconditioning service operates to the same standards. Anyone acquiring a machine that has been processed in this way can be confident that it will give good service and will be backed by the same support arrangements as a new machine. Myford 7 Series lathes are going to be producing first class work for a long time yet. It says much for the original design of the machine that, by the simplest of machining and hand fitting processes, even quite badly worn examples can be restored without the need to replace a large number of major components. Myford machines deserve their excellent reputation.



25. The re-assembled screwcutting gear train assembly



26. Back on its repainted cabinet stand, with new switchgear fitted, our reconditioned lathe awaits a new owner

GREAT OFFER FOR A MYFORD OWNER

As part of the MEW centenary celebrations, on behalf of Myford Ltd. Chris. Moore has very kindly offered a bed and saddle regrind on a Myford Seven series lathe, valued at around £355.00. If you wish to enter the draw for this most generous prize then answer the following questions from the above article:

1. Who matched the colour to the original grey?
2. What kind of inserts are fitted to the cutters used for milling the shears?

Send your answers with your own name and address, on a postcard to: **Myford Competition, Model Engineers' Workshop, HIGHBURY LEISURE Publishing Ltd., Berwick House, 8-10 Knoll Rise, Orpington, Kent, BR6 0PS.**

The winner will be the sender of the first correct card drawn on 10th September. Please note that the winner will have to arrange transport for his machine to and from the Myford factory, that the editor's decision is final, and no correspondence will be entered into.

Scribe A Line

Jim Whetren writes:

I am following with interest Harold Hall's Drilling Project currently running in MEW.

I note his views on safety when drilling. I should imagine most damage to the operator, the drill or the work is due to complacency or impatience. Securing the work properly is most important.

The method I use is as follows:-

I have an old Startrite drill which has a square table with two slots running from front to back, on which is mounted with a 'Nippy' drilling vice, which has two mounting notches which, fortunately, happen to have the same centres as the slots. As an alternative to using two bolts with nuts, I use a piece of $\frac{1}{8}$ in. x $\frac{1}{8}$ in. flat stock which spans the width of the slots. This is tapped for suitable bolts for the slots and the vice is secured to this. There is a $\frac{1}{8}$ BSF thread in the centre of this bar.

Between the bar and the table is a piece of $\frac{1}{8}$ in. x $\frac{1}{8}$ in. bar the same length drilled to clear the bolts, necessary to cover the large hole in the middle of the table. A suitable handle is threaded into the tapped hole and the securing bolts are tightened just enough to allow the vice to slide on the table. In use the vice holding the work is located with the hole position under the drill bit and a quarter turn of the handle firmly secures the vice.

This method is so quick and easy to use that it allows EVERY job in the vice to be firmly clamped before drilling. This method can be used with any vice/table slot configuration, although I can't think how it could be used with a round table!

Alan Timmins writes:

When I recently was in my neighbour John Newman's workshop, I noticed a neat idea for clearly displaying drawings in use anywhere in the workshop. It consists merely of a coat hanger, as found in most women's wardrobes for hanging skirts and trousers. Unlike the ordinary coat hanger, these consist of a couple of spring clips on a horizontal bar with the usual hook. Any women's high street clothes shop has thousands of them!

The best ones are those where the spring clips can be moved along the bar by a friction fitting. Then, you can adjust the clips to suit the width of your drawing. The photo shows an A3 drawing hung up over my lathe. Move the clips in and you can easily hold an A5 or A4 book open to show two pages. As I have recently done, using drawings and descriptions from one of George Thomas' books, I could hang the book over the relevant work area i.e. bench, lathe or mill and view the drawings on the spot and not get the book dirty.

I am going to put a set of strings up so that I can hang the drawings wherever I want them, very handy!



4. Hanging a drawing from a coat hanger

Turning to a different subject, I have a Prazimat lathe which I believe is no longer made. I read with interest Peter Foyle's article on the Myford half nut Quick Release and wondered if I could come up with a way to automatically stop the traverse on my lathe.

This was not as difficult as I expected and the system I came up with stops the feed within 0.5 mm of hitting the adjustable carriage stop fitted to this lathe. I have not read of any users of this well made lathe and therefore do not know whether there are many other users. However I may get around to writing up this device and some of the other modifications I have made to the lathe to make using it easier.

I note in MEW issue 96 where Mr Foyle's article appeared, Douglas Reid wrote on a power feed for the Hobbyvat milling machine made by the same manufacturer as the Prazimat. Also in the same issue, the photograph of David Hazel's Blast Box shows such a mill in the background. As there are Hobbyvat mills out there perhaps I am not alone in owning a Prazimat lathe and would be interested in what other users think of their purchase.

Derek Cooke writes:

Among the first tools I made for my hefty Taiwanese 125 CH x 600 BC centre lathe was a pair of "C" spanners for when the drive belt to the mandrel needed renewal. I didn't want to be caught with my pants

down! When the Nu-T-link belt appeared, I laid in a stock of the "B" belting, and of the "Z". The latter being used for various other machinery.

So when the drive from countershaft to Mandrel frayed recently, and caused the drive to be thrown out, I was not in the least worried, and fitted a Nu-T-Link belt in quick time. It was fine, but the stepped V-sheaves are contained in a cast iron box, and it proved impossible to feed the linked belt on to the biggest mandrel sheave - not enough clearance. I hoped that stretching over time would allow me to hook the belt over the big pulley, but got bored waiting to use 4 of the normally available speeds.

I tried Blackwoods, and they put me on to another mob (Mullins Fasteners) which I reckon are much more closely related than 'kissing cousins', and who carry a range of stock of interest to any amateur mechanic. They provided a "Power Twist Plus" belt of rather more length than was needed (They were 'out' of shorter lengths), and this is now in operation. It is from the same firm as that mentioned in MEW No 96 - Trade Counter. My belting came from the US of America, and was rather pricey, but as an oldie working as a volunteer for TAD (= REMAP in UK), I was given a handsome discount.

It proved, to my relief, to be possible to edge it into the "big" pulley with no effort. However, I viewed with some cynicism the large print on the cardboard sleeve which surrounded the belting, and had the instructions for applying it. Some "Spin Doctor" had written, "The Zero Downtime V-Belt". They had obviously not seen an ancient bloke with arthritic fingers trying to join the wretched thing up in the entrails of a lathe. It may be possible for someone with strong and nimble fingers to invert the belt in situ, connect and return it to normal, but I doubt it. I used a pair of fine nosed pliers, and a pair with blunt nose, and achieved success with an hour or two of downtime. However, the final answer is excellent, and I can recommend the belting.

Will Bells from Northampton writes:

Re a Plastics Identification Chart

The ingenuity of some of the contributors to this magazine never cease to amaze me, and Chris Fouweather's articles were certainly in that category. Who would ever have dreamed that surface mount PCB soldering or Plastic Injection Moulding would have been tackled in a home workshop? Certainly not me - well done Chris. I would just like to add a few words on the subject of plastics identification, which is pertinent to some of the correspondence in previous issues and relate to some of the potential safety aspects of moulding.

A few years ago, the company that I worked for, had a Manumold hand operated plastic injection moulding machine that, in principle, was quite similar

Marinus Kik from Ridderkerk, Holland, writes:



1. Knurling a slim component with the knurling pliers

The recent correspondence on knurling made us wonder if the simple tool described below, may be of interest to other readers.

When one wants to knurl a shaft it is normal to use a knurling tool equipped with one or two knurl rolls. The disadvantage of these methods is that one must have a shaft of a minimum diameter, because otherwise the shaft deflects too easily. Straddle type holders are better, but if fed in with a preset depth, then significant side loads are still present, and it may be that workpiece needs added support from the tailstock.

The Knurling Pliers described

operate with three rolls, and avoid side loads. The device is simple to make, and no detailed drawings are given as it is considered that the photos taken by my colleague Henk Salij, give sufficient information.

Amongst my odds and ends, I had two sets of three knurl rolls with a diameter of 20 mm and a shaft hole of 6 mm, of which one set of three were 8 mm thick and the other 10 mm. From four pieces of steel with a length of 220 mm and a width and thickness of about 17 mm, I have milled in two pieces a groove with a width of 8 mm and a depth of about 15 mm. The other two pieces have a groove with a width of 10 mm and a depth of about 15 mm over the total length.

Two knurl rolls are mounted with 6 mm shafts in the one leg, in line with each other and as close as possible but just clearing so that they run freely. This will then allow knurling on thin shafts. A rectangular block of 67 x 15 x 8 mm is then welded to this leg which I will call the fixed leg. In the block I drilled a series of holes, so that it is possible to adjust the moveable leg higher or lower, to accommodate larger or smaller diameters.

The third knurl roll is mounted in the moveable leg so that its axis lies midway between and opposite the first two. One of the photos shows a match for comparison with the diameter of the thin workpiece. The notes above apply also for the pliers using

10mm dia rolls, and with these I have successfully knurled shafts having a range of diameters from 3 to 70mm.

When one wants to knurl shafts with a diameters down to around 1 mm, then one needs smaller knurl rolls. In this case the whole assembly may be made smaller and lighter.

In operation, you simply pinch the pliers around the workpiece after this has been put into the lathe chuck. Run at a medium speed and it is ready in seconds.

On a different topic, when you have a caliper which is no longer accurate, this is frequently because

the edges towards the ends of the jaws wear, as that is where most measurements are made. When you look at the closed caliper against the light, you can see a small slit of light through the jaws near the ends. Do not throw the instrument away. Its accuracy can be restored as follows: you put the sliding jaw of the caliper (not the thick fixed part of the caliper) on a solid flat foundation e.g. the edge of a vice.

With a centre punch you strike a punch into the neck of the sliding jaw, so that the jaw is distorted a little, reducing the gap. Then close the caliper to zero and again check the jaws against the light. If you see no difference strike again a little harder. Check after each blow and you will see after several applications, may be 4 to 6 times, less and less light between the jaws.

Do not strike too hard or too much, otherwise too much distortion will occur causing inaccuracy.



2. One set of pliers assembled, and the components for a second.



3. Showing the centre punch mark to distort the jaw.

to Chris' design. This was occasionally used for prototype work where other methods were not acceptable, or higher numbers of samples were required. One of the model makers had a job requiring small components to be made in acetal (Delrin is acetal), which can be a little bit difficult to mould under certain conditions. Anyway, whilst getting the first shots off, there was a (very) loud bang which had people running into the prototype shop to find out what had happened. The acetal had become overheated and the barrel exploded, embedding a sizeable chunk of hot metal in a partition wall and sending the technician reeling backwards. Fortunately nobody was hurt, other than an extended ringing in the embarrassed technician's ears. But the point is make sure you know exactly what materials you are moulding before you use them and check with the literature for moulding conditions and risks.

One easy way of identifying plastics is to look for material designation codes, which are used for recycling purposes and are often moulded into the plastic part. For example, PC is polycarbonate, PA is nylon, PP is polypropylene etc. I'm sure these are defined on the Internet should you be interested.

There have also been some very useful material identification charts available from material suppliers over the years, but I

came across this one on the Internet just the other day that, I thought, would be useful for many of us. These are excellent to help determine the commonly available plastics, although there are some exotic blends around that are not quite so easy to identify. These charts give you a flow chart of simple tests to perform, such as 'does it float in water', or 'does it burn with a yellow flame' etc., which by following the logic will give a final generic material.

Try looking at:

www.texloc.com/closet Select the Plastics Identification Chart button and follow the instructions. Be careful not to overdo the sniffing though - there are some nasty substances given off some plastics when set alight, for example I seem to recall that the 'F' in PTFE (Teflon is PTFE) is given off as Fluorine gas above 290 ish degrees centigrade!

Mike Richardson of Kentish Town

In response to Mr. C E Hartland's query in the ME Workshop no 95 regarding scientific instruments protective lacquer, I am submitting the following information which I hope may be of some assistance.

According to my 1945 edition of Chambers Technical Dictionary the 'Dragons Blood' lacquer which has vexed Mr. Hartland is described as:

"A resinous exudation from the fruit of palm trees and the stems of different species of Dracaena. It is a red amorphous substance, melting point 120deg. C. Soluble in organic solvents. By destructive distillation the resin yields toluene and styrene. It is used for colouring varnishes and lacquers; also, in photo-engraving, to protect parts of the plate in the etching process".

As for the bluing of steel I was unable to determine whether the chloroplatinic acid suggested would have the desired chromatic effect on the steel, but as I believe the preparation requires Hydrochloric acid I would not be inclined to experiment!

An alternative method which I am sure is already well known to Mr. Hartland is to blue the steel with the application of heat. An absolutely first rate description of the process (especially in relation to small precision components) can be obtained from Mr. George Daniels splendid book "Watchmaking".

One possible way to blue the steel chemically is with the following witches brew. Brush the (polished) steel with a

solution consisting of two parts crystallised chloride of iron, two parts solid chloride of antimony, and one part of gallic acid in four to five parts of water. Allow the steel to dry in air. This process should be repeated two or three times. Afterwards wash well in water, dry, and rub with boiled linseed oil to deepen the shade.

Once again I am obliged to advise caution. This treatment was gleaned from a superannuated engineering textbook. I have not tried it personally. And I am certain you would need to follow quite severe Health and Safety stipulations on account of the

toxic heavy metal used in this solution. (If indeed such a treatment would be permitted by modern Health and Safety assessors).

I hope these suggestions have been of interest.

John Garnish of Wimborne:

Other readers may be interested in the following tip for very cheap workshop equipment.

Among the gadgets intended to help

with the installation of laminate flooring, B & Q are selling sets of stepped wedges by FloormasterLoc. These wedges are in hard plastic, 30mm wide by 70mm long with a 5° slope divided into 28 steps. One pair of wedges can provide packing thicknesses from 0.3in. to 0.6in. in increments of 0.0086in. with an accuracy of better than 0.001in. They would be ideal for packing up work on machine tables, etc., and a pack of 22 wedges costs £1.49.

Peter King writes:

Re. letter from Mr. Ludwik Allerhand, MEW Issue 98

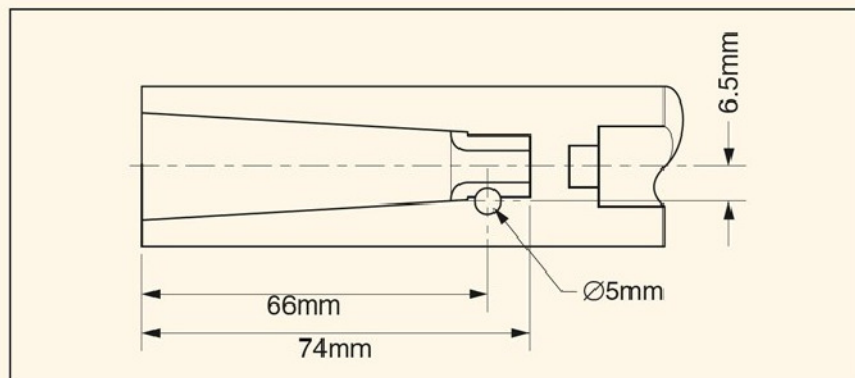
I have a cure for Mr Allerhand's problem that I am just in the process of applying to my Emco V10. This modification is adapted from the arrangement on my Tida toolroom lathe. The modification consists of a small cross-bore offset from the centre-line of the tailstock barrel, into which is secured a hardened pin to prevent a Morse arbor from turning. This modification if properly done, still allows the ejection screw to work in order to remove an arbor. The attached drawing shows the essentials for a V10 barrel, the offset of the pin allows the ejection screw to pass without interference while preventing rotation of a normal 'tanged' Morse arbor. The position of this pin also allows a non-tanged arbor to be fitted; this would however be difficult to remove if it is threaded for a draw-bar as the ejection screw will probably not be effective.

The essentials are firstly the distance from centre axis of the tailstock barrel that the centre of the pin is positioned, secondly the diameter of the pin and third the distance from the front of the barrel to centre of the pin. These dimensions may need slight adjustment if the ejection screw is very much larger than that on the V10. From memory I think the ejection screw on a Myford is about the same size, as also is the barrel. See attached drawing for a 2 Morse barrel.

The method I have used is to remove the barrel from the tailstock and to mount it horizontally in a suitable machine vice secured to the table of a vertical mill (a pillar drill could be used with much more care). I don't think it matters really where around the barrel that the pin is placed but for tidiness I placed it horizontal at the bottom. The method used was: when placing in the vice ascertain where the keyway is positioned and arrange so that the barrel is lying at 90° to its normal position. Then carefully place a long series slot drill (if you have one) of the required size in the right position for the hole, measure carefully several times for distance from the end of the barrel and from each side until you are absolutely sure it is in the right position. Then carefully and slowly mill down into the sloping side of the barrel until you have a nice clean circular flat at the bottom of the hole. At this point if you only have a normal slot drill, change over to a centre drill and centre drill the hole - then using a drill about 1mm smaller than the slot drill, drill carefully through to the point where you are just breaking through. Change back to the slot drill and take this through, opening up the hole and carefully cut another recess on the other side of central hole of the barrel, again centre drill and follow with the small drill to just breaking through. Then again follow with the slot drill to clean the hole this laborious process will have meant that minimum loadings are used on the cutters and with luck and skill the hole is both straight and close to diameter. With a "Long Series" slot drill, it is possible to very slowly cut through in one go, but the method given above may well be safer. Make a silver steel pin short enough to fit in the hole without interfering with the inside of the barrel housing in the tailstock and after hardening and tempering blue (?), secure in place with Loctite.

The above original arrangement on my 'Tida' lathe has effectively prevented any drill shanks or chuck arbors from rotating for the last 20 years which has resulted in a 3 Morse socket as good as when new.

The above arrangement has been published under my name in either Model Engineer or this illustrious magazine some years ago - the job sort of got delayed by locomotive building.



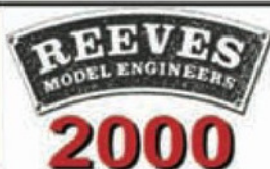
And finally, for a little light relief – one of a collection of poems by

Bert Martin from Verwood, Dorset.

"One good turn begets another"

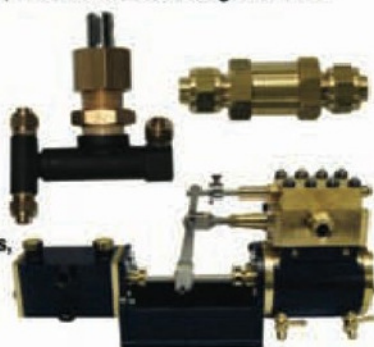
*Lathes are wonderful things
that make bolt-threads and rings
which an owner quite rapidly learns
needs patience and slowly-gained
knowledge that wholly
reveals how they do one good turns.
You will soon earn your due
making objects from new
or restoring worn parts that grew old,
using many a clue,
like a bolt from the blue,
with aplomb that becomes truly bold.
Take raw metal and chuck it,
avoiding to tuck it
no more than an inch or so deep
at the part you'll not use and the tool
won't abuse
as you part off the bit you don't keep.
The degree of precision is your next
decision,
for which you rely on a 'mike'.
that isn't a bloke but an anvil and yoke,
with its scale set the size that you like.
You study a drawing, which first may
prove boring,
inscribed on a background of blue,
initially poring all over said drawing
until you perceive a clear clue
to the draughtsman's intent of where
the part went
within the assembled device,
where each little bit should become a
true fit
if your finishes are quite precise.
There's great satisfaction that comes
from the action
of running a lathe of one's own.
You'll make parts for your car and beer-
pumps for your bar
when you're quietly working alone.
You'll go on to drilling and vertical
milling
with further committed devotion.
When sufficiently sage, you may like to
engage
in large-scale, steam-fired locomotion.
This means you're fully trained, by the
time you have gained
a peaked hat and a whistle and flag,
but don't feel complacent; I live close
adjacent,
awaiting repairs to my Jag!*

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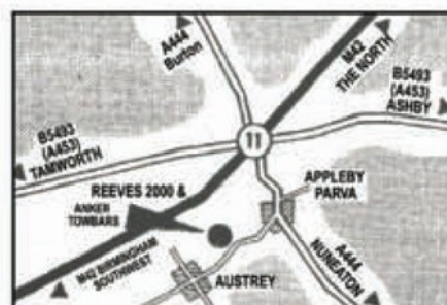


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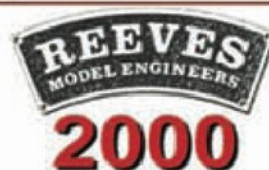
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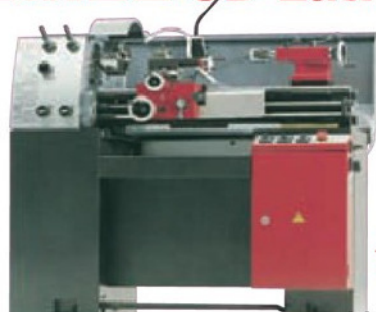
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19. ENDMILL SET, 3/16, 1/2, 1" DIA. WITH 1/2 THREADED SHANK TO FIT COLLET CHUCK
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21. REAMER SET (STRAIGHT SHANK) 1/16, 1/8, 3/16, 1/4, 5/16, 3/8, 7/16, 1/2 or (m/m) 2, 3, 4, 5, 6, 7, 8, 10, 12 m/m
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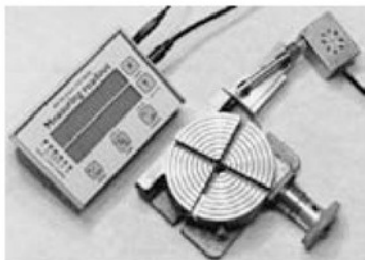
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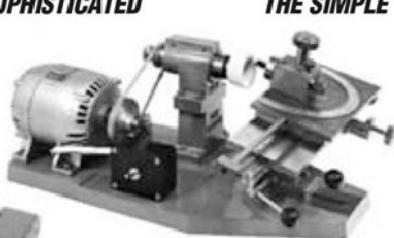
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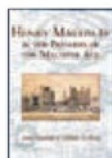


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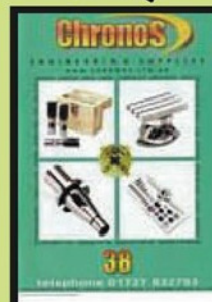


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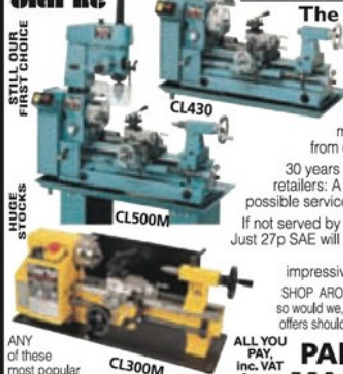
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- Motor: 1 1/2HP
- Spindle Taper: MT3
- Speeds: 6 Geared Head (50-1250rpm)
- Metric or Imperial
Machines Available



Super LUX Mill

£1500

- Table size: 240x800mm
- Motor: 1 1/2HP
- Spindle Taper: MT3
- Speeds: 6 Geared Head (80-1250rpm)



626 Turret Mill

£1299

"..I consider it to
be very good value
for money, and I
am personally well
pleased with my
purchase."

Mr J Cox
MEW 97



836 Turret Mill

£3495

- Table size: 200x910mm
- Motor: 3HP Motor
- Spindle Taper: R8
- Speeds: 10 (115-3500rpm)



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