No.40

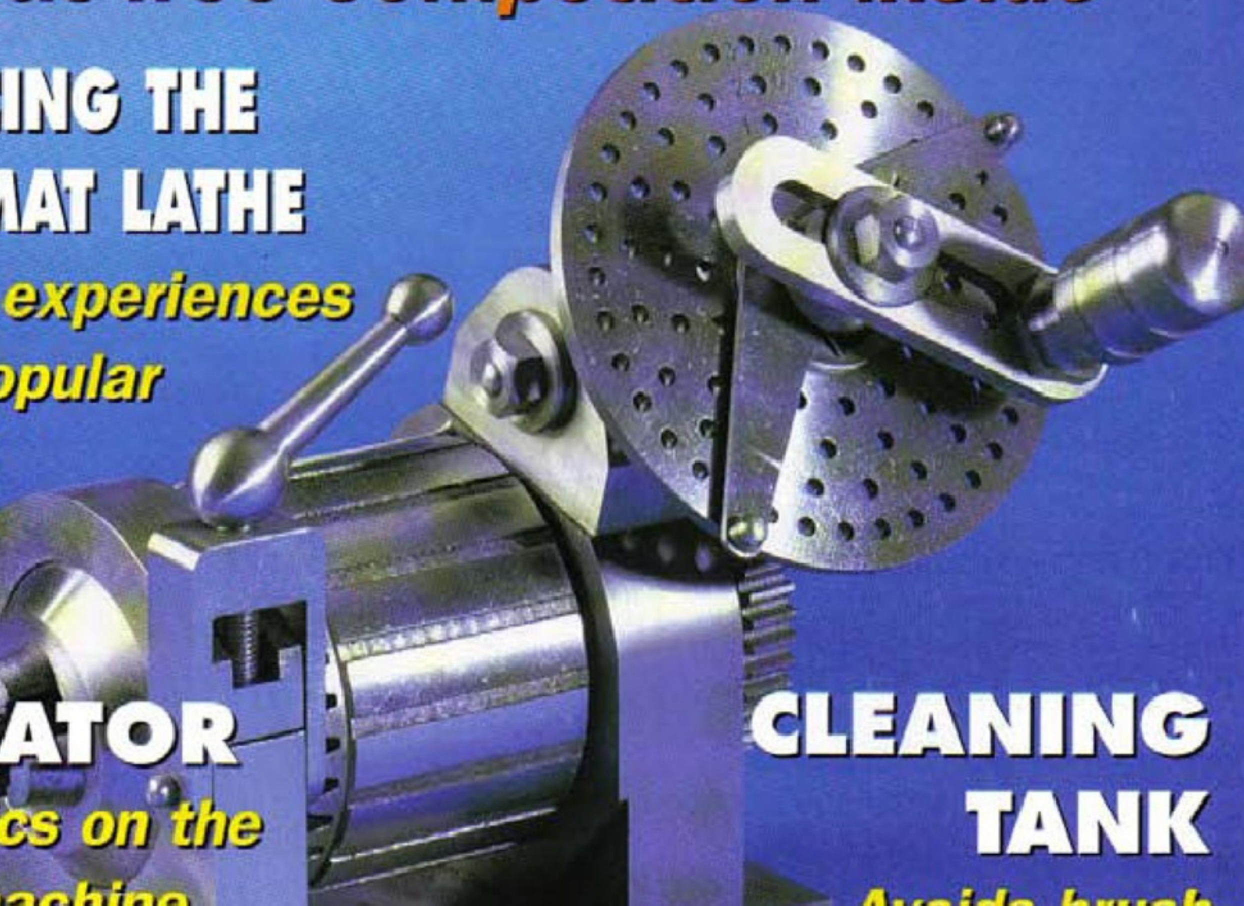
JANUARY/FEBRUARY 1997 £2.95

MODEL ENGINEERS' WORKSHOP

THE PRACTICAL HOBBY MAGAZINE

WIN A UNIMAT 4 LATHE

Great free competition inside



ENHANCING THE HOBBYMAT LATHE

A Tyro's experiences with a popular machine

LIMIT INDICATOR

Electronics on the milling machine

CLEANING TANK

Avoids brush spatter

ELECTRIC SHOOTING BOARD

Tooling to improve your router

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FOR ENTHUSIASTS BY ENTHUSIASTS
NEXUS

MODEL ENGINEERS' WORKSHOP JANUARY/FEBRUARY '97

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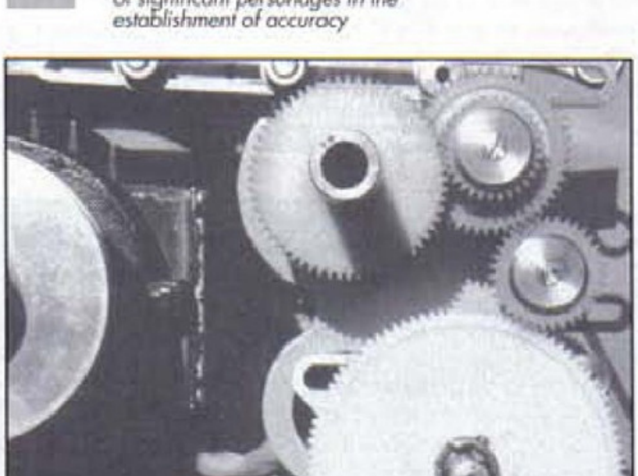
Issue No. 40

Editor: Geoff Sheppard

Nexus Special Interests, Nexus House, Boundary Way, Hemel Hempstead, HP2 7ST, tel. 01442 66551

Note the extra leads and boxes on the base of this milling machine. When the lamps light up you have arrived at the end of the cut. See how to make a unit to fit your X and Y axes, starting on page 12.



A familiar machine, seen from an unusual angle. It is the Hobbymat lathe, specially fitted for special screwcutting set-ups. Full details of the modifications start on page 52.

On the cover

Visitors to the 65th M.E. Exhibition last year had the chance to inspecting this excellently designed and made miniature dividing head. The work of Derek Collier of Bristol, it gained him a well merited Bronze Medal. We hope to see you at the 66th M.E. Exhibition at Olympia and to have numerous examples of what makes modelling marvellous for your inspection. Full details of dates, times etc. appear on page 45. (Photo: Manny Cefai).

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ADVERTISERS INDEX

ON THE EDITOR'S BENCH

Ted Hartwell

It is with great regret that I have to inform readers of the sudden death of our contributor Ted Hartwell.

Ted was the type for whom the saying "Ask a busy man.........." was invented. He was very active as a consultant in the automobile industry and travelled extensively, but still made time to write the occasional article and to enter into correspondence with readers and other contributors if he thought that his knowledge and experience could be of help.

In last month's 'In the next issue', I promised an article on the application of rolling bearings, which Ted had written. We had agreed that some additional drawings would clarify some of the points being made, so he was in the process of gathering them together. Unfortunately, he was unable to complete this task, so I have decided not to publish the article just yet. Hopefully, I shall be able to find substitute material to a standard of which Ted would have approved, and will include the article at a later date.

Ted was a professional engineer with extensive practical experience, and I shall miss his support.

We extend our deepest sympathy to Ted's wife and family.

Out and About

I derive great pleasure from my membership of a small number of model engineering societies, particularly of The Society of Model and Experimental Engineers (The SMEE), but distance makes it impossible for me to attend every meeting. It was, therefore, with great anticipation that I boarded the express bus the other Saturday for a trip to London.

For those not aware of the organisation, The SMEE was established by Percival Marshall in the same year (1898) that he founded *Model Engineer* magazine. My local society is one of many which sprang up in the provinces, modelled on the London Society, ours being formed in 1909.

The SMEE soon blossomed into an international organisation, with a large membership, such that it was able to purchase its own club premises.

These are currently located in Wanless Road, in South-East London and are named, appropriately Marshall House. Formerly a Coroner's Court, the building is large enough to house a lecture theatre, committee room, library and workshops. These are open at pre-arranged times, subject to the availability of stewards. A full lecture programme is arranged, and I was setting out to attend the annual President's Lecture, where I met up with my colleague Mike Chrisp, Technical Editor of *Model Engineer.*

This year the subject was the building of models of the Maserati 250F racing car, and was given by Tony Dennis. Tony is now in the business professionally, and after building a number of other high-quality car models, has found himself a niche making one-thirteenth scale replicas of this famous Formula One car from the 1950s. The unusual scale was, incidentally, set by the availability of a particular size of steel tube for the chassis frame.

Such is the popularity of this particular car that Tony has a steady stream of clients from all over the world seeking accurate models of a particular prototype. We were fortunate in that the latest example had just been completed, and was awaiting delivery to its new owner in Belgium. They don't normally hang about for very long once they have been completed, as the client is always keen to take possession!

The particular car we were able to see is a model of one (No. 2505) driven to victory in Argentina and Belgium by the great Juan Manuel Fangio, in 1954.

The prototype now resides in an Italian museum, but we are fortunate in being able still to see (and hear) other examples in action in Vintage and Historic races throughout the summer.

Tony's models are beautifully made to a high degree of detail and finish, with many of the parts working as in the original. He described his workshop, which is typical of many owned by many model engineers, with a lathe and a small milling machine. It is another illustration that craftsmanship of the highest order can come from the simplest of equipment; the main ingredient is the craftsman.

At the conclusion of the meeting, had the privilege of being invited to propose the Vote of Thanks, and I was followed by our President, Sir Hugh Ford, who seemed delighted at the choice of subject for 'his' lecture.

For the younger element

A journey in quite a different direction took me to the National Exhibition Centre, to accept an invitation to visit the Design and Technology Exhibition.

This gathering is aimed primarily at educationalists, and demonstrates products suitable for use by schoolchildren and students of all ages during their D & T courses. These ranged from the simplest clip-together plastic items for the very young to the most sophisticated numerically controlled machine tools for the more mature student. These were a most welcome sight, as an indication that an appreciation of engineering subjects appears to be making a welcome return to the school curriculum. The presence of a significant number of well-known manufacturers of high quality small machine tools illustrates that they are taking this market very seriously.

The products on display make it clear that the school workshop of the future will be a quite different place to those known to many of us. One flat bed Myford-Drummond lathe, a bench drilling machine and an off-hand grinder will not suffice. Modern youth's addiction to the computer is being channelled so that an initial understanding of machining processes is being allied to the technology which can ensure repeatability of required quality standards in a production environment, at optimum cost levels.

Unless we can find a way of adapting some of these techniques to the home workshop environment, the younger element will look upon our efforts as antiquated, and the practitioners as museum-pieces in themselves. The step change may be greater, but what is the view of today's workshop owner of the man who insists on clinging to a treadle drive for his lathe, just because it was the 'craftsman's' way of doing things?

Incidentally, I feel that Domestic Science classes (or whatever they call them nowadays) are changing too, judging by the number of computer controlled sewing machines whirring away, producing all manner of items! Anyone for a pair of numerically controlled overalls?

A NEW UNIMAT LATHE AND A GENEROUS OFFER

One of the exhibitors at the N.E.C., and one making a welcome return to the home workshop market, was Emco. Renowned for their high quality equipment, they have been concentrating on other markets in recent years, but have now returned as Emco Pro Machine Tools Ltd.

As part of the new initiative, they have introduced a new version of their popular small lathe, now known as the Unimat 4. With a wide range of accessories available, compatible with the Unimat 3, this lathe should be an ideal entry level machine or the basis of a machining centre for those wishing to concentrate on the manufacture of smaller components.

To mark the launch, Emco have generously offered one example as a prize for a competition featured in this magazine. This unit will be on display on their stand at the forthcoming International Model Show at Olympia.

Additionally, they have offered us access to one of the new machines, so I have asked that maestro of the Unimat, Bob Loader to run the rule over it on our behalf, and to give us his impressions for a future issue.

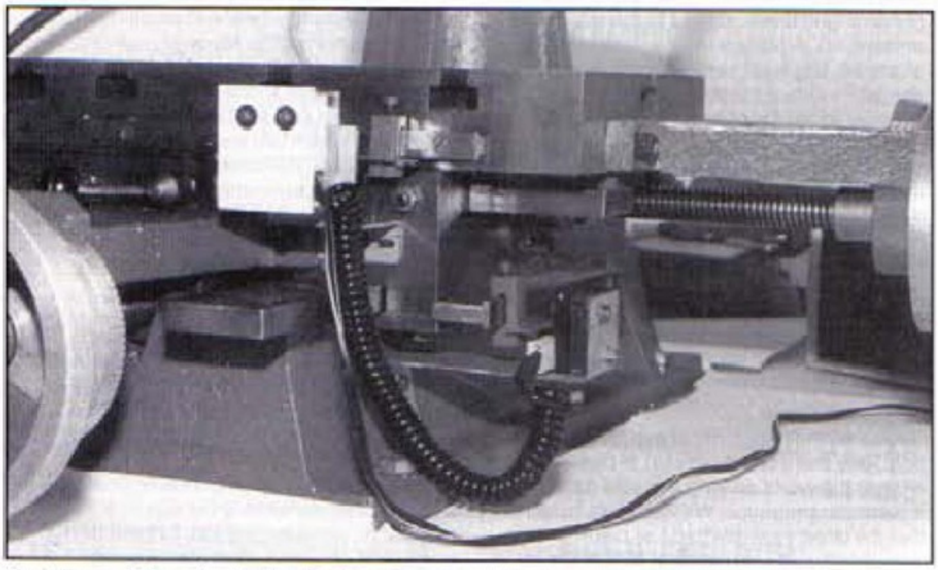
A success

Some while back, we published a request from Reg Cox of Harlow for people from the are to gather round and support a local model engineering evening class.

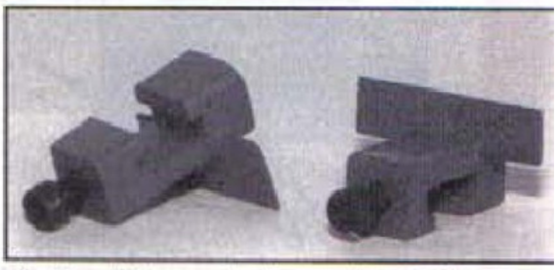
I have now received a note from one of those who rallied to the cause to say that it is operating successfully, and that Reg's efforts as prime mover are much appreciated by all. Well done. Long may it flourish.

A Milling Table Indicator

Bob Sims of Inverness devised this accessory for his Dore-Westbury, but it can be adapted for use on any similar milling machine. The components are available from several electronics suppliers.



A close-up of the units fitted to the X and Y axes of the author's Dore-Westbury milling machine.



The two sliders required to complete the job.

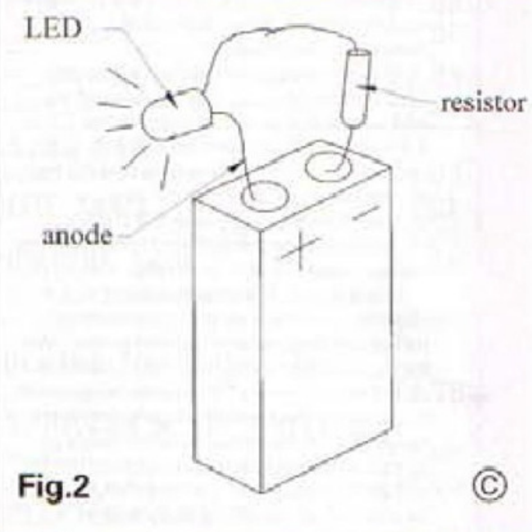


Fig.2

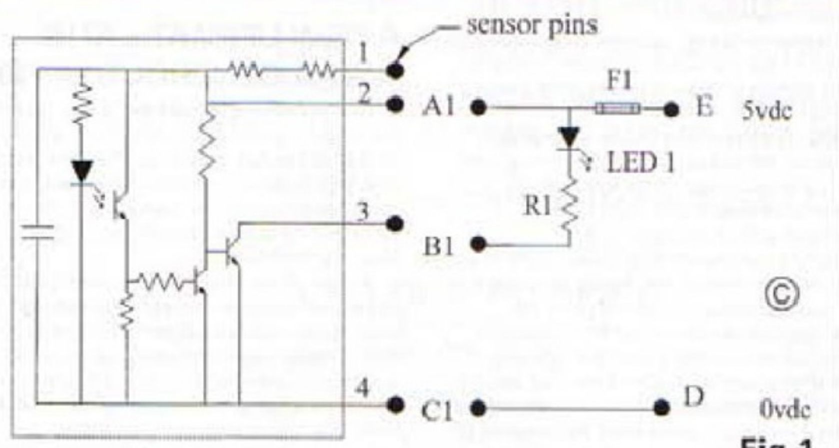


Fig 1.

Although the subject of this article was devised for the Dore Westbury Mk2 milling machine, it could without too much trouble, be modified to fit any similar machine. The idea for this device came about because I did not like the thought of running the table of the milling machine into a solid stop to tell me that it I had reached the end of its allotted travel. It seemed to be the only solution available, unless I were to fit a fully automatic system with motor control and, as cost prohibited this solution, this device was born. I do not claim any originality for this idea, although I have not seen a limit sensor like this in an article in any of the model engineering magazines. At first I planned to fit this device to only the longitudinal travel of the milling table, but as it was as simple to build two sensor units as one, I decided to add a unit to the cross-slide as well.

Here are some of the thoughts I had when in the design stage of the limit stops:

1. ***To make the stop simple to set up.***
2. ***To use low voltage (for safety reasons)***
3. ***To be expandable if needed.***
4. ***To be inexpensive.***

And so to work

First let's get the electrics out of the way. The circuit for the sensor can be seen in **Fig. 1**. This is based on a slotted opto switch which I took from an old photocopier scrapped by the company I work for. Being a service engineer for an office equipment company, I have access to lots of old bits and pieces to play around with. The opto switch I used incorporates a driver circuit as well as the light source and photosensitive transistor, so this means that the only other parts required to complete the circuit are a resistor, a light emitting diode (LED) and a power supply.

The part of the circuit in **Fig. 1** which is enclosed in the dotted line is inside the actual opto switch, the rest is what we are about to construct.

Now, a little theory (*sorry*). We have to fit a light emitting diode to this circuit. An LED has two legs, an anode and a cathode, and must have its legs connected to the circuit the right way around. Usually, the cathode is the shorter leg or has a flat on the body nearer to it. The anode must be connected to the more positive side of the circuit. That is, in this case, the 5 Volt DC rail, and the cathode connected to the more negative side of the circuit.

You can determine the anode and cathode of an LED of the sort used here with a battery and a resistor. Connect a 270 ohm resistor to the negative side of a PP3, 9 volt, battery, then hold one of the legs of the LED to the positive terminal of the battery and touch the other leg of the LED to the free end of the resistor (don't hold it on the resistor too long), as in **Fig. 2**. If the LED does not light, then reverse the legs of the LED to the battery and resistor. Once the LED lights, then mark the leg connected to the +ve terminal of the battery with a spot of white paint. This is the anode.

Note: The resistor is important to dissipate the power from the battery, and as such should not be omitted when testing.

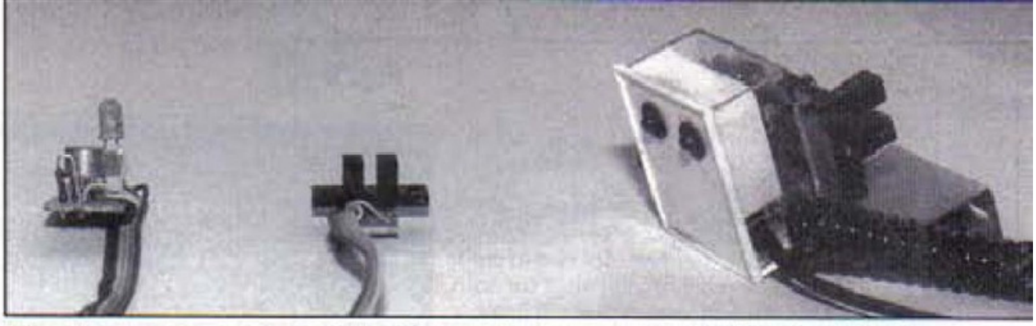
Once you have found the correct way around to fix the LED, then we can start to manufacture the circuit. It is best to solder LED 1(&2) and R 1(&2) to a small piece of stripboard, as in **Fig. 3**. You can easily get these boards from many electrical suppliers (Maplins, Greenwelds, Electromail etc.) The layout of the two (or four components if you are to make the cross-slide sensor as well) is not critical, but if you are to mount them in the sort of box I used, then I suggest you cut the board to fit the box first, then to drill holes in the box for the LEDs to poke through, arranging the components on the board to fit. By the way, the box I used was a plastic box that contained a brooch that I bought for my wife.

Solder the LED onto the board as shown in **Fig. 3**, then the resistor, then connect the flying leads that will come out of the box and terminate in connectors. The 'X's on the diagram are cuts in the tracks of the board. You can use a 3mm drill bit by hand to cut the track. Solder the leads coming from the photo sensor connector, making sure to get the correct leads to the right strips on the board. These connectors are optional, but I advise using them, as it enables ease of use and, if necessary, can help in tracing faults later on. There were four pins coming out of my photo sensor. I used only three of these, Pins 2, 3 and 4. The sensor you use may have different connections, so note which are the positive lead (pin 2), the negative lead (pin 4), and the signal lead (pin 3) (The pin numbers in the brackets are the pins of the sensor in **Fig. 1**). Connect according to Fig. 3. When completed, connect the leads 'E' and 'D' to a 5 volt DC power supply, the correct way around, and put a piece of paper or the like through the slot in the sensor to see if the LED lights. If it does, all is OK. If it does not, then you have probably put the LED in the wrong way around. Don't panic; usually you can take the LED back out and reverse the legs. Do not fit the assembly to the box yet. **Don't forget to disconnect the battery before unsoldering.**

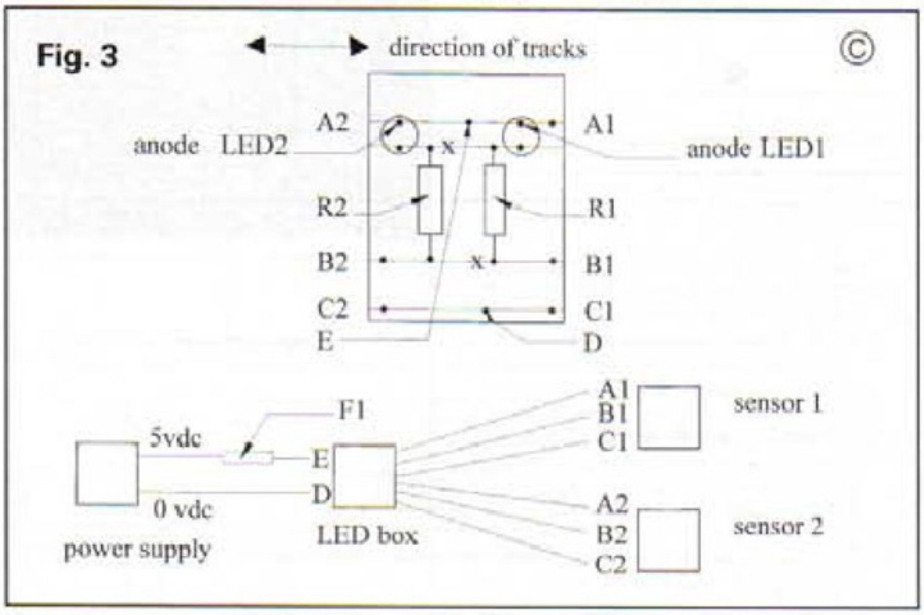
The sensor circuit for the cross-slide is just a duplicate of the above. I have shown the two of them in **Fig. 3**. All you have to do is omit LED 2 and R2 if you only fit one sensor. I inserted a 200 milliamp fuse in the line. I have modified my circuit to encompass another transistor to switch another circuit which will drive a traverse motor unit (still in the development days. Maybe another time.)

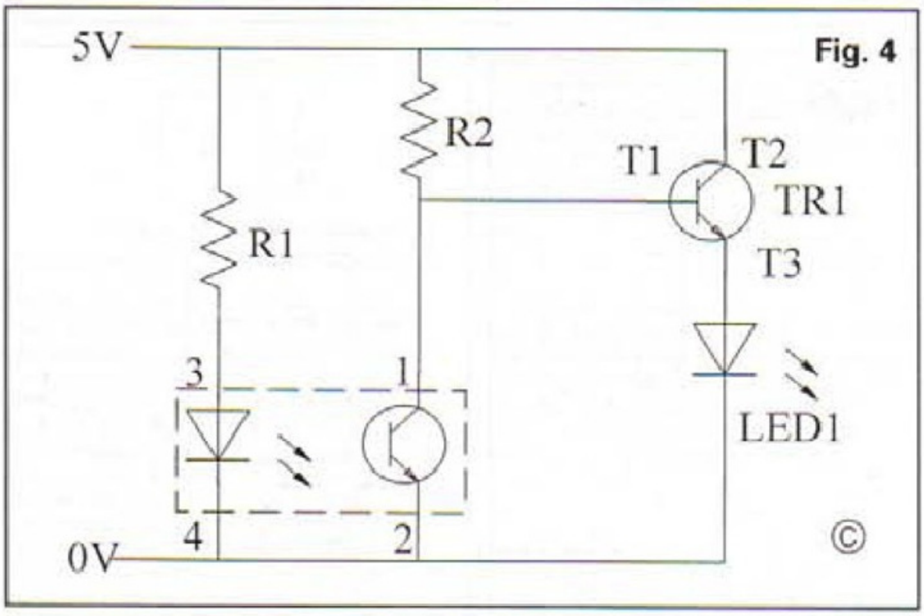
If you use another make of sensor

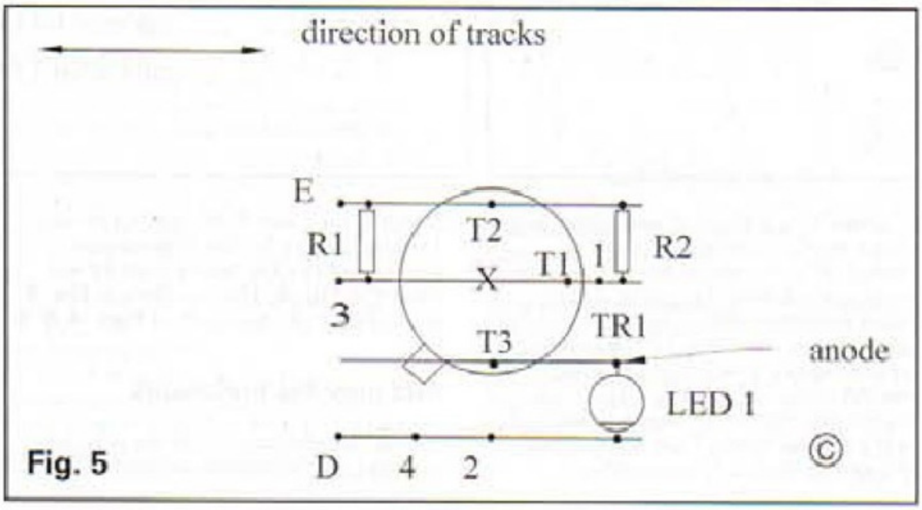
In **Fig. 4** we have a different type of sensor. This is shown inside the dotted line. This sensor has no drive circuit, so the extra components are necessary in order to make the circuit to work. The layout of the components is shown in **Fig. 5**. As this type of opto switch has no connector, just leads coming out of the bottom of the switch, you will have



The three types of sensor units, left to right:- LED unit with extra parts for different slotted switch. Greenweld's sensor before sealing in epoxy, and a completed sensor unit.







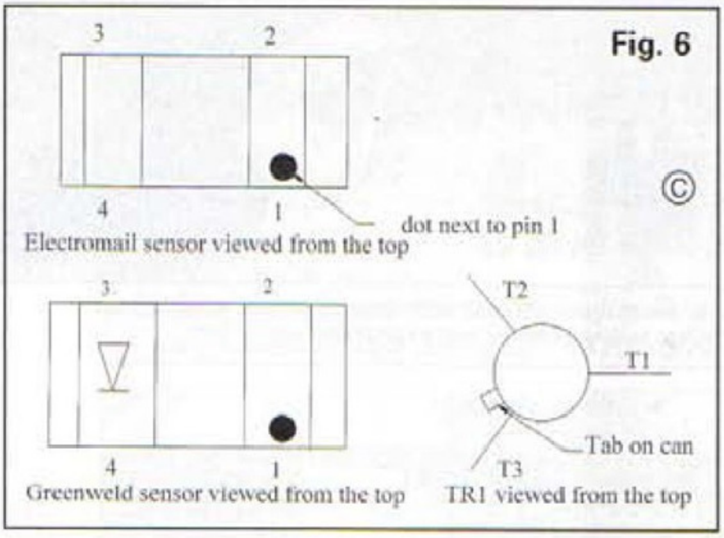


Fig. 6

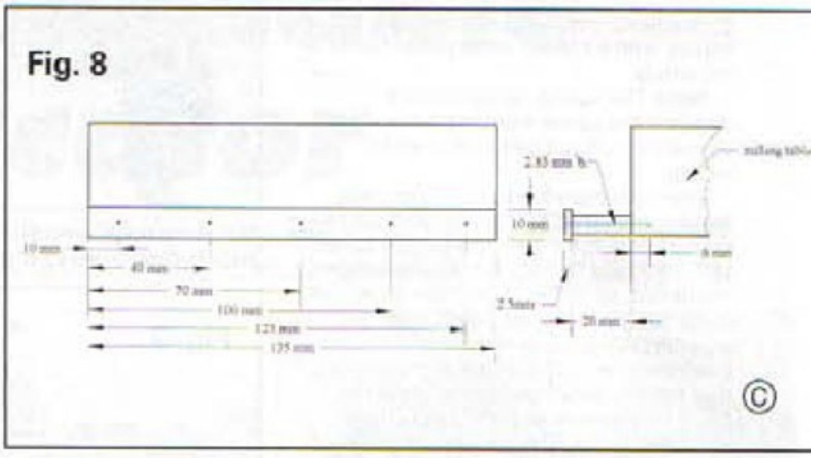


Fig. 8

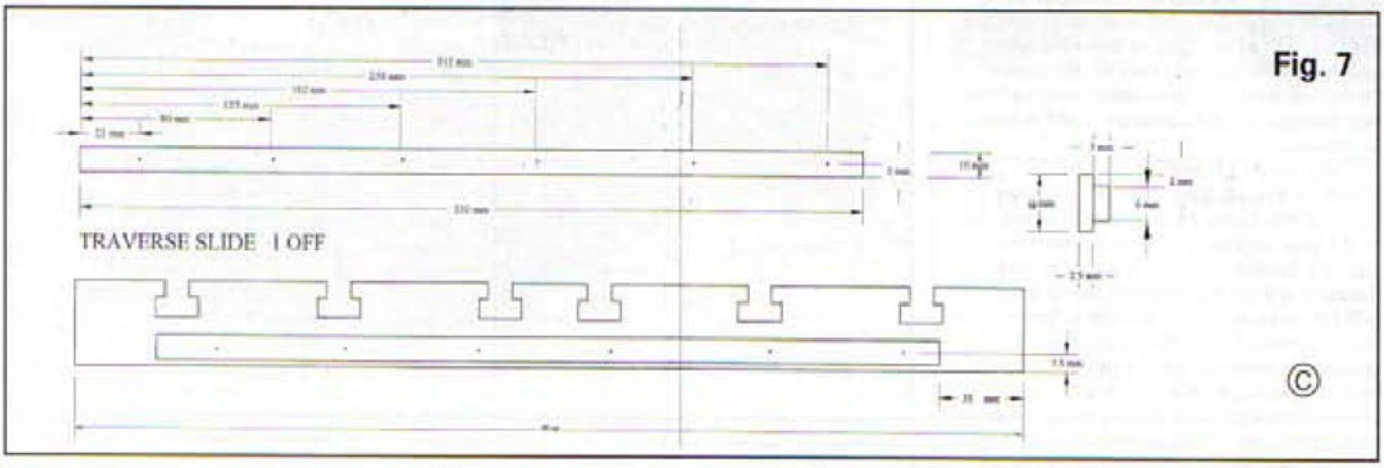


Fig. 7

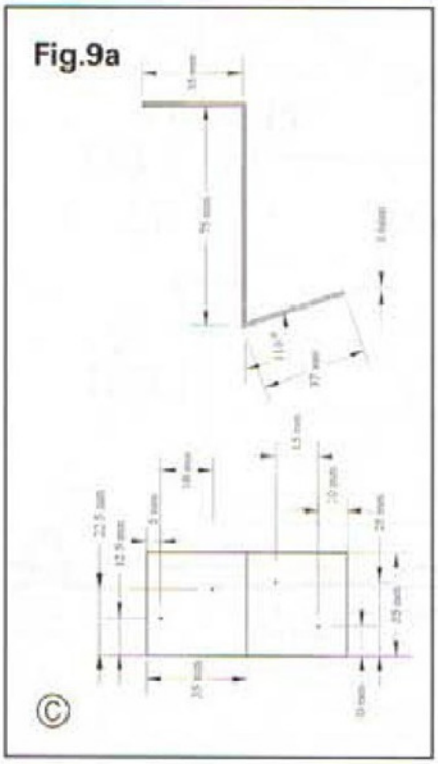


Fig.9a

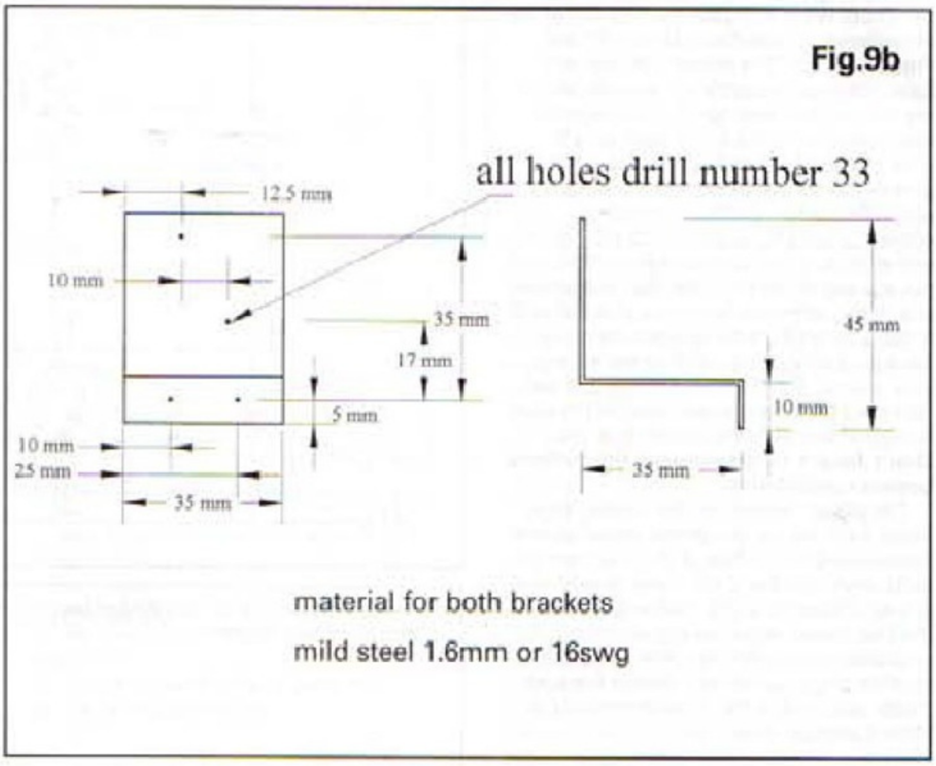


Fig.9b

to solder it to a piece of stripboard and solder flying leads to the board to connect it to the rest of the circuit. You must also insulate the tracks on the board from the milling machine and the surrounding area. This I did by putting a layer of epoxy glue in between the board and the mounting position. You must ensure that the circuit works before you seal it for evermore. Figs. 4 & 5 show one sensor circuit. If you use two sensors, then just duplicate this circuit. The pin layouts for the Greenwelds sensor and the Electromail sensor are shown in **Fig. 6**. The numbers in **Fig. 6** relate to the pin numbers in **Figs. 4 & 5**.

And now the metalwork

With the electrics out of the way, we can start on the mechanical parts The first parts to make and fit are for the slide bar assembly. This is, as you will see from **Figure 7**, fabricated from two flat bars of steel, one 10 x 2.5 x 330mm, and one 6 x 3 x 330mm. They are drilled at the points indicated, and the 10 x 2.5mm piece is countersunk to a depth sufficient for the heads of the 6BA countersunk screws to clear the surface. I drilled the bars using the same method as was used in the construction of the milling machine, i.e.

Suppliers

	Electromail	Maplin	Greenweld
Sensor	306-061	*	58-0300
LED1	590-446	WL27E	55-0115
TR1	293-634	QF27E	BFY50
R1	131-182	B270	CR25270
R2	131-299	B2K2	CR252K2
Power unit	597-734	XX09K	P006D
Strip Board	433-826	JP46A	G4020
Connectors	473-199	HH26D	P0430 Male
Connectors	476-227	HH42V	P1435 Female
Wire	365-571	XR89W	Y0270

● Maplin don't seem to have a slotted type sensor, but do have a reflective sensor you could use if you modify the sensor position on the bracket (part number UK 81C).This type of sensor picks up reflective light of an object passing in front of it.

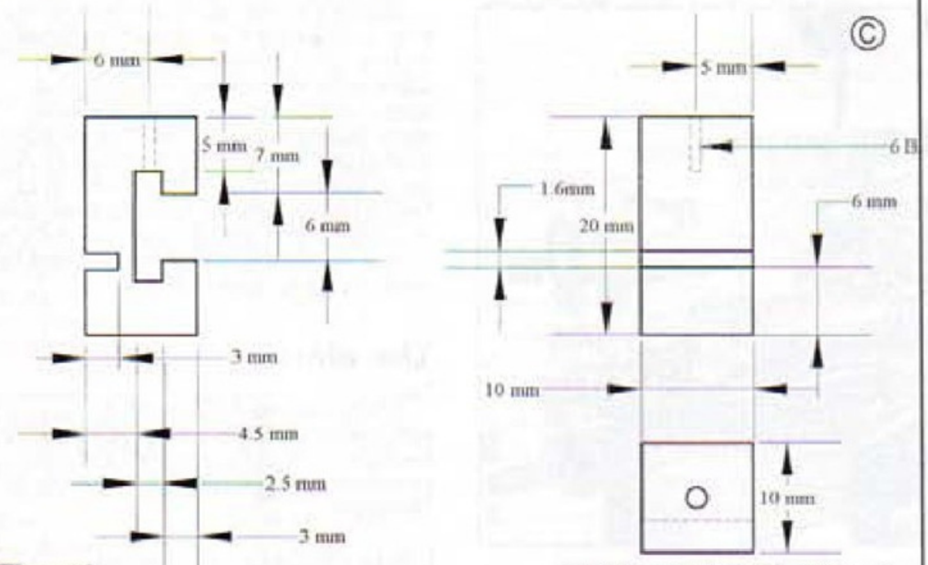
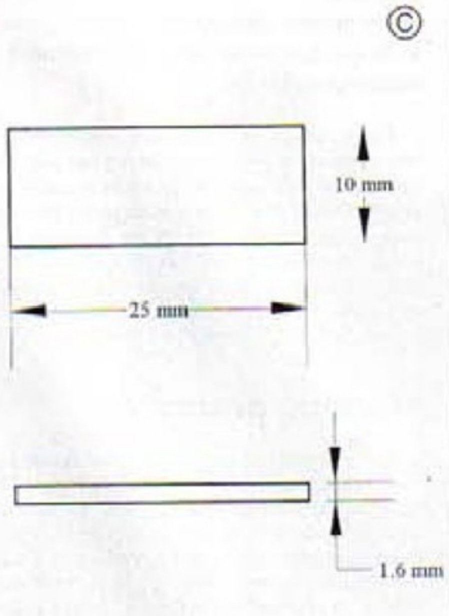


Fig. 10

1.6mm x 10mm x 25mm

Fig. 11



1.6mm x 10mm x 25mm

drill the 10 x 2.5mm with a No. 42 drill, then clamp this to the 6 x 3mm and the milling table, and copy the holes straight through to a depth of 10mm into the milling table with the same drill. This was followed by opening out the holes in both strips with a No. 33 drill, and countersinking the 10 x 2.5mm strip to the correct depth before tapping the holes in the table. I was still building the milling machine at the time, and so I built the stop design into the table as I was progressing (it made things so much easier, like laying the milling table on its side to drill these holes). Both slides are basically the same; only the dimensions are different **(See Fig. 8)**.

The next components to make are the sensor brackets, **Fig. 9a** & **Fig. 9b**. As you can see, there are two of these. The one for the end of the milling table has to be shaped differently, to accommodate the shape of the base of the milling machine and the lead screw bracket. The other to has the LED box fitted. These are no more than pieces of 16 SWG mild steel, drilled and bent to the dimensions shown.

The sliders are next. First mark out all dimensions, as **Fig. 10**, then mill a slot 6mm wide at a point 7mm from one end and 5.5mm deep. File the bottom of this slot to form a tee slot, or use a purpose made cutter. The slot for the flag is just a hacksaw cut 3mm deep. Drill with a No. 42 drill into the top, until you break through into the tee slot, and tap this hole 6BA. Take the sharp edges off the slides and file the tee slot to a good sliding fit on the slide rails. It is best if you insert a small piece of copper or brass into the bottom of the 6BA hole for the screw to bear on, instead of directly on to the slide rail. The flag **(Figure 11)** is just a piece of flat steel, glued or soldered into position, with an even amount protruding from either side.

The job is now ready for fitting to the milling table. Put the slider onto the slide rail at a position that is at the right-hand limit of the milling table. Temporarily fit the sensor to the bracket with two 6BA screws and nuts, then offer up the bracket to the base and mark the milling machine frame through the holes in the bracket when the flag of the slider is in the middle of the sensor. Remove the bracket and drill the milling machine base with a No. 42 drill. Tap the holes 6BA and fit the sensor bracket to the machine. Try a few passes slowly back and fore by hand, to make sure there is nothing to obstruct the sensor in its travel. Remove the sensor from the bracket, add the box to the bracket, then refit the sensor and screw together.

Once everything was working, I sealed the box with silicon (the stuff you get for bathrooms seems to work OK and does not seem to be affected by cutting lubricants.

The cross-slide slide bar **(Fig. 8)** is slightly different in size, to avoid the leadscrew bracket, as mentioned before, and the bracket does not have to carry the LED box. Otherwise, the method of construction is the same.

This then completes the indicator sensor unit. I have a limited number of the sensors used in the circuit that I would be willing to give away on a first come, first served basis, on receipt of a s.a.e. (The power supply mentioned earlier can be of the battery eliminator type, with an output of 6 to 10 volts DC, with a current rating of 400 milliamps. The connectors used can be DIN type, as used for Hi Fi systems, and you can use speaker wire to join things together.

Take care

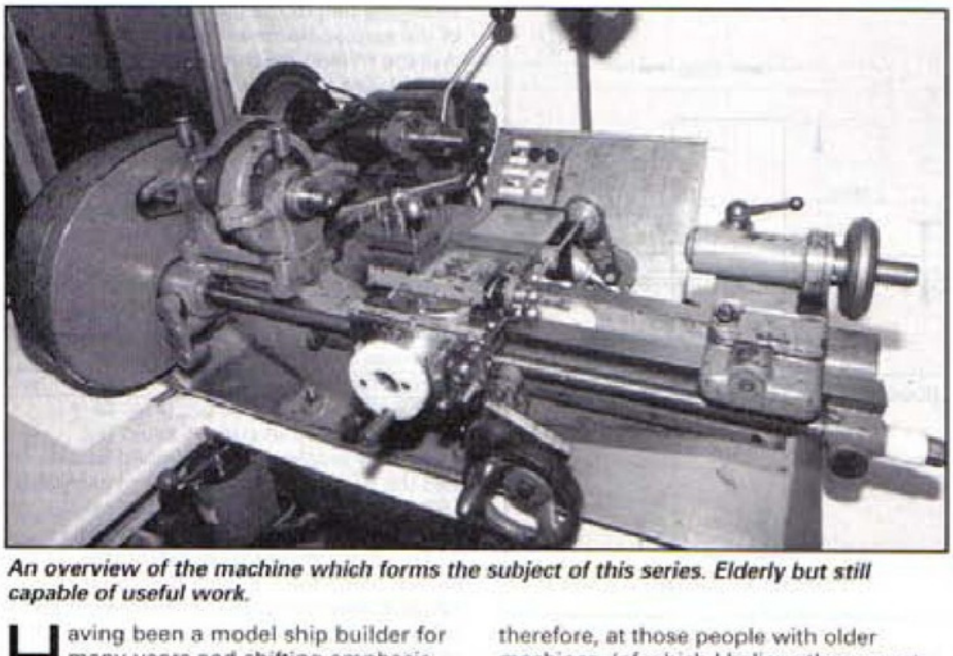
You must take care when ordering from some suppliers, as they only supply items in bulk numbers, i.e. Wire in 25 metre drums when you only need

Addresses

Electromail, P.O. Box 33, Corby, Northants, NN17 9EL.
Tel. 01536 204555
Greenweld Electronics, 27 Park Road, Southampton, SO15 3UQ.
Tel. 01703 236363
Maplin Electronics, P.O. Box3, Rayleigh, Essex, SS6 2BR.
Tel. 01702 554161

LATHE UPGRADE ON A BUDGET

Many of our readers own older machines, and we frequently receive requests for information which will assist in refurbishment. A popular lathe was the Myford 'M' type, of $3^1/2$in. centre height. John Shrubsole of Bury St. Edmunds has renovated his and added some new facilities, and in this first article describes the reconditioning of the headstock assembly.



An overview of the machine which forms the subject of this series. Elderly but still capable of useful work.

Having been a model ship builder for many years and shifting emphasis more into a model engineering way of building, I found that my rather ageing Myford 'M' type $3^1/2$in. (Drummond) lathe wasn't producing turned work to an acceptable standard. This could, and probably was, as much to do with my lack of knowledge and skills in this area, as with the condition of the machine, which had given sterling service to it's original owner. Just prior to this event arising, I'd had a good job, and was giving thought to purchasing a new machine, when along came redundancy, and the future began to look rather bleak. The last thing I now needed was any unnecessary expenses, so this objective also became redundant. It was now time to have a serious look at my Myford, and to see what could be done to enhance its capabilities and performance.

It was at this stage that I decided to take time out from model ship building to try to improve my workshop and its equipment. In doing this, I surprised not only myself, but a few friends as well, learning a great deal more about the machine and its operation in the process.

Having achieved these pleasant results, and having put a great deal of thought and work into them, I feel it is worthwhile to try and share them with others who have similar interests. This article is aimed, therefore, at those people with older machines, (of which I believe there must be many by the number of pictures of them that appear in this and other associated publications), who cannot or indeed do not wish to justify the expenditure on new machinery, but would like to achieve a little more from their existing equipment.

Although this work has been based on a Myford $3^1/2$in. 'M' Type lathe, I'm sure that with a little ingenuity, most of it can be applied to other makes and models. Most of the work was done on the machine, without seriously losing it's availability.

Work started a few years ago really, doing a bit at a time, and it then began to get more in-depth and involved, so it's not just a weekend job. Not all of it has to be done; you choose the parts that are useful to you, and enjoy the experience and better results. While I will place measurements on the drawings, they are by no means the final word. The drawings are to scale or near scale, and will always be in proportion. This will give you the opportunity to change dimensions to suit your needs and the use of materials you have at hand or are able to obtain. Where special parts are required, I will give an indication of where they can be obtained and a relative cost if possible, but don't worry about that too much. Remember the title "On a Budget"

Just one further slight diversion to say that, having read a number of magazines on how to do various projects, I found some quite intimidating with technical jargon and processes, which can deter some people from even starting, let alone getting part way through and then giving up. In this project I will do my utmost to keep it in plain English and to a basic way of working. This will be inevitable really, as I know no other way, so have a go and see what can be achieved between us.

The aims

Before starting the projects, I subconsciously set out a set of criteria for the work to be done, and they are now examined before doing any further work. These are :-

i. To be effective on the machine
ii. To do as little cutting and interference with the original equipment as possible, and to retain the original parts
iii. To use materials that are readily available
iv. To be cost effective
v. To be capable of being manufactured on existing equipment

Referring to item **v** above, this can mean many things to different people, so perhaps a word of explanation is called for at this point. My lathe is equipped with 3 and 4 jaw chucks, a faceplate & angle plate. I also have a bench drill and a range of associated tooling to complement them, so nothing too spectacular or more than is found in many home workshops.

Working practices

Before moving into the actual work, I feel it necessary to say a few words on Health and Safety. This is likely to raise a sigh of boredom in some people, but by the sheer nature of our hobby, most of us are likely to be working in a fairly confined space, probably overcrowded with our bits and pieces, and also working *alone*, in a shed at the bottom of the garden. So before commencing any repair to machinery, switch it *off* and *isolate* it. (Remove the plug from it's socket or remove the motor drive belt). Also, remove any tooling from the toolpost and tailstock. After all, we will be in amongst gears, belts and pulleys, and it will almost certainly be too late if a loose shirt sleeve or digit were to be in the wrong position and the machine was accidentally switched on. So think!! and hopefully your health will not become another statistic.

When dealing with a particular section about repair or modification, please read the whole section thoroughly before starting work, as matters which I consider to require additional explanation may come after that part's introduction. I hope that this will lessen any confusion by not bogging the reader down with a lot of detail at the start of the job.

The Headstock

This is the business part of the lathe where, if the bearings are not set correctly, all manner of ills can occur. Rather than explain the problems that arise, let's check the adjustment.

With the machine switched off and isolated, place a round bar, 9 to 12in. long, 5/8-1in. dia. in the chuck and tighten. Holding the bar at the free end, try moving it about. There should be no movement except for the flexing of the bar. Any movement which feels like a clunk or knock, denotes that bearing wear has taken place requiring inspection and possibly adjustment.

This should be relatively straightforward; on older machinery it can be a little more involved. To take account of most eventualities, I will explain how to dismantle the Headstock and to re-assemble and adjust the bearings. Before starting, we need to acquire two tools which may not be at hand, and to manufacture a drift for dismantling plus a dummy shaft to assist in reassembling.

Tool 1: A 'C' spanner to fit the bearing adjusting nuts. This can be produced by filing out a cycle bottom bracket spanner.

Tool 2: An open ended spanner 1 1/8in. A/F, for the backgear adjusting nuts. This is an expensive tool to buy for just the one job. One can easily be made by opening out an obsolete 11/16in. BSF/5/8in. Whitworth spanner with just a few strokes of a file (try a car boot sale or similar if you don't have one in stock), and will be much better to use than an adjustable spanner of that size.

Drift: This needs to be made on the machine, and to be shouldered sufficiently to fit into the tail-end of the mandrel. (See **Fig.1**).

Dummy Mandrel: A piece of material 3/4in. dia., about 4-5 in. long, drilled and faced off at one end, to be used as an aid to reassembling. (See **Fig.2**).

Now to the real work

The parts we shall be dealing with are shown in **Fig. 3.** Study this before carrying out the following dismantling operations:-

1. Clean the machine down and create a clean work area where parts can be laid out in order of removal.

2. Remove both backgear covers (two screws in each)

3. Remove backgear lever upper stop pin (slotted screw).

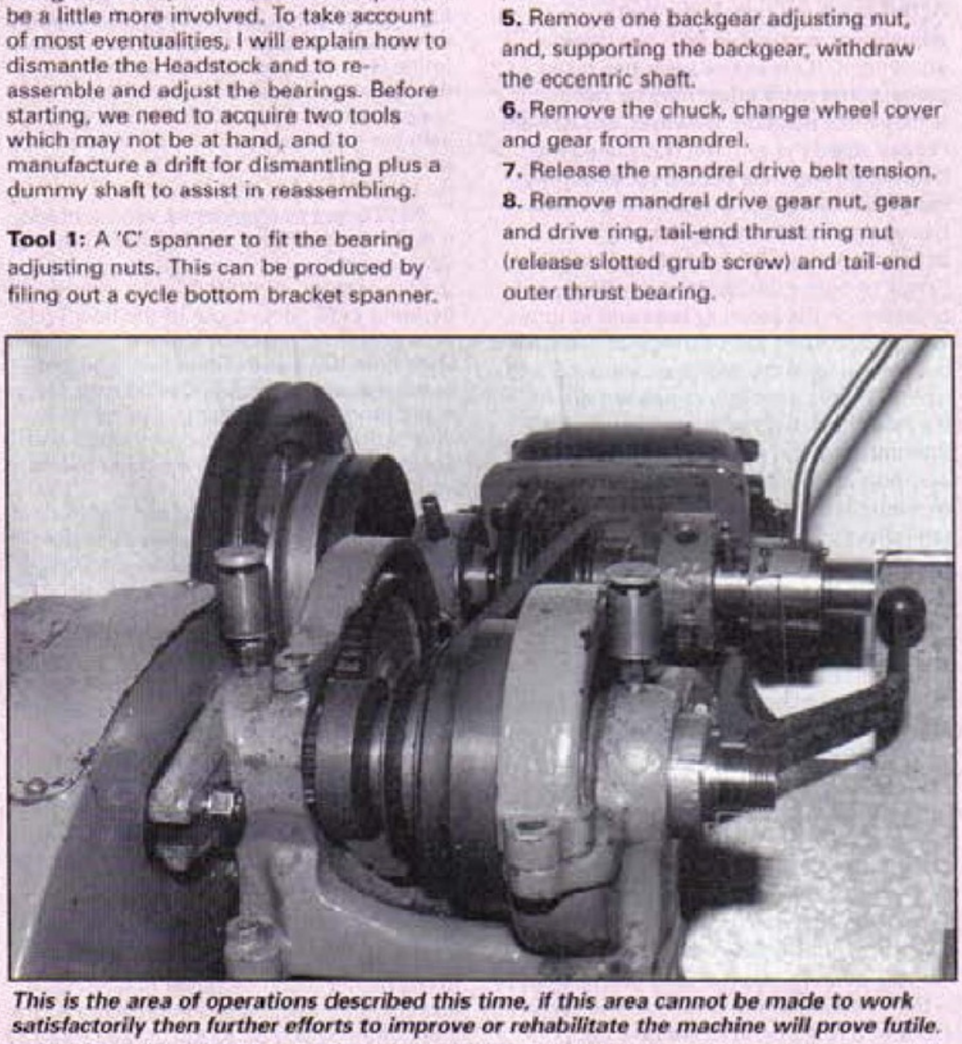
4. Remove backgear lever to shaft taper pin and then the lever.

5. Remove one backgear adjusting nut, and, supporting the backgear, withdraw the eccentric shaft.

6. Remove the chuck, change wheel cover and gear from mandrel.

7. Release the mandrel drive belt tension.

8. Remove mandrel drive gear nut, gear and drive ring, tail-end thrust ring nut (release slotted grub screw) and tail-end outer thrust bearing.



This is the area of operations described this time, if this area cannot be made to work satisfactorily then further efforts to improve or rehabilitate the machine will prove futile.

9. Release both mandrel bearing ring nuts, using a 'C' spanner (modified cycle bottom bracket spanner).

10. Remove both lubricators.

11. Supporting the pulley assembly, withdraw the mandrel towards and along the lathe bed, laying the pulley, backgear and thrust bearing to one side.

12. Remove both mandrel bearing ring nuts and withdraw both bearings with their locating keys to the centre of the headstock

If some of the above appears somewhat alien, take this process and study it at the machine, identifying the various parts, imagining the procedure before actually starting. Now to elaborate on some the above features :

Cleaning and clear work space

This is always good practice, even though we all don't necessarily do it on all occasions, but it can be difficult enough trying to find something we are familiar with, dropped in a pile swarf and debris. Imagine the problem if an article is dropped without ever having seen it, knowing what it looks like or if it even existed! Need I say more?

Removing the chuck

Tighten a bar in the jaws across the chuck or use a spanner on a jaw, but don't use the chuck key in it's position to lever on. This can break or damage the mechanism of the chuck, which will of course cause an unnecessary expense.

Mandrel tail-end bearing 'thrust ring nut'

This part has a slotted grubscrew set in it. This screw bears onto the thread on to which the ring nut screws. If the grubscrew has been over-tightened and the mandrel thread damaged, it may call for some patience in the removal of the ring nut. Moving it backwards and forwards, (which in effect will re-roll the thread on the mandrel) should release it.

The main bearing ring nuts

These may be quite tight, so perhaps a judicious tap with a hammer and punch in one of the slots may be necessary to start them moving. Remember that any excessive use of these tools will, at worst wreck the part, and at minimum create a more difficult job in reclaiming and making it reusable. Having released the two ring nuts by perhaps half a turn, (the one nearest the chuck position will butt up against the shoulder on the mandrel) remove the two lubricators, as these locate and lock into two locating keys for the main bearings. The main bearings are of a parallel bore and taper fit into the headstock housings. The locating keys are a wedge fit into the bearings, thus creating a very good securing arrangement. To release this assembly, it is time for that judicious hammer and punch again. Holding the punch on the face of the ring nut, one sharp tap with the hammer towards the centre of the headstock should release the taper locks. Further undo the ring nuts until all is loose and free, with the bearing moving towards the centre of the headstock. The mandrel should now be really loose in the bearings.

Withdraw the mandrel

This is keyed to the backgear next to the pulley wheel, and is a 'snug' fit. If the machine has not been lubricated adequately, it may even have some rust in there, which obviously cannot be seen, but may make it tighter; hence the drift we prepared earlier. With the drift placed into the tail-end of the mandrel, gently tap towards the tailstock. As it moves, it will become free, and can then be manipulated by hand.

I have laid emphasis on the use of punch and drift. By using these, you can control more accurately what effect the hammer is having, without causing damage that may be irreversible. So in this case *care* is the watchword.

Cleaning and inspection

Having got the headstock apart, now is the time for cleaning and examining the various parts, and our main interest here is the mandrel and bearings, but don't forget to clean the headstock and remove any debris from the recesses in the bearing housings. The key in the mandrel need not be removed, and to ensure that it stays put, wrap a piece of tape around it. In this way it won't get lost or left out when rebuilding. The first things we will probably notice is the amount of scoring on the mandrel journals and in the bearings. If this is only very light it can possibly be smoothed out by using a strip of fine emery cloth soaked with oil, and then finished with a fine grade wet and dry paper soaked with penetrating oil or similar. Try and cover over half the diameter if you do this, and rotate the shaft. Keep a rough count on the number of strokes and try to equalise them all round the shaft to even out the amount of metal removed. This process cannot be overdone by hand, it is entirely possible to get an out of round mandrel by over enthusiasm in this direction. If the scoring is significant it may be better to look in Yellow Pages for an engineering company who could regrind the shaft for you. Obviously the more material removed in this process, the greater the amount of adjustment necessary when reassembling. What we are trying to achieve is a balance between a smooth surface and the retention of as much material as possible, which will allow the mandrel to slide smoothly inside the bearings.

Now that you have handled the bearings, you may have noticed that where the locating keys were positioned, they have indented into the sides of the keyway. Gently dress the keyway sides with a fine file until the locating keys can slide freely in the key way. Also, on the outside of the bearings, adjacent to where the locating keys have sat, there may be a raising of the surface which would have been squeezed into the recess of the headstock. Again this must be removed using a fine file.

Examine the thrust bearing for any signs of wear. If there is an annular groove in the hardened steel washers, or if the steel balls are loose in the bearing race, it should be replaced. By now we should have all our components cleaned up, free from any burrs, and ready to reassemble.

Trial assembly

Before final assembly takes place, it is a good idea to place the bearings and mandrel in the headstock without the pulley and backgear. This will give familiarity with the assembly and will also prove that adjustment can take place with or without any further modifications. So, try this:-

1. Insert both bearings in headstock; insert both locating keys; locate the lubricators into the locating keys loosely; screw on both bearing ring nuts.

2. Insert the mandrel, installing the thrust bearing, thrust washer and thrust adjusting ring nut.

3. Using the 'C' spanner equally pull the bearings through the headstock, ensuring that the lubricators and locating keys remain correctly positioned and free. Continue this process until both bearings lightly clamp the mandrel.

At this stage we now know that adjustment is possible with our original equipment. If excessive wear has taken place, some extra effort may be needed to achieve this position. However, adjustment ceases when the ring nut has pulled the bearing through the headstock enough to reach the end of the thread. For the time being, let's assume that we have a satisfactory adjustment and can continue. Screw in both lubricators; this will apply pressure on the locating keys and in turn will tend to open the bearings and release the clamping of the mandrel, allowing it to rotate. This is the basis of adjustment of the headstock bearings, and two or three attempts may be necessary to achieve the optimum of free rotation with no side movement. When satisfied, make some temporary marks on the ring nuts to assist in the final assembly.

4. Tighten the thrust adjusting ring nut by hand, to eliminate any end float of the mandrel. Over-tightening of this will cause overheating and further problems. One thing to check here is that the thrust of the mandrel is being taken on the thrust bearing, and not on the collar of the mandrel to which the chuck abuts. This can be ascertained by ensuring the lack of free play between the thrust bearing and the shoulder of the mandrel to which it butts. As we adjusted the bearings in the headstock, we have in fact pulled them apart, and although the thrust is taken on the rear bearing, the mandrel has moved in the direction of the tailstock. The likely event of this action is to create a gap between the thrust bearing and it's locating shoulder. If this is the case, measure the gap and find a suitable washer a few 'thou' thicker to put there (the diameter of the mandrel at this position is 0.750in.). This will position the mandrel towards the tailstock, and provide a clearance at the mandrel collar and front bearing.

Final reassembly

Remove mandrel from headstock as described previously, and reassemble, replacing pulley, back gear and belt, and adjust. It is here that the dummy shaft is used. Inserted through the tail-end bearing, it will temporarily locate the thrust bearing and any additional washer placed on the inner end. With the pulley and backgear (with the belt) held in place, the mandrel (with the key correctly positioned and any retaining tape removed) is inserted through the front bearing. It should pick up the dummy shaft, retaining the thrust bearing in location. The two shafts are then moved together until the mandrel is in position and the dummy shaft removed.

At this stage it may be a good idea to fit a new drive belt. To do this it will be necessary to dismantle the lay-shaft assembly. Having got this far, this small exercise has got to be considered fairly straightforward, and therefore is not detailed in this article. However it will be highlighted when I describe how to build a drive clutch. If a new belt is to be fitted (mine was fitted with a linked belt), take the old belt as a pattern to your local supplier and I'm sure that you will get a suitable replacement 'V' belt. The machine will run much more smoothly and quietly for this little extra attention.

Having got the headstock reassembled, it is time to lubricate the bearings. I would suggest adding oil (I use car engine oil) to the lubricators, and rotating the mandrel by hand until oil runs out of the bearings, thus ensuring adequate initial lubrication. With both drive belts fitted and adjusted, select a speed of about 500-600 rpm. Now is the time to :- *stop, think! and recheck* your work, and make sure all tooling and equipment is clear of the machine before starting.

Adjusting the drive belts can again mean many different things to different people. In this application, I adjust them 'not too tight'. To achieve this, initially adjust the belt to a loose tension. When the machine is run, the belt will almost certainly flap. Now adjust the belt to a position where the flapping is just eliminated and then lock the adjuster.

With care this can be done with the machine running; make sure that you have no loose clothing or long hair which could get caught up if you adopt this course, think safety at all times. If you feel happier, stop the machine and do it in stages. If you were to continue increasing the belt tension beyond this point, you would hear a change in tone of the machine, which is the result of increased load being applied to the mandrel and bearings that we have just spent time and effort in reclaiming. Try it and then back it off to the 'not too tight' position. This should give a situation where:-

i. Shafts and bearings are not overloaded (less wear)

ii. Oil, being gravity fed in small quantities has a better chance of fulfilling it's objective

iii. Should the lathe jam up for any reason, there is a good chance that the belt will slip, perhaps avoiding any further damage and personal injury.

Hence, 'sensible' belt adjustment can have real benefits.

Now that we are happy that all is well, start the machine, and if all continues to be satisfactory, allow the machine to run 'off load', continuing to lubricate the bearings. Giving regard to the rotating shaft, lightly touch the headstock bearing areas with a finger tip. Note the rise in temperature; both bearings should be at a similar temperature, and only slightly warm. If one or both reach a temperature with which we wouldn't want be in constant contact, then they are too hot and possibly slightly over tightened, needing to be released a little. If only the tail end bearing overheats, check the mandrel end-float. If there is none, slightly release the thrust ring-nut. Continue this 'running in' until the machine runs with the bearings at equal (just warm) temperatures.

Remember, if adjustment is required, to release the lubricators which lock the locating keys, and that it may be necessary to tap the headstock with that judicious punch and hammer.

All that is left to do is to rebuild the remaining parts onto the machine in reverse order to that which they were removed. It may be necessary to add a washer to the backgear eccentric shaft to obtain proper alignment of the gears.

The thrust bearing (number FT $^{3}/4$) and V belt can be obtained from bearing factors such as Wyko-Ewb, a nation wide distributor who can be found in good old Yellow Pages.

Should you be unfortunate enough to have a mandrel and bearings which are not fit for re-use, then a visit to your local machining engineers to have replacement parts made may be necessary. There may even be some professional engineers who read this publication who can help in this area. If you have friends or colleagues with home workshops, perhaps they will be able to help you out. Before committing yourself to any major expense, you would be well advised to examine the rest the machine and assess the viability of this route.

In future articles I hope to be able to describe improved lubricators and a way of increasing the ratio between the mandrel and the lead-screw, giving a finer cut in auto feed and hence a better finish.

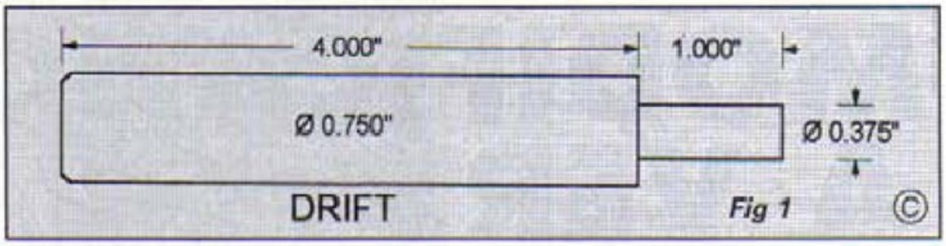


Fig 1

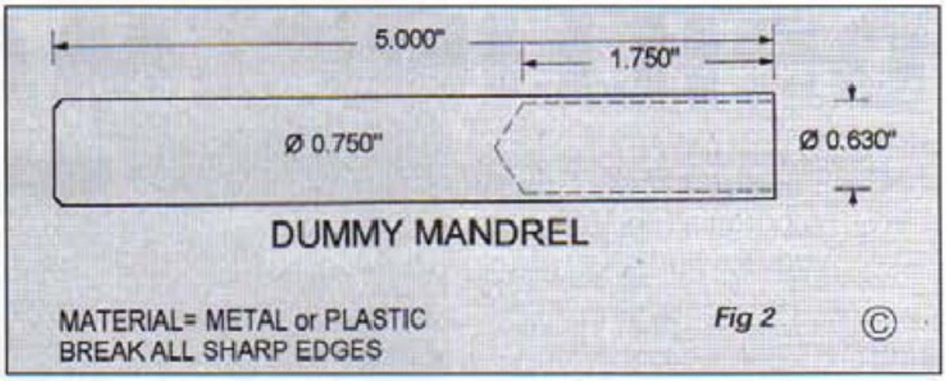
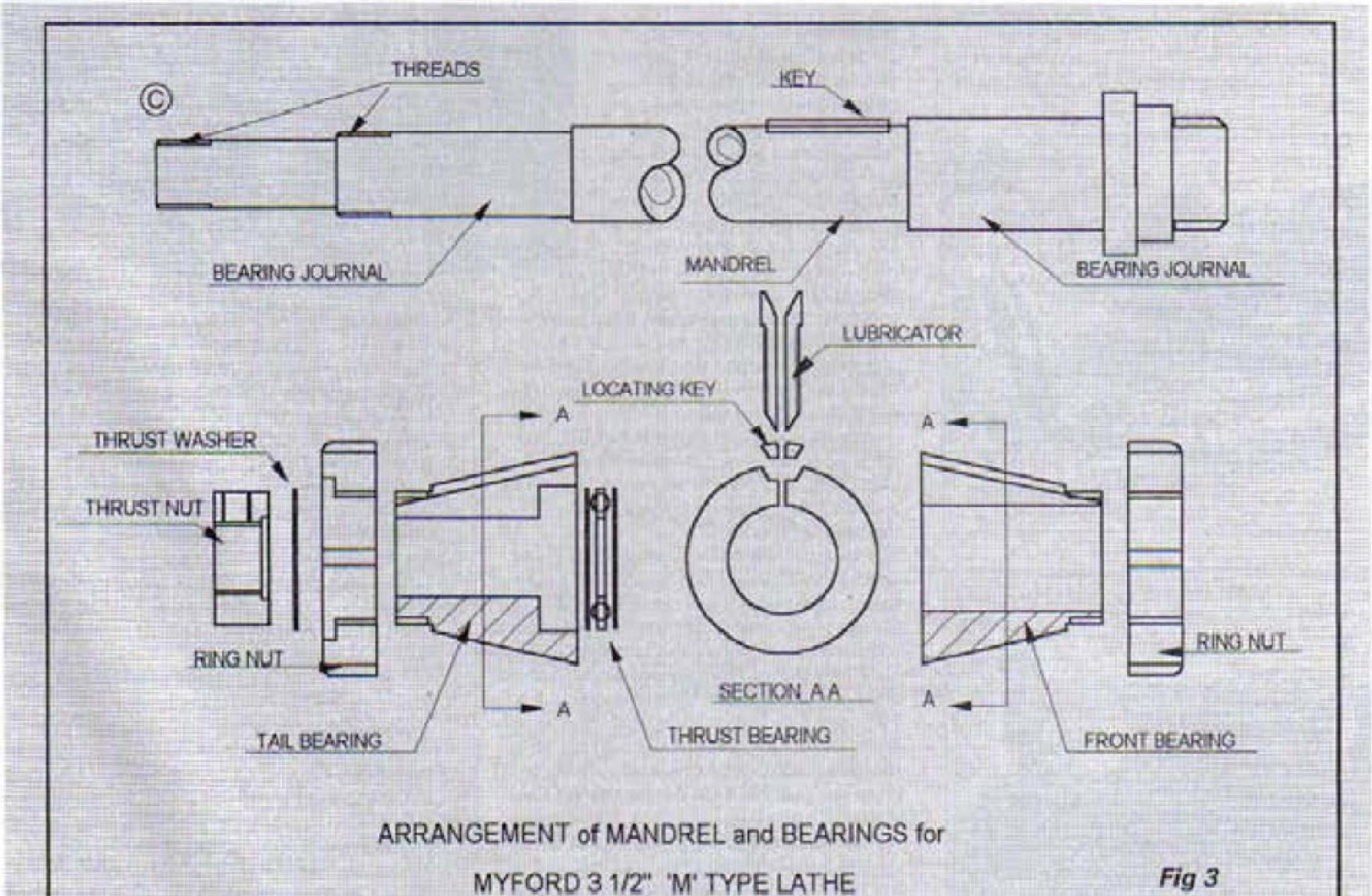


Fig 2



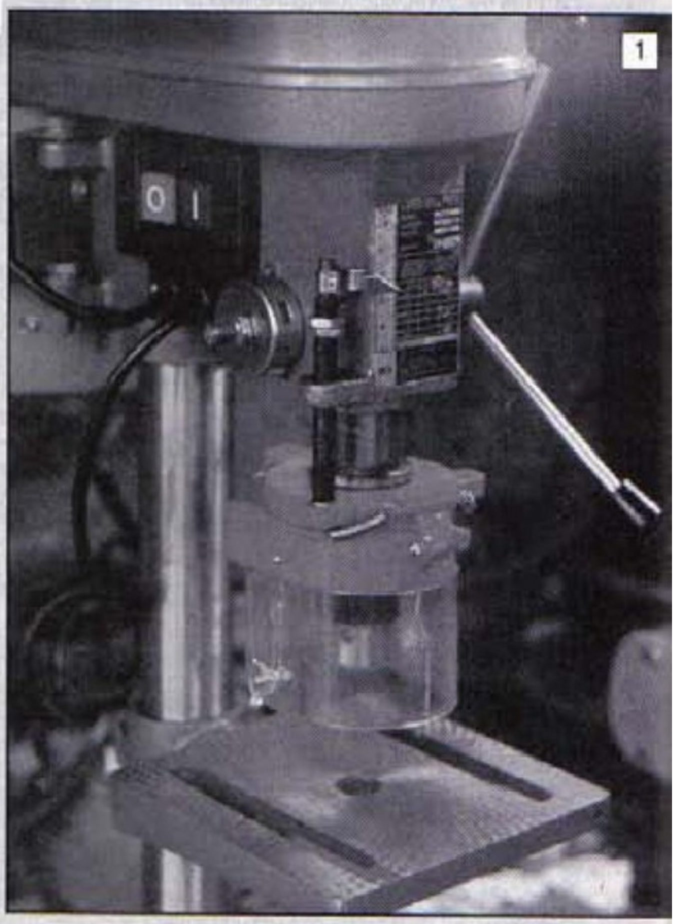
ARRANGEMENT of MANDREL and BEARINGS for

MYFORD 3 1/2" 'M' TYPE LATHE

Fig 3

MODIFICATIONS TO A VERY LOW COST DRILLING MACHINE

Geoff Bartlett of Selly Oak, Birmingham couldn't resist a bargain, and found that, with a few hours work, he had a very useful little machine



1

I have little doubt that many people have seen these little machines for sale in DIY stores for silly money (less than £40), and been tempted as I was, and they have also wondered how they could possibly be made for the price. What do they pay the Chinese workers?

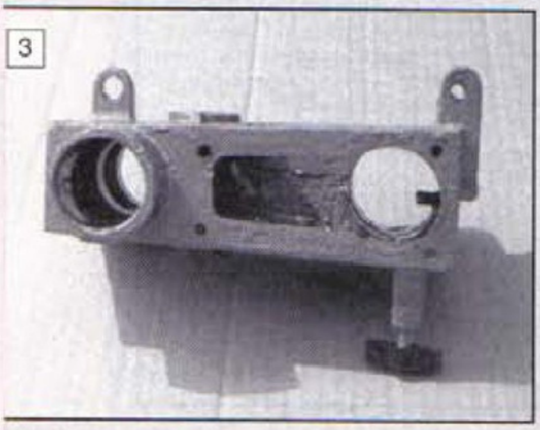
Well, I didn't really need another drill, but could not resist the temptation and, of course, it would be very useful to fill the gap between my little home-made co-ordinate machine and the large pillar drill, which has a big capacity, but needs two strong men and a boy to raise or lower the counterbalanced table.

A colleague has purchased one of these machines, and he gives it a right bending for woodwork and metalwork. His hobby is making armour, pots and pans, weapons and other artefacts for the Viking Society. His comments on the machine were that he liked it except for drill wobble (as he put it) and being a little under-powered for wood chobbling.

Looking at the machine in the store, I was impressed with its rigidity for such a light-weight construction and by the nice handy size. It seemed quite well made, considering that you can't expect real precision engineering for the price, and I decided that any shortcomings could be improved upon. On getting it home, I was pleased with the purchase as, for the purpose for which it was sold (i.e. DIY and hobby use) as it stood, it would be fine (**Photo 1**. We do, however, need a little better, and the somewhat scraunchy feel and amount of play in the quill slide (or column) meant that it needed some work. Quick first order tests showed that the drill was at right angles to the table and parallel to the pillar, and that the chuck ran true, so that was OK, but the aforementioned play and poor finish on the sliding quill were the real problem, and I must admit that these were a satisfying challenge to correct.

2

3



I thought maybe that it would entail machining out the bearing surfaces in the head casting and fitting bushes, or even maybe at worst making a new quill, but decided to reserve a decision until the head was stripped down to see what was what, and for this purpose I completely dismantled the head.

Photo 2 shows the component parts, and at this point, I must say that if anyone wants to do what I am describing, it is not necessary to strip it this far. All that is really required is to remove the handle and pinion gear spindle and the set screw and locknut at the right hand side of the head casting. The complete column and quill can then be withdrawn. Of course, it is desirable to remove the complete head assembly from the pillar and lay it on the bench to look inside (**Photo 3**).

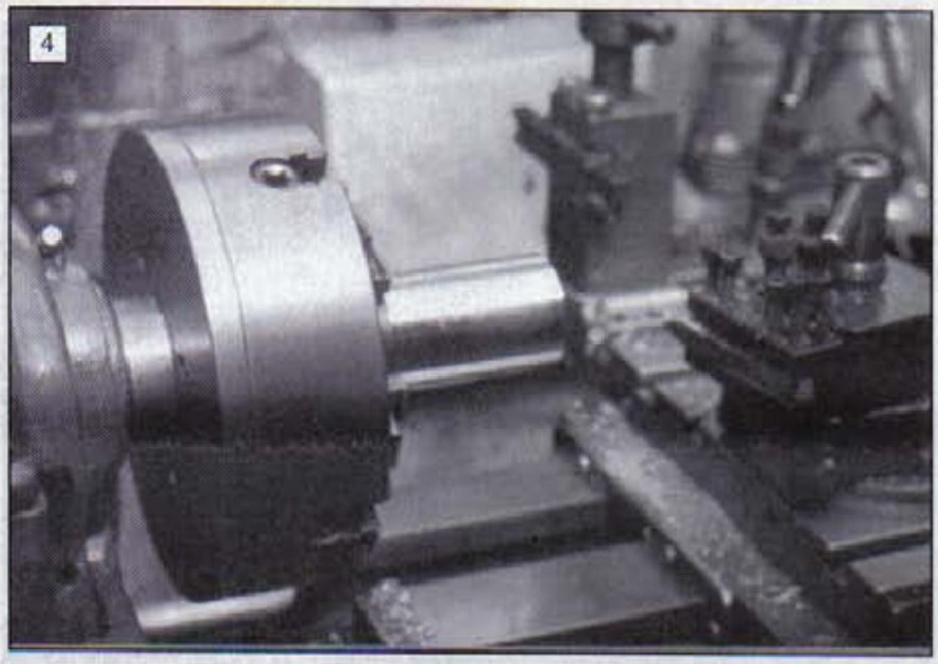
The set screw mentioned above is really an anti rotation guide, but it is inferred in the manual that it can be used to reduce play in the quill. This is a non-starter, as can be seen when the quill is examined, as the bottom of the keyway has a surface like the Welsh mountains (more later). The quill itself has an extension which is squared off to slide inside a square hole in the drive pulley spindle, this spindle being held in two good quality ball races fitted in the top of the head casting. These bearings are well fitted, as also are the main spindle bearings (no detectable play here). The turned finish on the quill itself was so bad that one wonders how it could be done other than deliberately. A pole lathe and hand held tool could have done better; very odd since the bearing housings have a much better finish and are to size.

On examination, it seemed to me that to machine out the casting would:-

a) be too much work and

b) cut into the sides of the casting wall somewhat.

However, it seemed feasible to take off a 25 thou cut or thereabouts from the quill and to make a thin walled sleeve to fit inside the head casting. This would hardly encroach on the rack gear teeth and would not weaken the quill, so seemed to be the best approach.



A hunt through the scrap box revealed a piece of thin walled brass tube of nominally 1.5in. inside diameter, a bit marked, but not dented (to the naked eye). I needed 2.5in., but cut off a piece 4in. long, as this would go right inside the 4 jaw chuck, with just over 2.5in. extended. I am quite used to performing on thin tube walls for hot air engine displacer cylinders, so this held no fears, but a plug is essential for this work. A steel offcut was therefore turned to a tight fit in the tube and fitted so that 2.5in. plus was clear inside the tube to enable boring to take place.

When setting up the 4 jaw with the tube, it is necessary to discriminate in your mind's eye between run-out and out-of-round depressions, and hope that your mental calculations and guesswork will have left you with enough material for the job. Having done this successfully, I turned the outside diameter of the tube to a few thou. less than that of the head casting bearing surface **(Photo 4)**. It was felt desirable to not have too tight a fit, as it was going to be Loctited anyway, and there is nothing worse than getting a test assembly stuck especially with a thin tube.

This having been completed without leaving any depressions in the surface, the sleeve was bored out to 1.530in. and honed to a fine finish.

Caution

Please note that the dimensions given are as remembered, and apply to my machine, so make your own checks and modify as necessary.

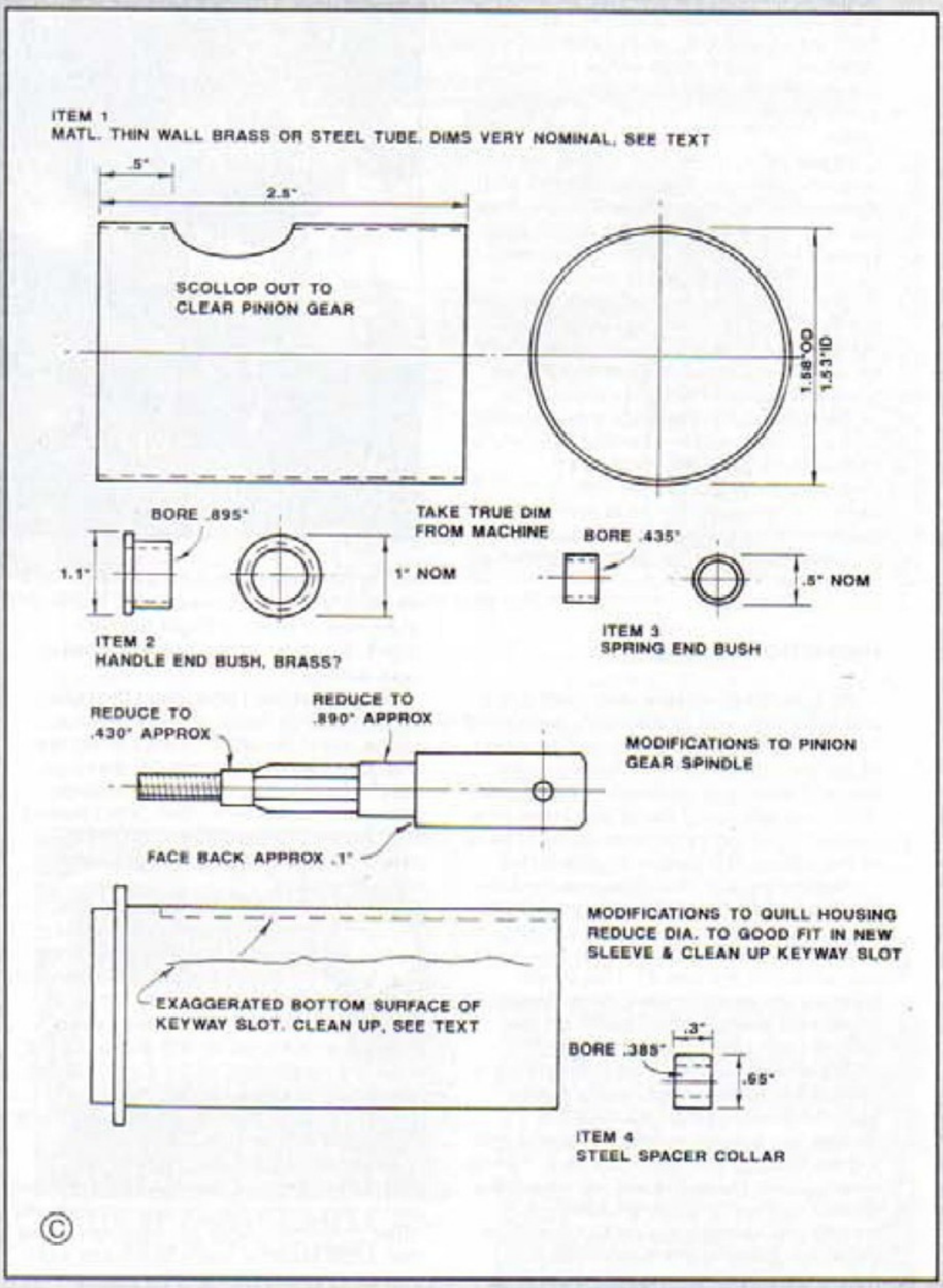
Operations on the quill

The next step was a trial fit in the head, and it was tight but removable (just). I resisted the temptation to part off the sleeve as the waste piece is a boon for fitting, and is removable later.

Attention was now turned to the cast iron quill, which was also held in the four jaw, but supported at the tailstock end on a plain centre in the drill's own spindle (which was not removed). The quill was now turned down to a fine finish, to be a close sliding fit in the new sleeve **(Photo 5)**. While set up, the opportunity was taken to clean up the keyway slot. I would normally use a slot drill in the toolpost mill to do this, but in this case opted for the quick way, (which I don't really like), with a parting tool turned on its side, using the lathe as a shaper **(Photo 6)**. This need not put any undue strain on the lathe, as it is only necessary to gently shave off the bumps and, as soon as it feels tight, just to back off a little and to retract a few thou, repeating until a clean scrape is taken over the length. Remember the setting then rotate the chuck a little, and repeat the process. A final clean up with a bit of wet and dry on a slip of metal, and you have a near-perfect slot.

I used an indexing device to hold the lathe chuck, but you could just as easily prevent rotation with one hand while operating the carriage with the other.

Reverting for a moment to making the sleeve, I did not in this case use a steady, as

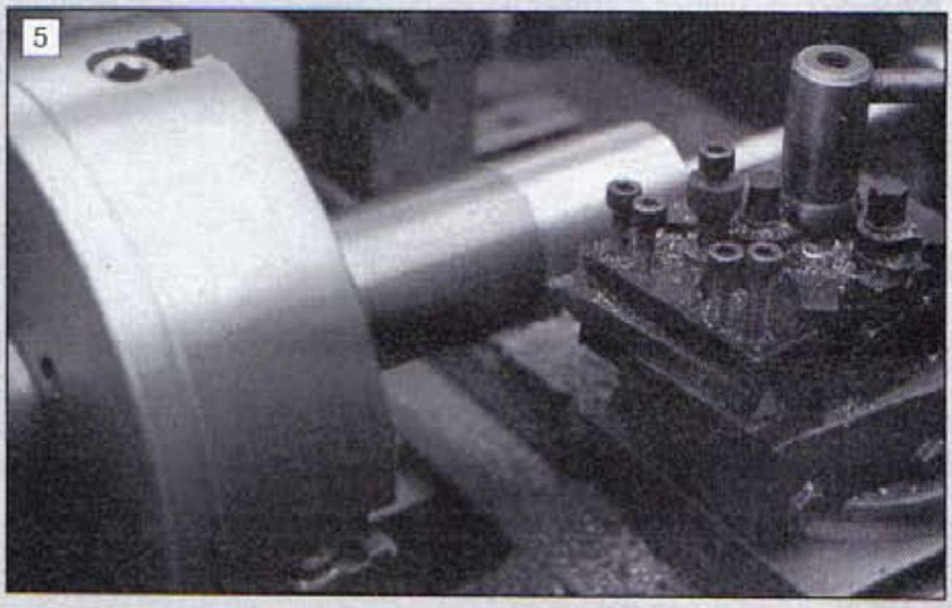


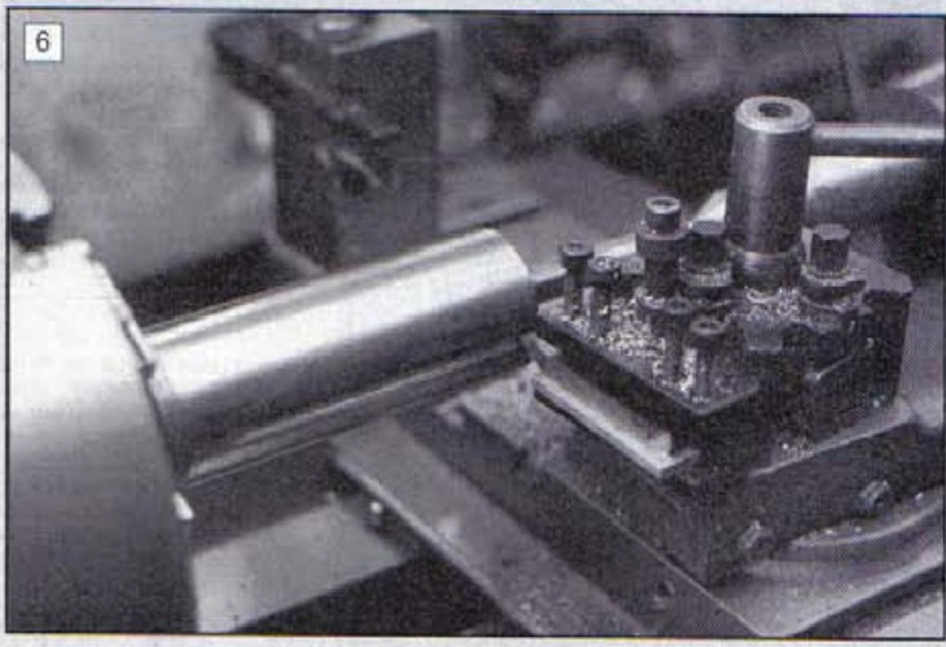
the cuts were so small and the tube was very securely held. As the material was brass, the cutting forces were minimal. Had it have been stainless, I would have used a steady, together probably with a plug at the outer end. Of course if you are a masochist, the sleeve could be made from the solid, but I would need a special dispensation from on high to waste that much material!

The sleeve needs a section scalloped out to clear the pinion gear, and various methods are possible. The one used was to hold the sleeve end-wise in the vice, with pads, and starting 0.5in. from what was to be the outer end (i.e. where the waste material finished), very gently to saw out, with a junior hacksaw and a blunt but not damaged blade, a section about 1in. long. This was gently cleaned up with a smooth half round file, and finally, with one of those very useful deburring tools. A check on the quill would soon reveal any distortion.

The next step was to smear the sleeve with Loctite then slide and gently tap into place, making sure that the scallop was in the right position. Having allowed the Loctite to cure, with a little heat to speed up the process, the waste piece was sawn off flush with the casting, and gently filed and deburred. A trial fit, with a little oil applied, did reveal a few tight spots which were easily scraped out to get an easy, shake-free slide.

At this point, apart from drilling out the setscrew hole with a tapping size drill and again deburring, the job was virtually done, but I decided also to bush the pinion shaft bearing surfaces. The pinion did not wobble about in the casting, as the tension in the wind-up spring tended to disguise any play, but the fit was poor, and play not too apparent, more due to misalignment than to close fitting. Again, thin-walled bushes were made, and in fact I had to resort to pulling one hole in the casting over slightly with a file, followed by reaming to improve things. Once again, the method of removing material from the spindle was used to make room for the bushes, and so any dimensions given are not absolute, i.e. part A is made to fit part B as you might say (who cares).





Assembly

All that remained now was lubrication and assembly, and all was well, but a word here about the wind-up spring. The action of the quill slide, although feeling quite free and easy, was obviously a little tighter than originally, and I found that I was on a hiding to nothing by increasing the tension of the spring. The reason for this is that increasing tension also increases the side loading and friction on the pinion spindle as it passes through the spring housing, so to alleviate this, I made another little bush (not shown in the sketch). This simply takes up the space in the hole in the spring cover, and prevents the threads on the spindle from binding on said cover.

The easiest way to tension the spring is to hold it in place in its housing and to pass the pinion spindle through the casting just enough to locate in the spring, but not enough to engage the rack, then to wind up with the pull down handles to the tension you want before pushing the spindle and spring housing fully home. A big word of warning though. Hold the spring housing either with a gloved hand or using a piece of strong cloth. I have a piece nicked out of a finger because I didn't. If it slips, its like holding a flail in your hand.

To gild the lily, I also made the collar (item 4), which fits on the table clamp screw. It has the effect of improving the feel, and also of throwing the clamp handle further out, making it easier to operate. Another small item (not shown) is an aluminium knob fitted on the belt guard lid, which makes it very easy to open and close.

Changing speed on this machine is, incidentally, delightfully quick and easy, and I must say a far better method than that found on some much more expensive machines. I mean, who really wants to undo two knurled nuts and then wrestle with a heavy motor on stiff slides? I'll bet drills are rarely used at the correct speed on many machines for this reason.

Well, I am very pleased with the results of these mods, as I am with the little machine in general. No play can be detected in the quill, even at full extension, and it very nicely fills the gap between my other machines., After all, what has it cost me? Little expense and a few hours work one weekend. Oh! I forgot—and a nicked finger.

My colleague's remark about being a little under-powered is true to some extent, but hardly likely to cause me much trouble.

A motor puzzle

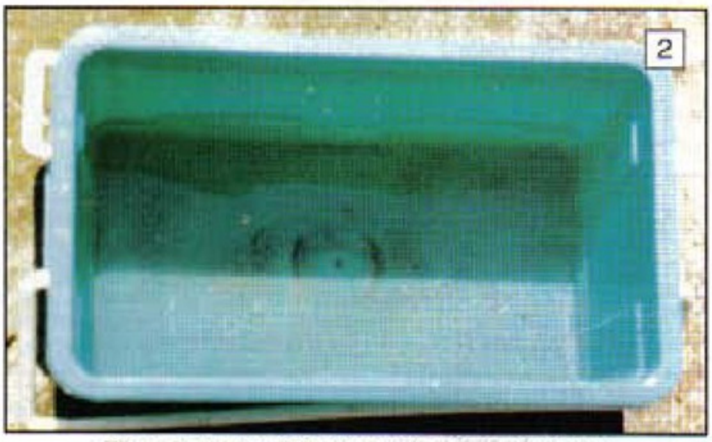
It does however raise a query which has puzzled me for years, and someone out there may know the answer. We all know the difference between electrical rating and Torque RPM rating, which should be the figure quoted on motors. However, I would bet on my Granny's teeth that the larger frame size motors available in say, the 50s and 60s era, actually produced more power for a given rating than that attributed to some modern motors.

My explanation, right or wrong, is that modern ones produce their quoted ratings at the shaft just before stalling, but the older ones were very conservatively rated at the maximum safe power on a continuous basis, but could produce considerably more than this before stalling. Any answers?

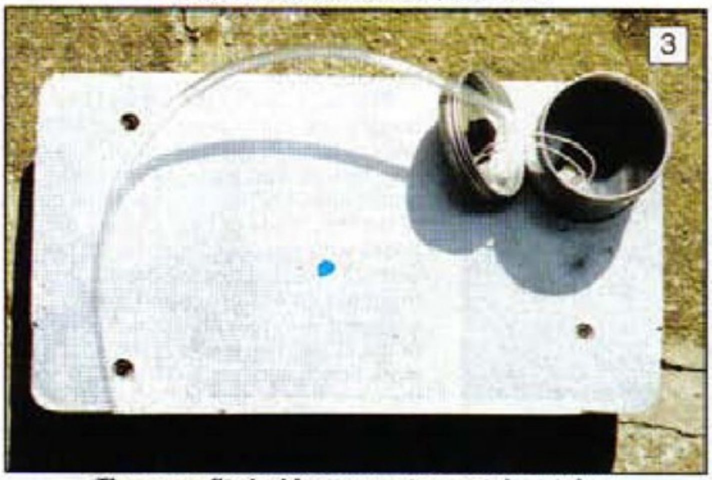
A SIMPLE CLEANSING TANK

D.O. Coe shows how one of the many plastic items now available can be transformed into a handy piece of workshop equipment

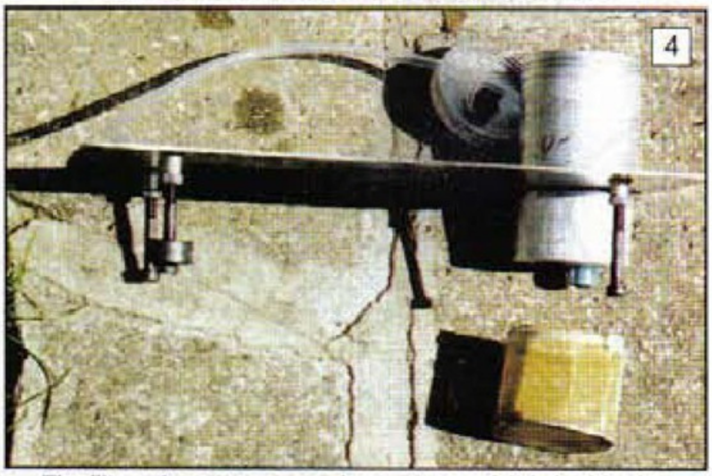
The plastic picnic box, as purchased



There is plenty of depth for the pump assembly.



The pump fits inside a screw-top metal container.



The filter, plate supports and magnet are visible in this shot.

The idea of making a cleansing tank came to me when I saw a suitable container, with lid and handles, in a local store. It was originally intended for picnic use and cost £3. To adapt it, the following parts were required:-

Car windscreen washer pump (mine came from an old Metro)

Aluminium plate to fit box at halfway height.

Four long cap head screws or studs to hold the aluminium plate at half height in the box.

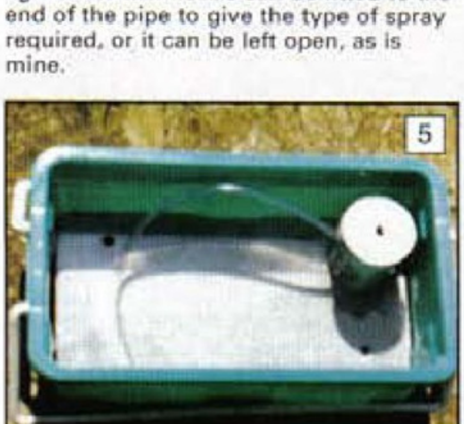
Metal container, with lid, to house pump. (mine was aluminium, soldered into plate).

Gauze to make filter to fit over the bottom of the pump housing (secured with a nylon tiewrap).

Magnet to collect ferrous particles.

Tube from pump (windscreen washer tube).

No sizes are given, as the builder will probably use odds and ends from his 'junk box'. The photos give a general idea of construction. Power comes from a 6v. motor cycle battery (or 12v. car battery charger, which will give increased flow). I suggest that you use paraffin or white spirit as cleansing agent. A small nozzle can be fitted to the end of the pipe to give the type of spray required, or it can be left open, as is mine.



'The Works' installed, leaving adequate space for the workpieces.

I have found the cleansing tank very useful to wash small parts before assembly and for cleaning metal swarf from the scroll thread and jaws of lathe chucks.

To clean the tank, simply lift out the plate, complete with pump unit, leaving the fluid in the container. A small magnet could be left loose in the bottom of the container; I found a round magnet, which I fitted to one leg of the plate support. It has proved to be very effective in collecting ferrous swarf.

When cleaning operations are finished, the lid is fitted to keep everything clean.

Safety note

The use of goggles is advised, to prevent any splashes from reaching the eyes.

AN ELECTRIC SHOOTING BOARD

Many home workshops are now equipped with an electrically powered router. Mike Delaney of Oakville, Ontario added some accessories which helped to solve a long-standing problem.

When I was in Woodshop classes at school back in the forties, we were taught to use a wood 'Jack plane' with a device called a 'shooting board' to finish the end grain of pieces of wood. To the despair of Mr. Lacroix (Gummy), I seldom managed even to get the plane adjusted. The procedure required that one strike the plane body, the plane iron and the wedge in the right order and with the right weight of blow from a wooden mallet. Use of a hammer was a detention offence! Also, a mistake, in order or strength, could result in the sharp blade being fired out onto your foot or worse, from the instructor's viewpoint, the concrete floor! Then, when in pity, the plane was set for me, I usually managed to chop as much off the shooting board as the workpiece!

1 *The router suspended in the table top.*

2 *Cutting a 3in. dia. hole in thin plywood using a false centre attached with double sided carpet tape.*

I am now a little better a performer with hand tools. Hooray for the iron plane! I even made a shooting board.

Now I have the answer to many prayers - an electric router.

As I am much more a machinist than a joiner, it wasn't long before my router was suspended beneath a small table and was used as a jointer, spindle moulder, etc. It then occurred to me that if components could be simply clamped perpendicular to the direction of movement of a sliding table, a straight router bit would cut the end square in both planes. An electric shooting board!

Photo. 1 shows the set-up I use. I first bought one of the plastic router tables that are available in the tool stores, but I found it so flexible that accurate work was impossible. My home-made table consists of the top, made of high density particle board with phenolic laminate on both sides (a recycled display panel); this is mounted on a sturdy wood frame, enclosed with thin plywood, to trap some of the chips. The router table stands on the work bench and has a clamping piece at the front that is held in the bench vice. The router is suspended by its base mounting screws, in the centre of a disc of $^3/_{16}$in. thick transparent polycarbonate (Lexan), which is carefully recessed into the table top to give a flush surface. I found it is better to be a little bit too deep, rather than shallow with the recess. The mounting disc could then be brought up flush with paper shims. All the circles were cut with the router, using the guide sold by the router manufacturer as shown in **Photo 2**. To retain the centre point when cutting out holes, I used a piece of scrap material fixed across the work with double sided 'carpet' tape; the cut can then be made right through. (The carpet tape is useful for many purposes even for light chucking in the lathe. I have used it in particular when making shim washers. It can also be used to customise abrasive discs and pads.)

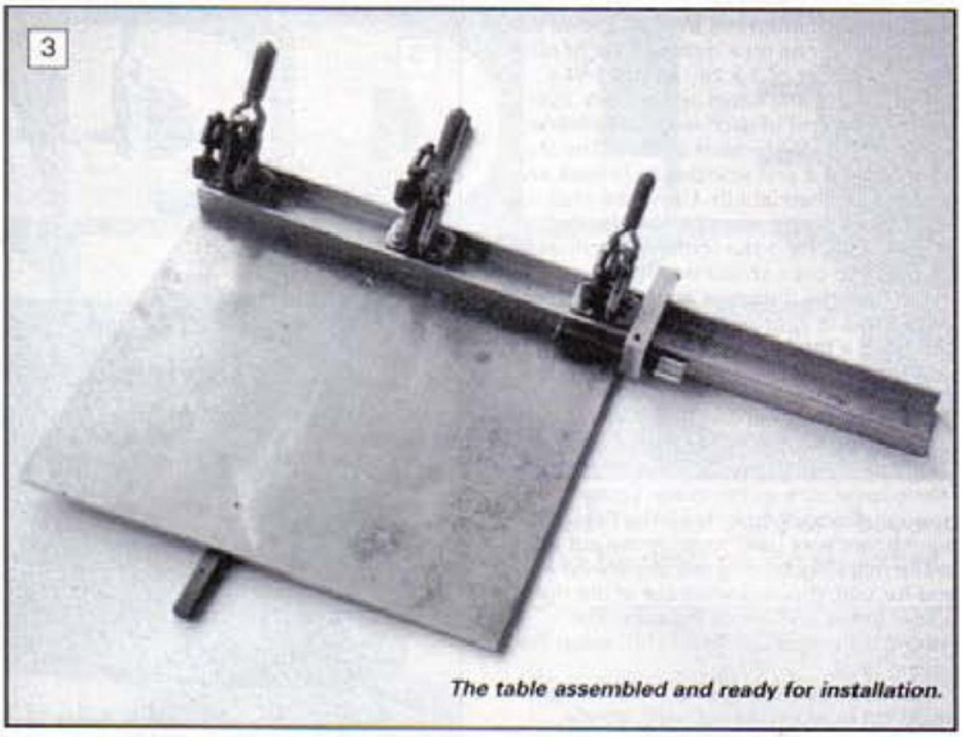
The thickness of material that can be finished in one pass by the sliding table device is limited by the length of straight cutter available. In my case, I could buy a two flute carbide tipped bit with $^1/_4$in. dia. shank, $^3/_8$in. dia. with 1in. cutting length; this decided the dimensions for fitting the sliding table. The slot for the slide was made about $4^1/_2$in. from the cutter centre, with a $^3/_8$in. dia. straight cutter, using a straight edge clamped across the table top as a guide. This slot is seen clearly in

Photo 1. The sliding table shown in **Photo 3** is a piece of $^{1}/_{4}$in. thick aluminum, 11in. wide x 10in. long, preferably in the 'hard' condition. Across the back of this, a piece of $1^{1}/_{2}$ x $^{3}/_{4}$in. aluminum channel is fixed to form the back stop. The three 'toggle clamps' that secure the work, rest on $^{1}/_{2}$in. thick packing blocks, and the assembly is secured by the twelve No. 10 screws which are tapped into the aluminum table. A 16in. long piece of $^{3}/_{8}$in. square steel was selected to form the feather key. The slot was actually shimmed at one side to get a really shake-free sliding fit. The shim was stuck in place to the side of the slot with 'thick' cyanoacrylate cement (Krazy glue).

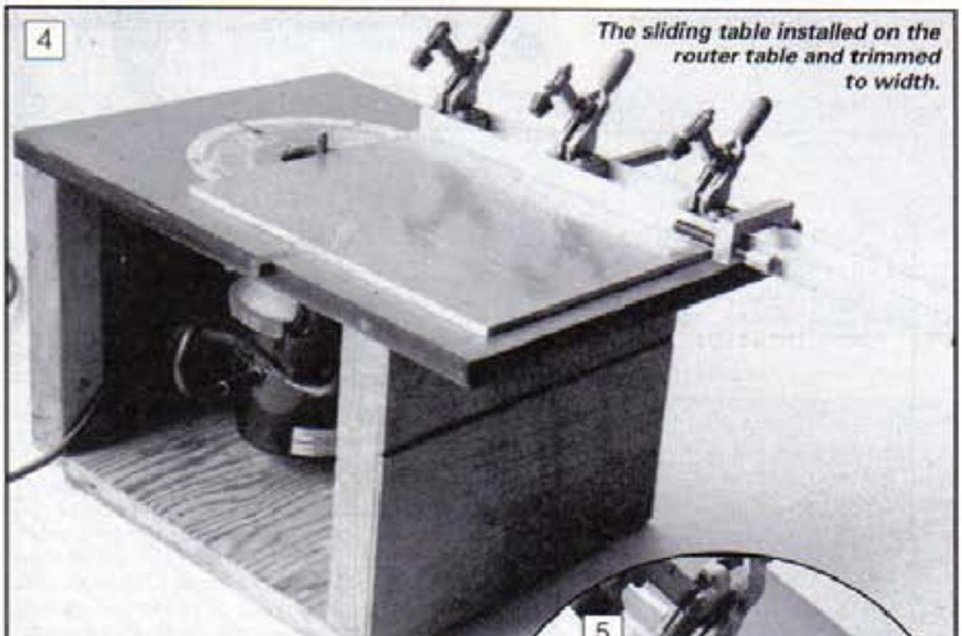
Now we come to the difficult part. The table has to be fixed to the key so that the reference stop, the side of the aluminum channel, is perpendicular to the key. This has to be as exact as possible. The method I used is shown is shown in the sketch, and was as follows. The distance from the cutter edge to the face of a piece of $^{3}/_{8}$in. stock set in the table slot was measured with a calliper. In my case electronic, but dial or vernier will do. To this dimension $^{3}/_{16}$in. was added to give the dimension to the centre of the slot, and 0.02in. added to give an allowance for final finishing of the edge of the table. At this distance from the edge and $^{1}/_{2}$in. from the face of the channel, a hole was drilled and countersunk for a No. 8-32 UNF screw. The matching tapped hole was drilled and tapped $6^{1}/_{2}$in. from the end of the feather key and on the centre line. A $^{7}/_{64}$in. dia. pilot hole was also drilled in the table, the same distance from the edge and 1in. up from the bottom. The table and key were assembled as near square as possible, using an engineer's square, and the assembly installed on the router table. Next a large draughtsman's set square was clamped against the reference face of the sliding table and a fixed reference set close to it at about the centre of the cutter. The end of the reference was set at a slight angle to the square edge. The gap between the square blade and the reference was then measured with feeler gauges at each end of the square blade as the table was moved past the reference. The tapered gap makes it easy to feel when a blade goes through or stops. The table was adjusted by pivoting about the fixing screw until the gap was constant. (If you are fortunate enough to have a dial gauge this operation can be simplified.) When I was satisfied that the gap was as close to constant as I could get it, and with the screw tight, the table was taken to the drill press. The pilot hole was opened up and drilled right through $^{1}/_{8}$in. dia. for a roll pin. A check after pinning showed the run out to be less than 0.005in. over 6in. If you aren't satisfied, you can punch out the pin and repeat the process with a new pilot hole.

Next, the edge of the sliding table had to be trimmed. Although I don't make a habit of it, aluminum can be machined with a router bit. The cuts must be light and you need good control. I left 0.02in. as the clean-up allowance. I have found 0.025in. to be about the limit with my router. Rather than risk the hard and rather brittle edge of a carbide bit, I used a high speed steel type. I set the router bit fully into the router collet and tightened it firmly. Then I used the router depth control to adjust the bit, so that the bottom edge was just below the bottom of the sliding table, and locked it.

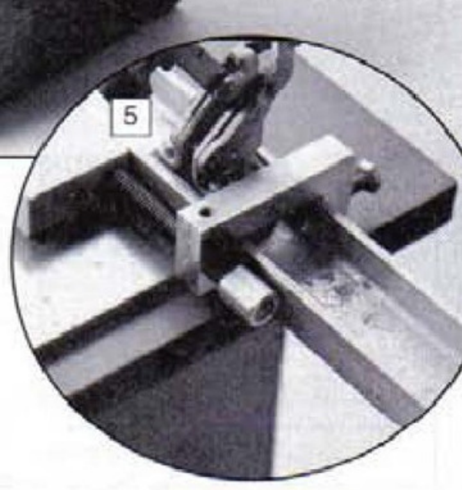
I should now remind you that you must always cut with a router against the rotation of the cutter. This means by sliding the table towards you. I installed the sliding table so that it was behind the cutter, started the router and slowly and steadily slid the table, past the bit, trimming the edge. I took particular care when going past the end of the channel. As the cutter was not long enough to trim the channel all the way to the top, I had to take a second cut with the cutter raised. There is a possibility, if the aluminum you have is in the soft (annealed) condition, that it will stick to the cutter and stop the cut. If this happens, and you will know if it does, you should clean the metal from the cutter and then use a lubricant such as WD40 while finishing the cut. The finished table is shown in **Photo 4**.



The table assembled and ready for installation.



The sliding table installed on the router table and trimmed to width.



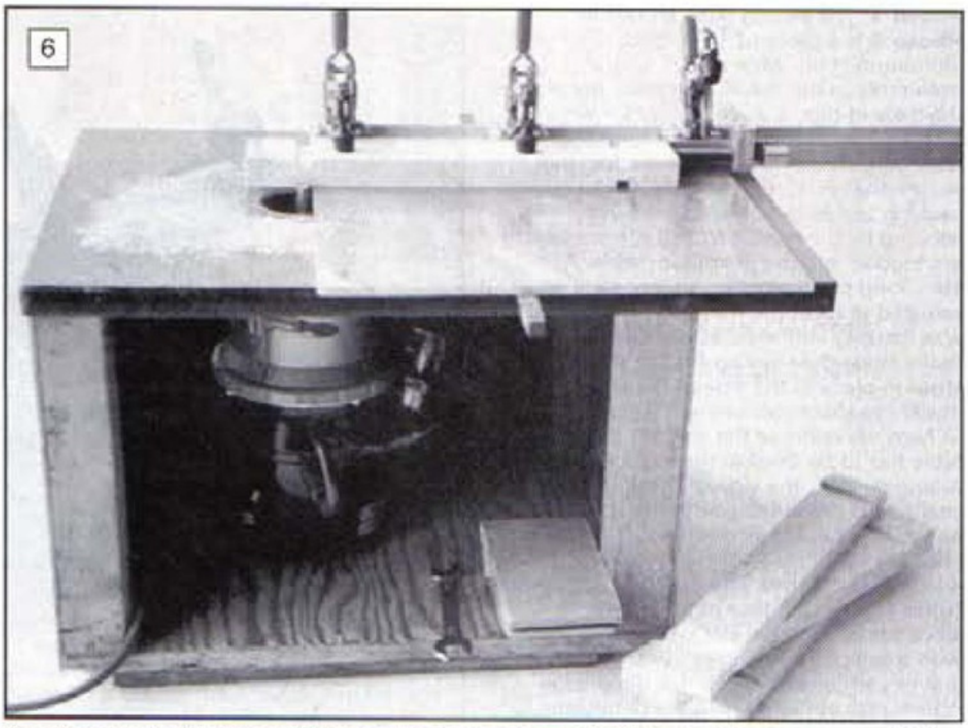
A close-up view of the adjustable stop.

As you can see, I left the stop on my table as long as the piece of channel happened to be. I then made the length stop to clamp to it as shown in Photo 4. The fine adjustment is a $^{3}/_{8}$in. x 16 UNF bolt with a square head. Turning one flat equals $^{1}/_{64}$in. of advance.

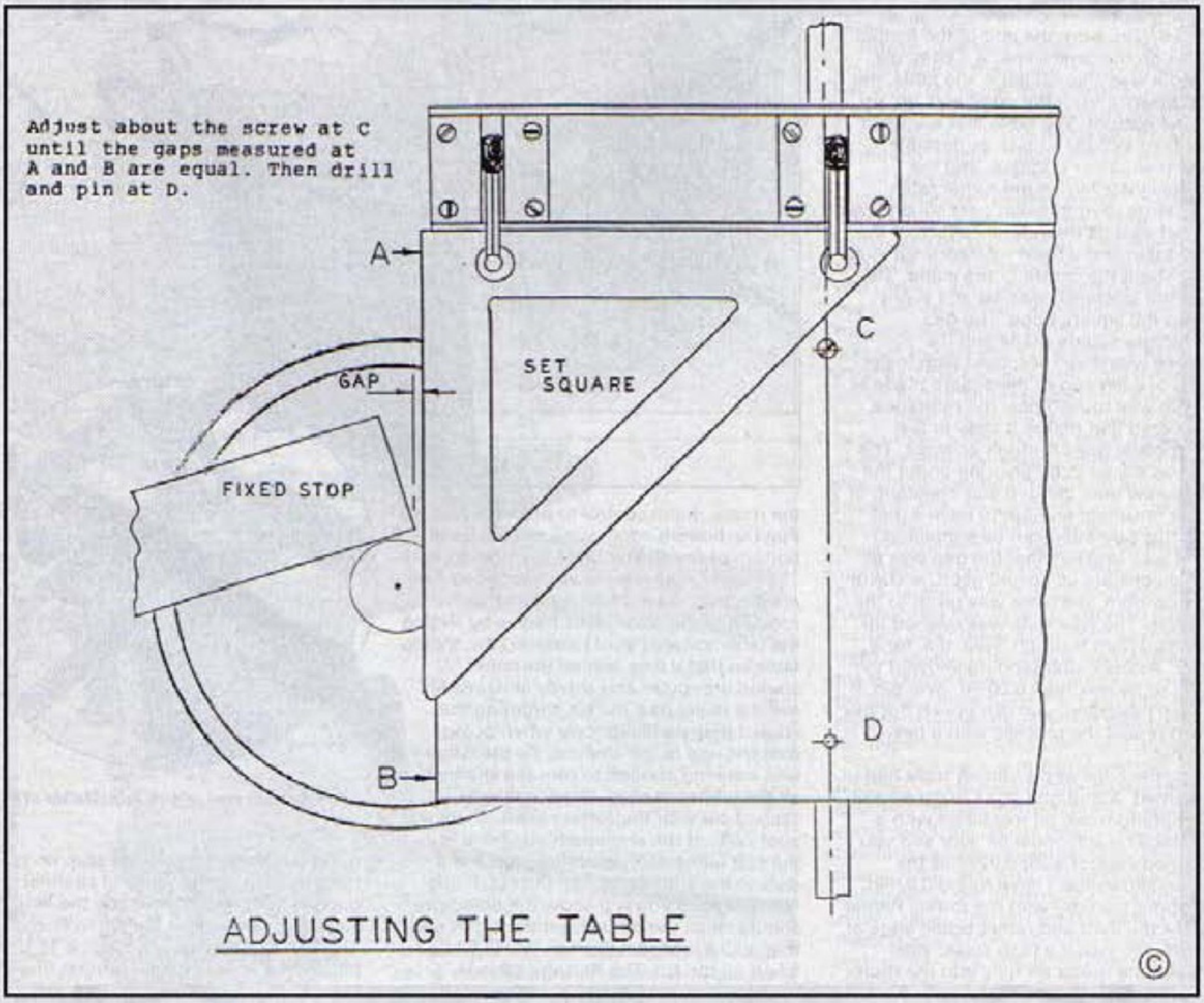
The final photograph **(No. 6)** shows the cutting of tenons on a matched set of rails. The four pieces of 1 x 2in. planed ($^3/4$ x $1^1/2$in.), were first sawn about $^1/8$in. over length. One end of each was then cleaned about $^1/16$in. on the sliding table. The stop was then used and adjusted to reduce one piece to finished length. Using the stop the other three pieces were finished to the same length. Next the router was adjusted for depth to cut a shade less than a quarter of the material thickness above the sliding table. (This is approximately $^3/16$in. and will leave a tenon that is a tight fit in a mortise cut with a $^3/8$in. bit.) The length of the tenon was then marked on the side of the first rail. The rail was clamped to the table with the mark a little back from the table edge, and a groove cut right through, taking extra care as the cutter broke through the back face. Then the fine adjustment was used to bring the cut right to the mark. By turning the piece over and end for end, grooves were cut at the right places in the ends of all the rails. The tenons were finished 'free hand' using the sliding table.

I use my table whenever I need a right angle cut in wood, fibre board, acrylic, polycarbonate, phenolic laminate, glass-polyester, or any other material that doesn't melt too easily.

6



Cutting tenons. The last defining cut is about to be made. One end has been completed out of sequence to show the finished tenon.

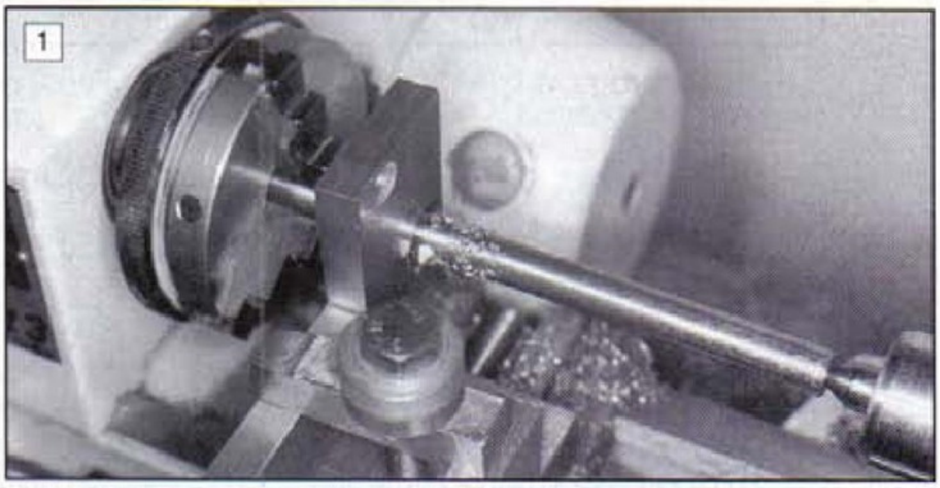


SADDLE BORING

Once again, Bob Loader shows how to make the Unimat 3 tackle jobs which, at first sight are beyond it's capability. In doing so, he describes some accessories which could also be used on larger lathes

One of the snags in using a small lathe for everything, is that some jobs are of a size and shape which will not hold in a chuck or clamp to a face plate. A common problem is that the work won't 'swing' without hitting the lathe bed or some other part. **Photos 1 & 2** illustrate both the problem and the solution.

The component in **Photo 1** has been clamped to the cross-slide, packed up to the right height, and bored from there. The one in **Photo 2** has a better shape, but is too long. It has been clamped to an angle plate, lined up and bored. Each was done using a boring bar, and the method was saddle boring.


A simple boring bar used to bore out an awkward shape.

The saddle boring method

This is a way of boring holes in awkwardly shaped work. It uses the cross-slide as a datum and the saddle feed to move the cutter.

It can be difficult to make boring bars for the smaller sizes, and an accurate indexing device is not easy to build in. There is too, a bit of setting up to do to put the hole in the right position. It can be simplified by marking out and centre punching or centre drilling. An accurately turned or ground point at 60deg. included will pick up the centre. I use the one shown in **Photo 7**, which was made a long time ago from a broken end mill. It can also be used where the marking is just two scribed lines crossing. To set work where there is an existing hole, a plug can be made, with a centre punch mark or centre drilled hole in it.

Once the work has been set, the operation is quite simple. A hole large enough to pass the boring bar through is drilled, the bar passed through and supported between centres, or in a chuck or collet with a tailstock centre at the other end. The hole can then be bored.

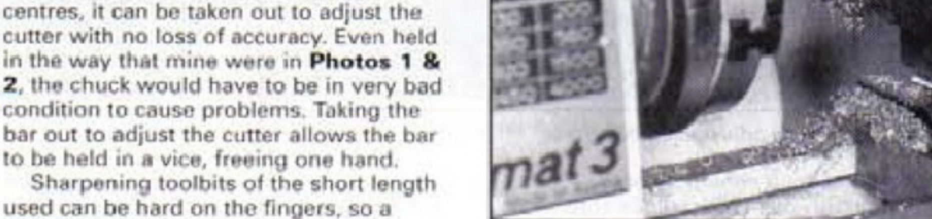
A simple saddle boring bar

Photo 3 shows the central section of a boring bar. It is cross drilled and reamed to fit a suitable tool bit, and another hole at right angles to the first one is drilled and tapped for a locking screw. **Figure 1** gives the details, actual sizes depend upon the work being done.

With the smaller boring bars, it is important that the tool bit doesn't stick out at the back. If it is under flush, measurements can be taken from the back of the bar to the cutter point. **Always** use a piece of material of a known size between the measuring face of the micrometer or calliper and the point; a lot of damage can be done otherwise. If the bar is held between centres, it can be taken out to adjust the cutter with no loss of accuracy. Even held in the way that mine were in **Photos 1 & 2**, the chuck would have to be in very bad condition to cause problems. Taking the bar out to adjust the cutter allows the bar to be held in a vice, freeing one hand.

Sharpening toolbits of the short length used can be hard on the fingers, so a grinding fixture is a good idea. It only needs to be a piece of 6mm diameter


A component which will not 'swing' because of its length.


The simplest form of boring bar.

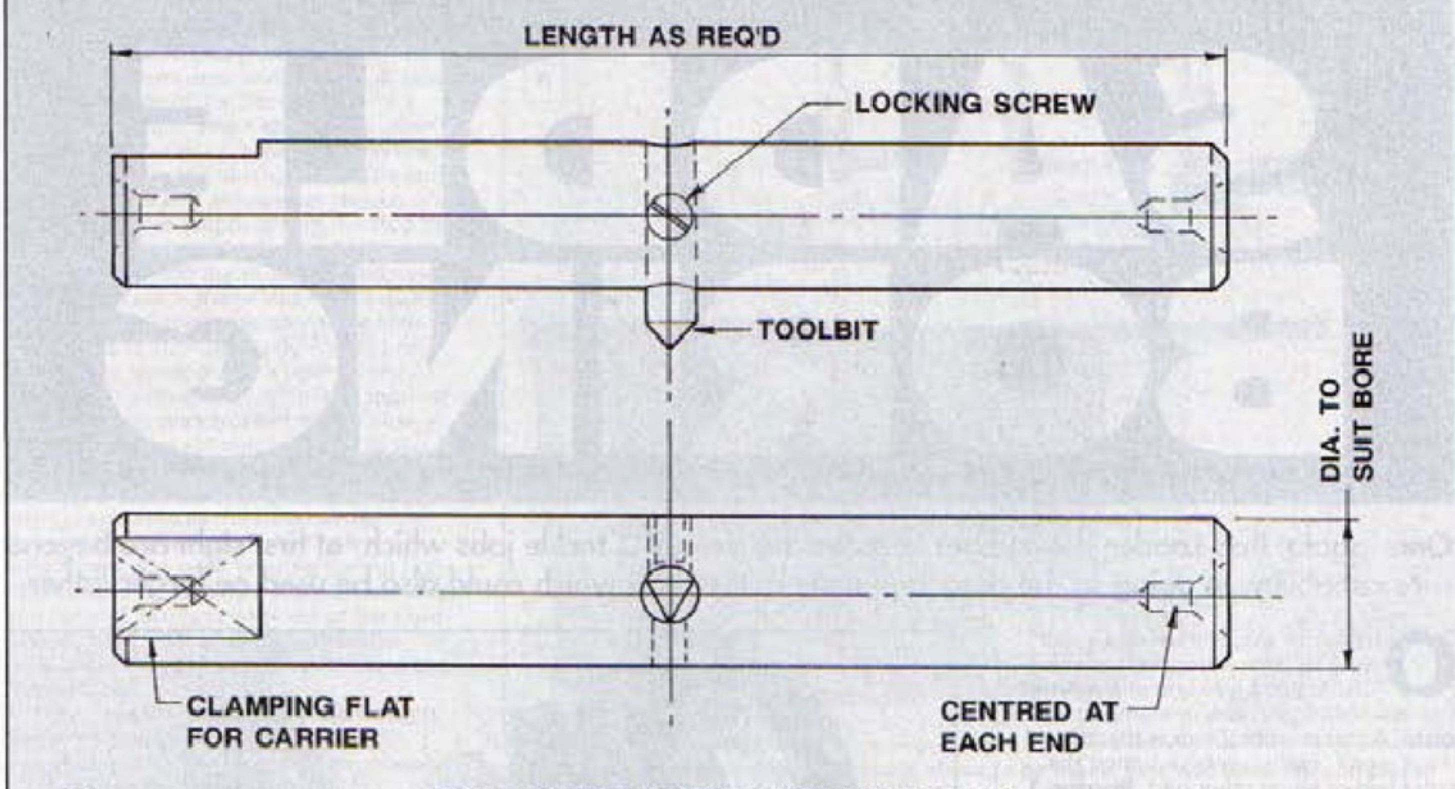
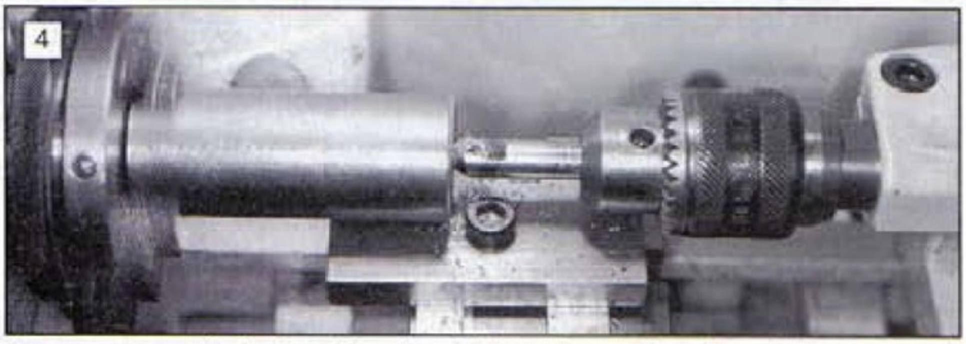
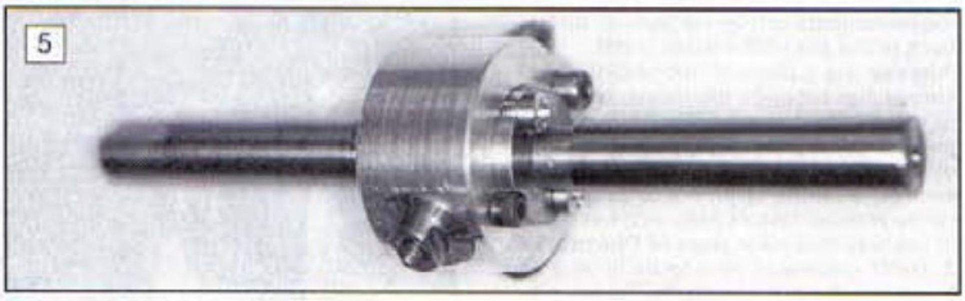


FIG. 1. SIMPLE SADDLE FOR BORING BAR



An emergency method of centring a bar which won't pass down the spindle.



The completed adjustable boring bar.

mild steel, long enough to hold comfortably, with a clearance hole for the bit and a cross hole drilled and tapped for a locking screw. The saving on finger ends and aggravation is considerable.

Problems with centre drilling

The boring bars in **Photos 1 & 2** are of small diameter because they will pass down the lathe spindle. If I want to centre drill larger diameters of any length over 400mm or so, I have to use emergency methods like the one shown in **Photo 4**—not an ideal situation. Packers and shims support the bar until it just rests on the support. By stopping it from moving in the vertical plane, it usually holds still enough to do the job. I wouldn't, of course, use it for anything else.

What I really need for such jobs is a fixed steady. It is on the list of things to do, and the excellent article by Alan Jeeves in Issue 34 has given me some ideas. To make a steady, I need to be able to bore out large hole, and that set me thinking about a larger boring bar for the Unimat, one which would be big enough to build in an indexer, and make use of the tungsten carbide tips I often use for turning.

The design stage

I made some rough sketches first, then, when I was fairly sure of what I wanted, I started to draw it. I have a Rotring Rapid A3 board and the usual drawing tackle. It takes time to draw the job, and often more than one try, but mistakes on paper can be rubbed out. A mistake half way through a complex piece of machining is a different and often more costly thing.

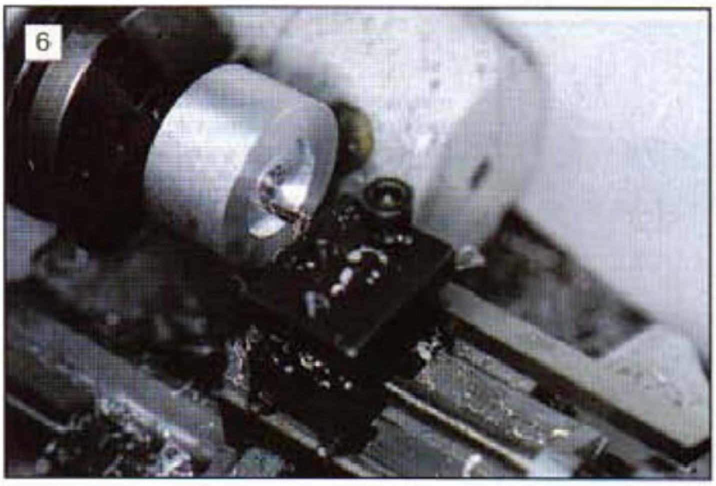
It took quite a long time and a lot of head scratching, but I finished with something which could be made on the Unimat, had no obvious snags, and wasn't over-engineered. The final design is the one shown in **Fig. 2, page 33** and **Photo 5**.

Design features

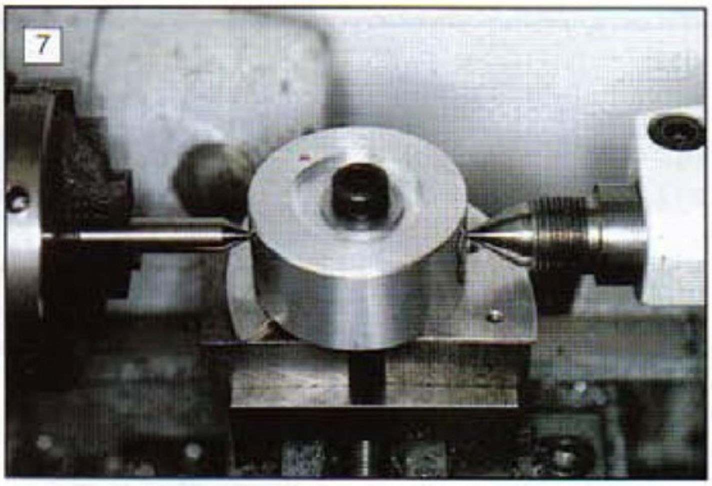
Making the boring bar with bolted-on spindles simplifies the machining. The materials I have specified are those which I had available and, as usual, they can be changed. The same goes for the unimportant dimensions. The cutter holder was made to take the Stellram tungsten carbide tips made for small lathes and stocked by firms like Millhill Tools. The indexing device was as simple as I could make it, and uses the 1mm pitch of an M6 × 1 screw. It gives a reasonably fine adjustment if a dial having 20 divisions is used. 1mm divided by 20 = 0.05mm. Finer movement would need a finer thread, a different number of divisions on the dial and a bit of modification.

Almost a costly mistake

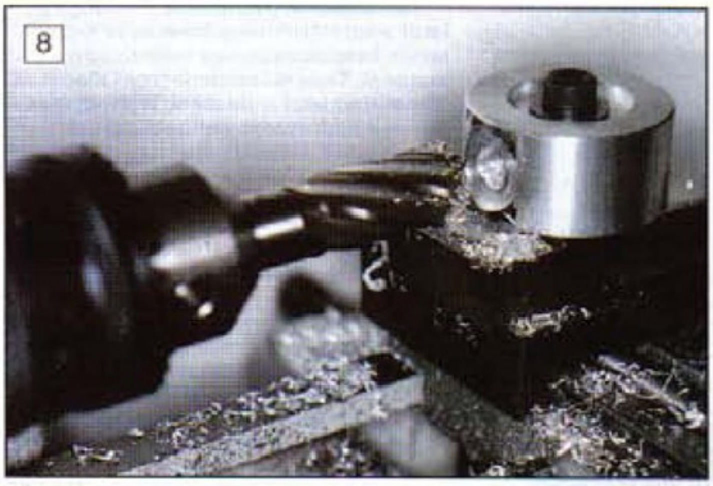
Most of the parts are easy machining and fitting, but I made the mistake of



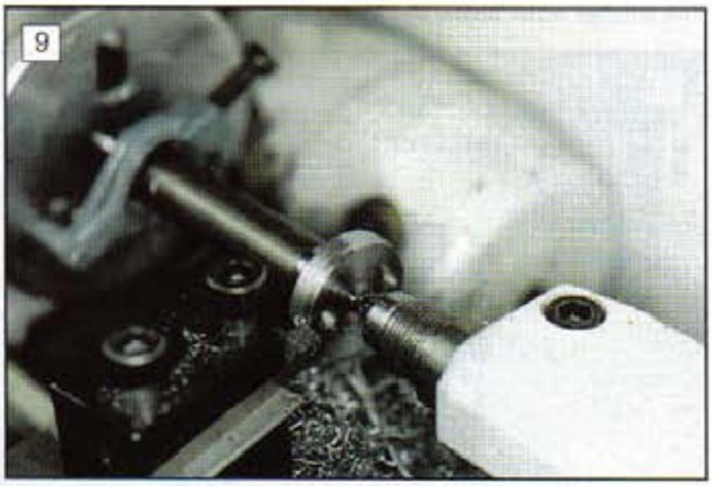
Boring out the recess in the head.



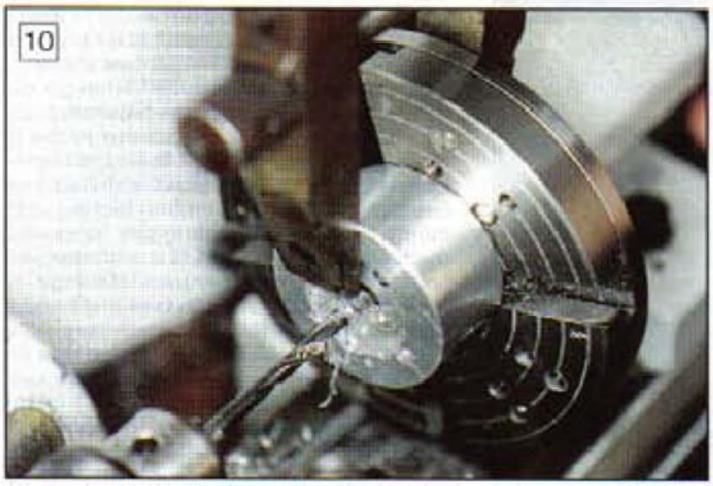
Lining up the head for cross drilling; note the packing and the use of the ground point.



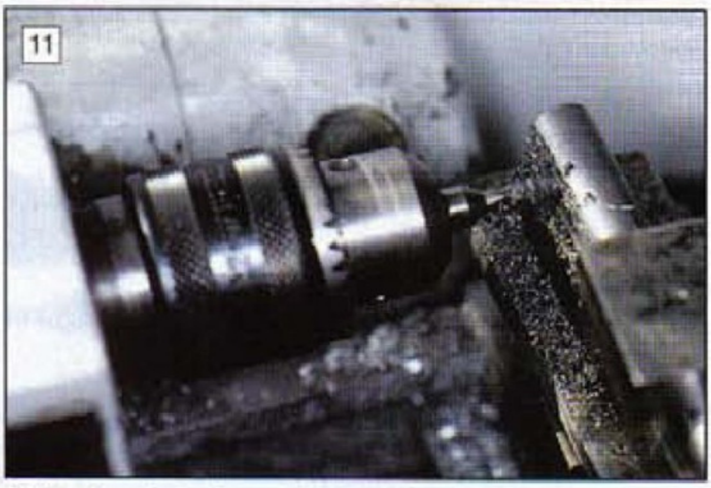
Using the large chuck to hold the 5/8in. end mill for counterboring.



Turning the diameter of the spindle flange.



The method of drilling the holes in the head. The work must be clamped.



Milling the slot in the cutter holder body.

trying to make a square cutter holder. The square hole it would fit was too much for the method I chose. I made a simple broach, and when I tried to press it through, using the vice, there was a sharp crack, and the vice came in half at the flange. When I looked, I found it to be not very well designed or made, and from inferior cast iron. It served me right for buying from a shop which serves the needs of motorists who do their own repairs. I took it back, got a refund, and bought a new one from a shop I trust. This one was more expensive, but had the name of an English maker on it, unlike the broken one, which was anonymous.

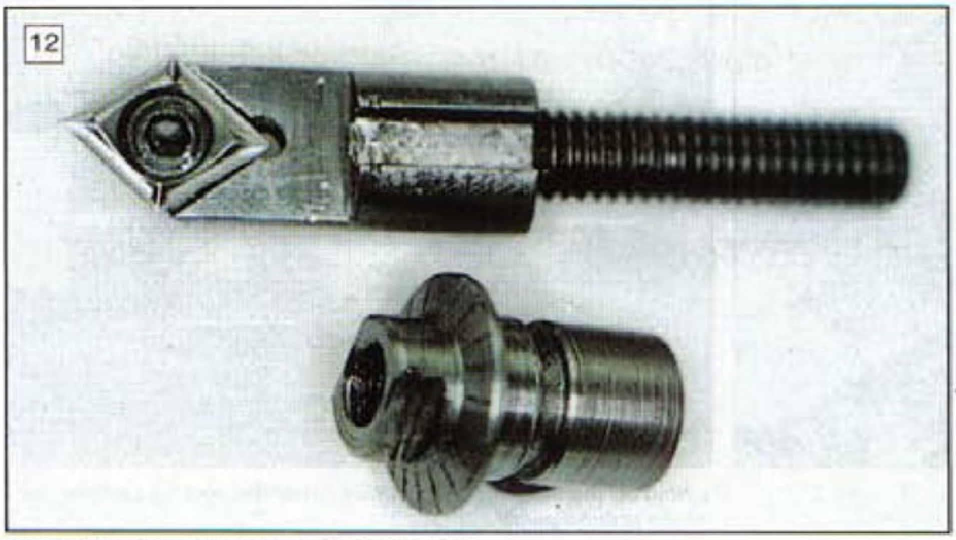
The boring head

This is the heart of the device, and as I had a piece of Duralumin of a size which would do, I used that. It machines easily and gives a good finish. **Drawing 2.1** gives the dimensions.

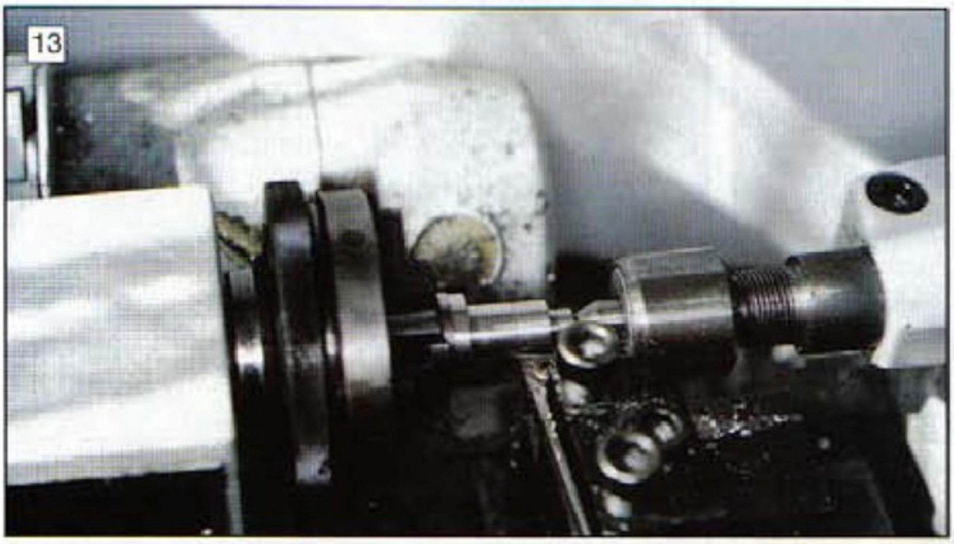
Once the length had been roughly faced to size, the 8mm hole was drilled and reamed. It was a size which needed the reverse jaws for the facing and drilling. I made an expanding peg to fit the reamed hole so that the 22mm. recesses could be turned true with each other. **Photo 6** shows one being bored out. If a note of the cross slide setting is made when the first recess is finished, it can be repeated for the second.

Still using the peg, the faces were finished and the outside diameter skimmed. With the external turning done, the centre lines for the 10mm hole were marked. The head was bolted to an angle plate for this, the centre height found and a line scribed on each side. It was then stood on a parallel, and the crossing centre line marked in the middle of the 20mm dimension. Each intersection was centre punched lightly.

Once marked, the head was clamped to the lathe cross slide, packed up until the centre punch mark lined up with the



The finished cutter holder and indexing dial.



Roughing out the indexing dial.

Starting the tap in the indexing dial. The lathe is turned off at the mains.

ground point mentioned earlier, and left clamped but still able to move a bit. A centre in the tailstock was then lined up on the other side and the head gently moved until it was trapped between the two, as in **Photo 7**. The head was then on the lathe centre line. The cap head screw clamped it to the cross-slide, and the drilling had to be done from each side, the second setting done by trapping the head in the same way, but with the ground point replaced by the drill. The drilling was done in stages, as is best for the Unimat, and the last drill was a 3/8in., which is a good size to use for reaming 10mm. It took a bit of shuffling about, and the last cutter I used was a 3/8in. end mill to get up to the 6mm cap head used for clamping. The last thing to do before taking the head off the cross-slide was to machine the 16mm counterbore shown in **Drawing 2.1**. I did this with a 5/8in. end mill, which was the nearest I had. I had to use the larger drill chuck for this, see **Photo 8**.

The 10mm hole was reamed in the vice with a hand reamer and with a smear of Vaseline to lubricate. I use this quite often for hand reaming and tapping, and it does a great job.

My setting for machining the 10mm hole was very slightly different due to the abortive attempt to broach a square hole, but I'll draw a veil over that. The tapped holes shown on the drawing were left until later.

Spindles

The spindles (**Items 2.2 & 2.3**) are fabricated. Machining from solid would take a long time and be wasteful on material. They were made from stock 12mm diameter mild steel, with flanges pressed and riveted on to spigots turned on the ends. I haven't specified the diameters; I made them a bit over 8 mm diameter and 7mm long. It made a shoulder for them to butt against and enough length to rivet. Both ends of the spindles were centred.

The flanges were made from a short length of 25mm dia. mild steel, drilled and reamed 8mm dia. and sawn off in 6mm pieces. I made three, so that one could be used as a jig. All three were faced to 6mm, and the two to be used for flanges were countersunk for the riveting; not too deeply because a large countersink takes a lot of filling.

The third piece was put on the expanding peg which was used for finishing the head, and turned to fit the 22mm recesses in the head. It was marked out to the 17mm centres shown on **Drawing 2.1,** and drilled 5mm diameter. When the jig was finished, I used it to spot the hole positions in the flanges. A short length of 8mm did the locating, and the flanges were drilled 5mm. While I had the drilling tackle handy, I drilled the tapping size holes in the head, spotting them first with the 5mm drill and using my usual drilling method:- the home-made face plate and the drill chuck in the head stock (see **Photo 10**). The simple jig worked fine for the spotting.

Once the flanges were finished, I made sure that these almost fitted the spindles, about 0.02mm is a reasonable amount to make a good press fit. I filed a bit of a lead on each spindle to give a start, then pressed them on. The new vice coped beautifully, and with a 5/16in. washer for packing the flanges went right down to the shoulder. To rivet them, I stood them upright in the vice on a piece of Tufnol, with the jaws just touching. The riveting went smoothly, but made a bit of a mess of the centre holes. I lightly re-did them. The last two operations were facing the ends of the flanges clean and turning the outside diameters to fit the head recesses. It was done between centres, so that everything would rotate truly when the boring head was used. A half centre in the tailstock gave room to get the tool in for both facing and turning, but it needs constant checking for lubrication and tightness. **Photo 9** shows the flange diameter being turned to size. The reduction in diameter next to the flange is to be able to get the securing screws in.

Lastly, I filed a flat on one of the spindles, so that the carrier wouldn't slip under pressure, and filed the 5mm holes into slots to make it easier to fit the screws and to do them up.

Cutter holder

Quite a bit of thought had to be put into this component because of the shape of the tungsten carbide tip. The best way to hold the tip in position is to make it fit in a recess which is a nice snug fit. It can be milled, but it would be a complex operation and awkward to clamp. The solution was to fabricate the holder by making a shaped insert from 3mm steel strip, and fastening it to the holder body. The insert would be shaped to fit the tip. Figure 3 shows the assembly. The body (**Item 2.5**) was no trouble to make from stock 10mm mild steel, left with enough length for holding. The 3mm slot was milled with a three fluted end mill, but as it is an open slot, any end mill will do. All I had to do was to pack it up to the right height and set it true with the cross-slide. **Photo 11** is the set up for milling the slot. When that was done, I cut the body to length, faced it, drilled the 3mm hole and cut and filed the step where the insert would fit.

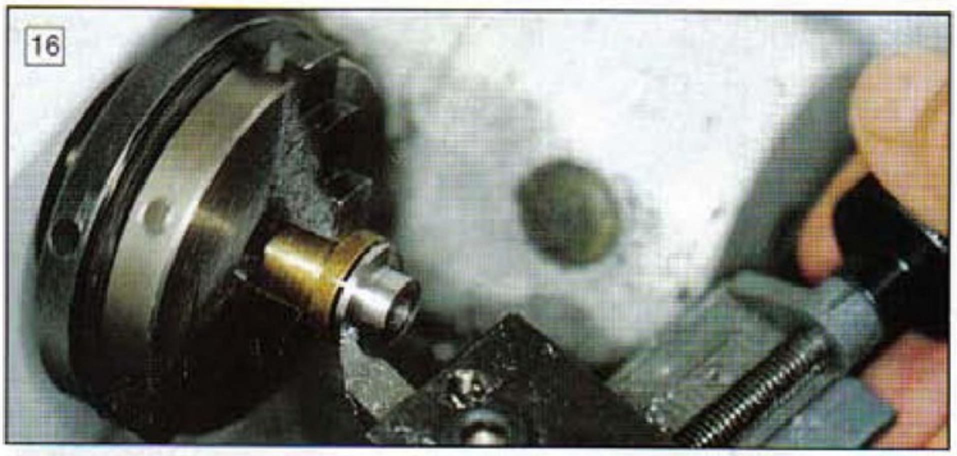
Insert

The 12 x 3mm steel strip from which **Item 2.7** was made was left long, so that it could be held and worked on. It needed a bit of careful filing to get the fit of the tip right, not forgetting the 10 deg. clearance shown. When the tip fitted into the 2.5mm relief hole and showed no daylight, it was time to think about how to fit it to the body. Normally I'd rivet a thin piece to a thicker one, but this one wasn't so straightforward, mostly because of the curved shape I'd have to rivet to. Even with the smallest rivets I had, it would be a bit fraught. A reasonably effective alternative would be to solder it. It is only a locating piece, and has very little stress on it.

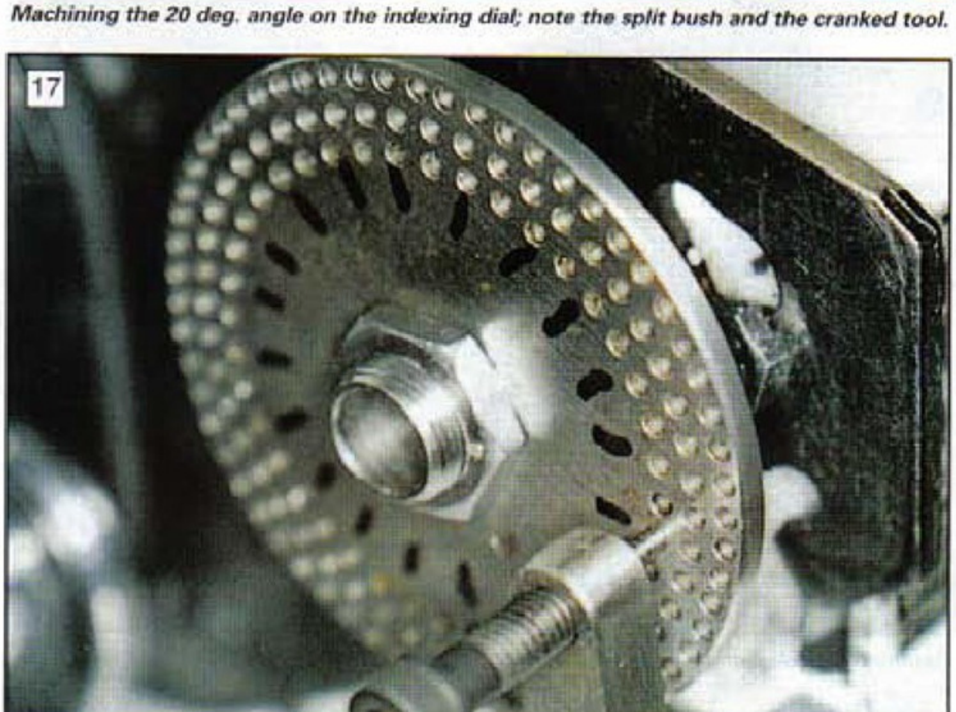
The soldering

Mild steel solders beautifully if the tinning and fluxing is right. A sheet metal worker once told me "If it's tinned properly and you use the right flux, you can solder a cat's ear'ole to a brick wall". I have paraphrased the saying very slightly!!

Undercutting the indexing dial.



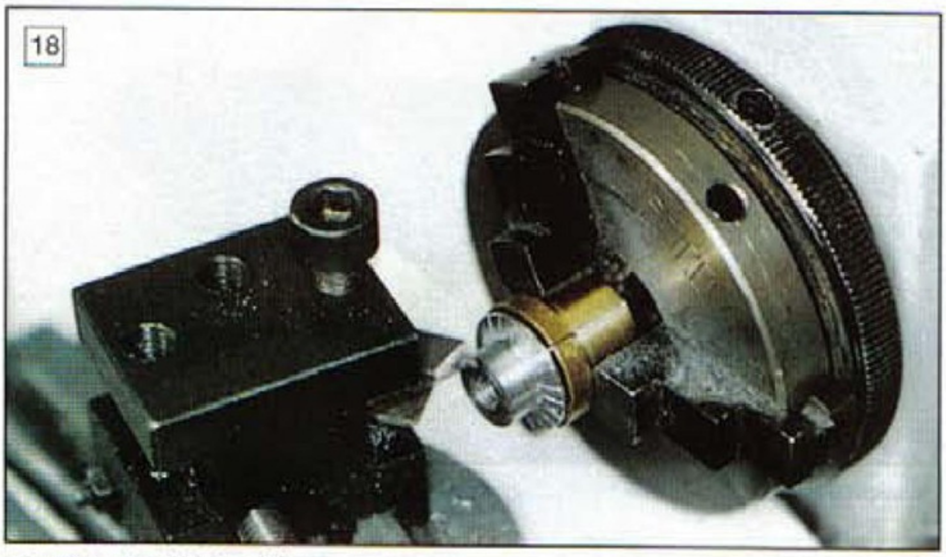
Machining the 20 deg. angle on the indexing dial; note the split bush and the cranked tool.



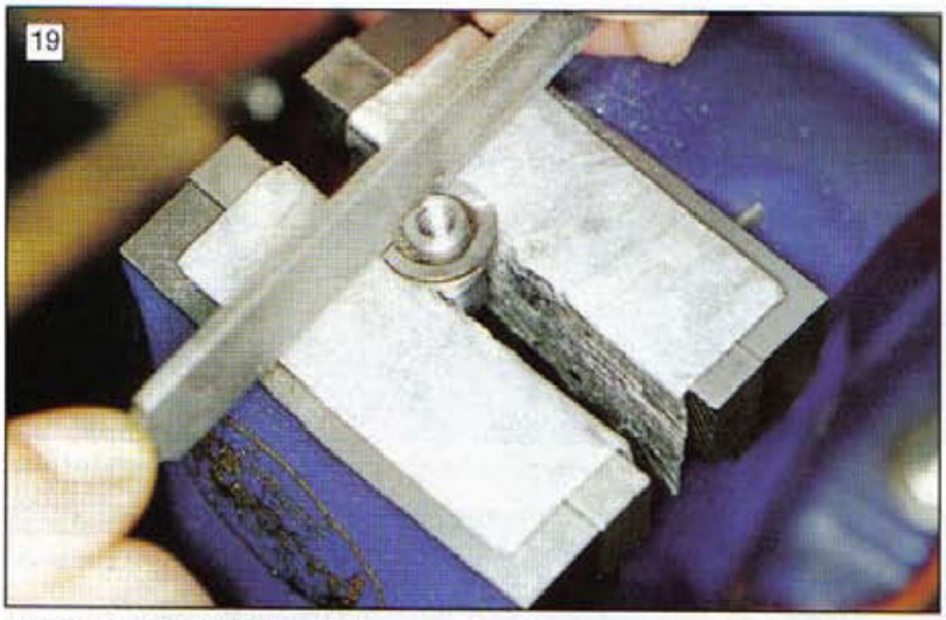
The set up for indexing the 20 divisions on the dial.

Tinning the insert and body was a matter of getting them to the right temperature. I used my small propane torch and some electrical cored solder with a melting range of about 180 - 200 deg. C. As the tempering colours start at the same range, aim for the work to be just starting to show a tinge of colour; that's what I did. I used a smear of flux, any of the resin based ones like Fluxite or Coraline does fine. The flux will spit and crackle when it is ready. I kept trying the solder until it ran, covering the work, then I wiped it off with a **clean** rag. The film left is ideal for 'sweating' the two parts together. It is a good idea to hold the parts in a vice to do the tinning, or to hold them in a clamp and hold the clamp in the vice. With both parts tinned and checked for fit, I smeared a very thin trace of flux on the body and clamped the insert to it. A gentle heating till the solder just ran, and the joint was made.

A tiny dab of solder can be added, but the odds are that capillary action will have done the job. I remember capillary action well from when I was at school. I'd underlined some homework answers, and capillary action made ink blotches between the ruler and the paper. I got six of the best, so I learned about capillary action by the impact method.



Engraving the indexing dial.



Filing the spanner flats on the dial.

Turning the 60 deg. angle on the tip fastening screw.

When the soldering was finished, I cleaned the flux off with meths, put the body back in the lathe and skimmed off the excess. The joint hardly showed.

If you haven't got a heat source, a gas stove or electric hot plate will do, but **ask permission first** from the chef, and clean up afterwards. Soldering irons, even the big ones, won't get the work hot enough. If possible, avoid using acid fluxes like Baker's Fluid; they will find the smallest hole or crevice and corrode it, making an unsightly mess.

Indexing screw

The cutter holder is completed by the screw (**Item 2.6**). It is made from an M6 x 1 cap head screw with the head cut off. The 3mm diameter should be as concentric as possible with the thread. It also has to be a tight fit in the body, pressed in so that it won't come loose. I did it in the three jawed chuck, moving it about until it spun as true as I could get it. Not quite true enough, as I found out later. When it would just enter the hole, and no more, I filed a small flat along the length to let the air out, dropped a little Loctite 602 in the hole in the cutter holder and pressed it home. **Photo 12** shows both the cutter holder and the indexing dial.

Indexing dial

This was the last major part, **Item 2.4**. I roughed the part out first, see **Photo 13**. The M6 x 1 thread was drilled and tapped, starting the taper tap by the method shown in **Photo 14**. When the tap began to slip, it had got enough of a start, and I finished it off in the vice. After tapping, the thread was centred just enough to let a tailstock centre locate in it. I machined the 10mm diameter and the 2.5mm undercut. A centre support stops the undercutting tool 'grabbing'' or breaking. I used a cutter narrower than 2.5mm, and made two cuts of it, another way of avoiding breakages. The undercutting is shown in **Photo 15**.

With one end finished, it was time to turn the chamfered end of the dial (**Photo 16**). A split bush protected the finished diameter and held it running true enough. The angle was 20 deg., and I use a cranked tool to get into the corner, turning away until there was a rim of about 0.75mm at the 15mm diameter.

To engrave the 20 divisions, I set up my simple indexing device described in a past article, selected the 40 hole circle and marked every other hole with a marker pen, just in case. I know it sounds stupid, but I wish I had a fiver for every stupid mistake I've made. **Photo 17** shows the indexer, and **Photo18** the engraving method, using a vee tool set sideways.

Photo 19 shows the last operation to complete the indexing dial, the filing of the spanner flats. Made to the dimensions shown on **Drawing 2.4**, they fit a 4BA spanner. I filed them in the vice, with protection for the diameter. A thin washer stopped the file from graunching into the face, and the safe edge made a nice square corner. A 6in. smooth hand file did the job.

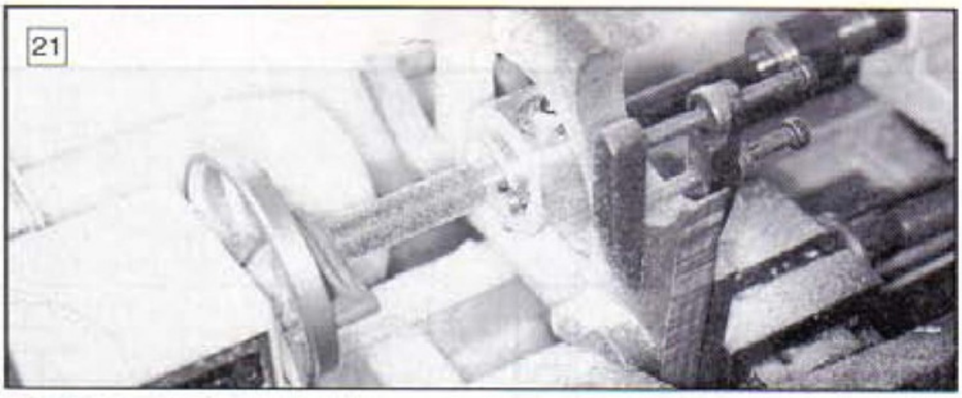
Modified screws

There are three of these, the countersunk one (**Item 2.9**), and the two locating screws (**Items 2.10** and **2.11**). The countersunk one screws the tip into the cutter holder, and is an M3 cap head turned to an included angle of 60 deg. (see **Photo 20**). An ordinary countersunk screw **will not do**, because the tungsten carbide tips are very brittle, and will break if not clamped properly. I used a tipped tool for the turning because cap heads are made from a tough grade of steel, and the forming process to make them can locally work harden the heads. I also used a longer screw and trimmed it to length afterwards, so that the thread didn't get damaged.

The two locating screws can be made from any suitable ones, and all that needs to be done is to turn the spigots. The M3 one has only to locate the undercut in the indexing dial. If it fits and retains it, that's good enough.

The larger, M4 one fits the slot in the cutter holder, guides it straight and locks it when a cut has been set. The spigot must be long enough to bottom in the slot for locking.

When the locking screws have been made, the threaded hole can be drilled and tapped to suit. I left them until last to make sure that they went in the right place. I tapped the M3 one with the taper tap only, and when it was just deep enough, stopped, so that it would be a bit stiff. It also had a drop of Loctite when it was assembled.



The tool in use boring a large hole.

A small assembly problem

With all the components finished, I tried out the movement. It was stiff in places and locked solid in others. The cause was, mostly, not enough clearance for the cutter holder in the head. As well as that, the M6 thread didn't run as truly as it should.

The problem was solved by the old toolmakers' trick of shimming the reamer used to ream the original hole. If a thin shim is wrapped round about half of the reamer, it will mask some of the teeth and make the others stick out a bit more. I did this and it worked. The size of shim depends on how much too big the finished hole should be. It was time to try out the boring bar.

I've had some odd pieces of Tufnol for a long time, good stuff, the fibre bonded type, so I thought I'd have a go at some of that with a view to making parts for a lathe steady.

I rough cut out a circle in a piece of 1/2in. with a coping saw. I've re-stocked my supply of blades from the same shop where I bought the new vice, branded ones with the name of a reliable maker on them. If you go to the big out-of-town superstores, the blades they have will have a name you have probably never heard of, or the store's own name. Look carefully and they may be labelled, 'for wood and plastics'. Buy those, and you won't be able to cut metal or the harder plastics like Tufnol.

The testing

I lined up the Tufnol piece and clamped it as well as I could. The boring bar worked well. It made a lot of dust, as can be seen in **Photos 21 & 22**. I shall say nothing about the clamping method, just that it is not for the nervous, and everything shakes.

The project was a success, and I can bore holes between about 68mm and 86mm. I could have clamped the work better if I had used the raising block I made some time ago, but I haven't made the raising block to go under the tailstock yet. It would need the support.

Another view of the large hole being machined.

The boring head could be converted into a conventional one by taking off both spindles and replacing one of them with a shorter one, threaded to fit the headstock. There is scope for experiment. It would also suit larger lathes than the Unimat.

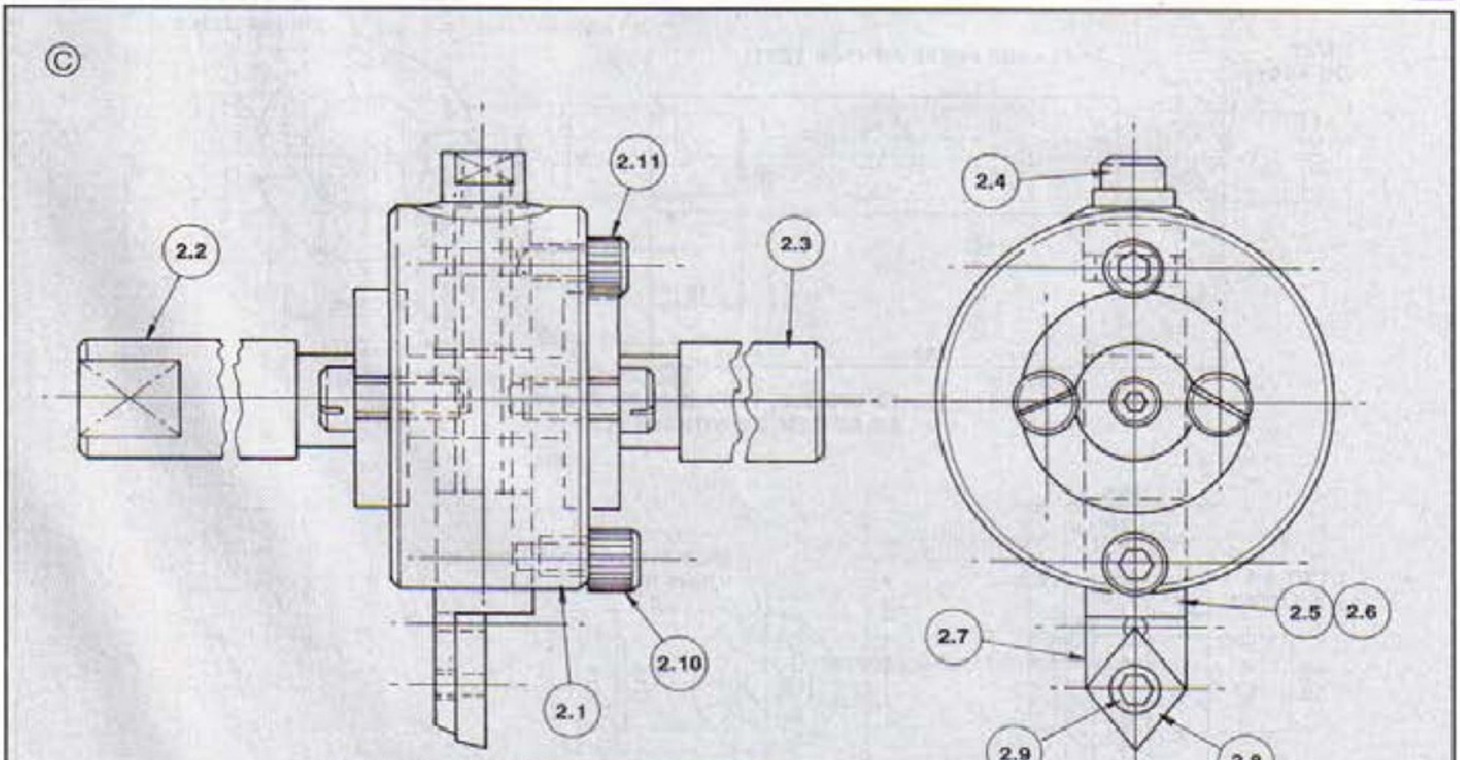
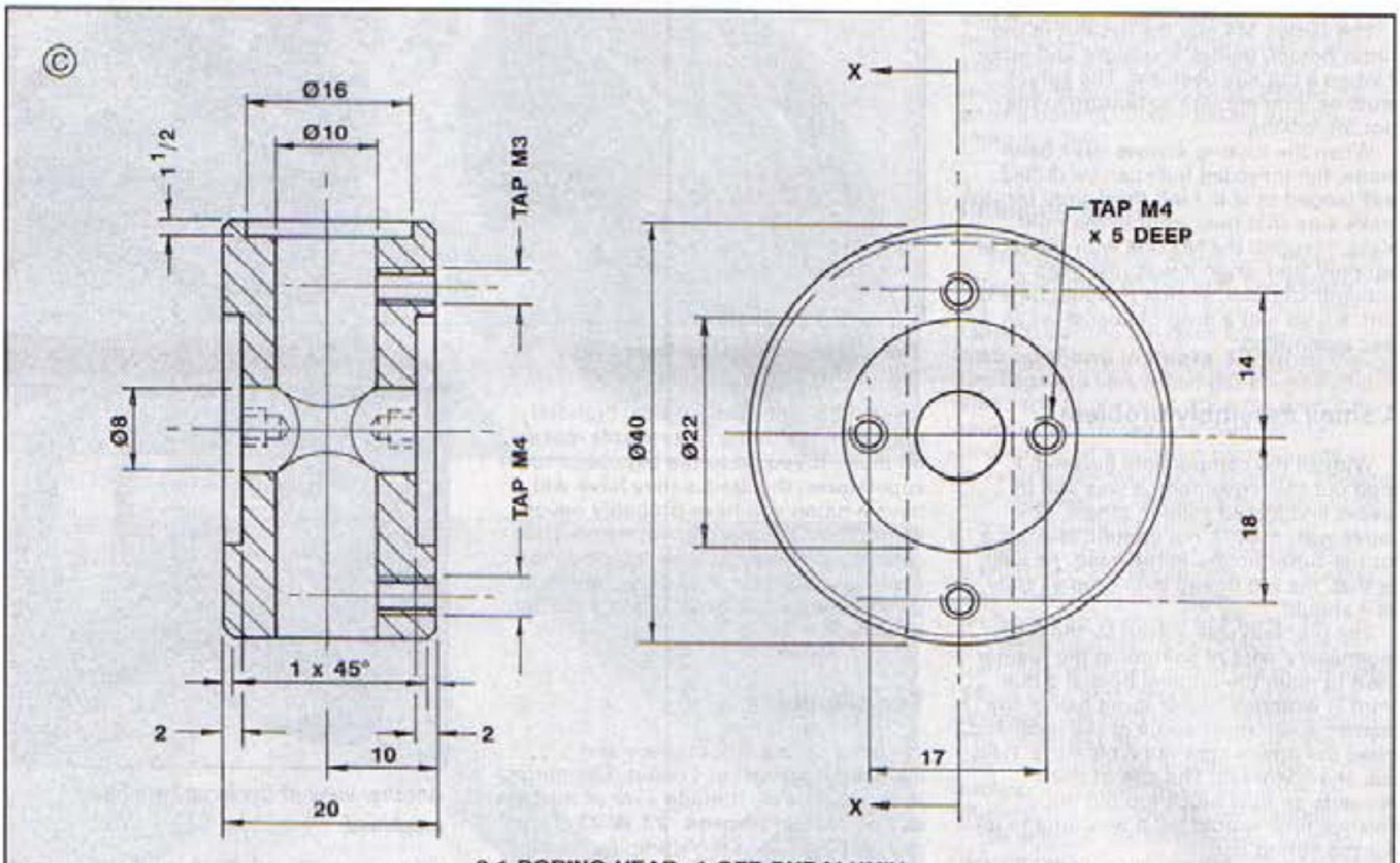
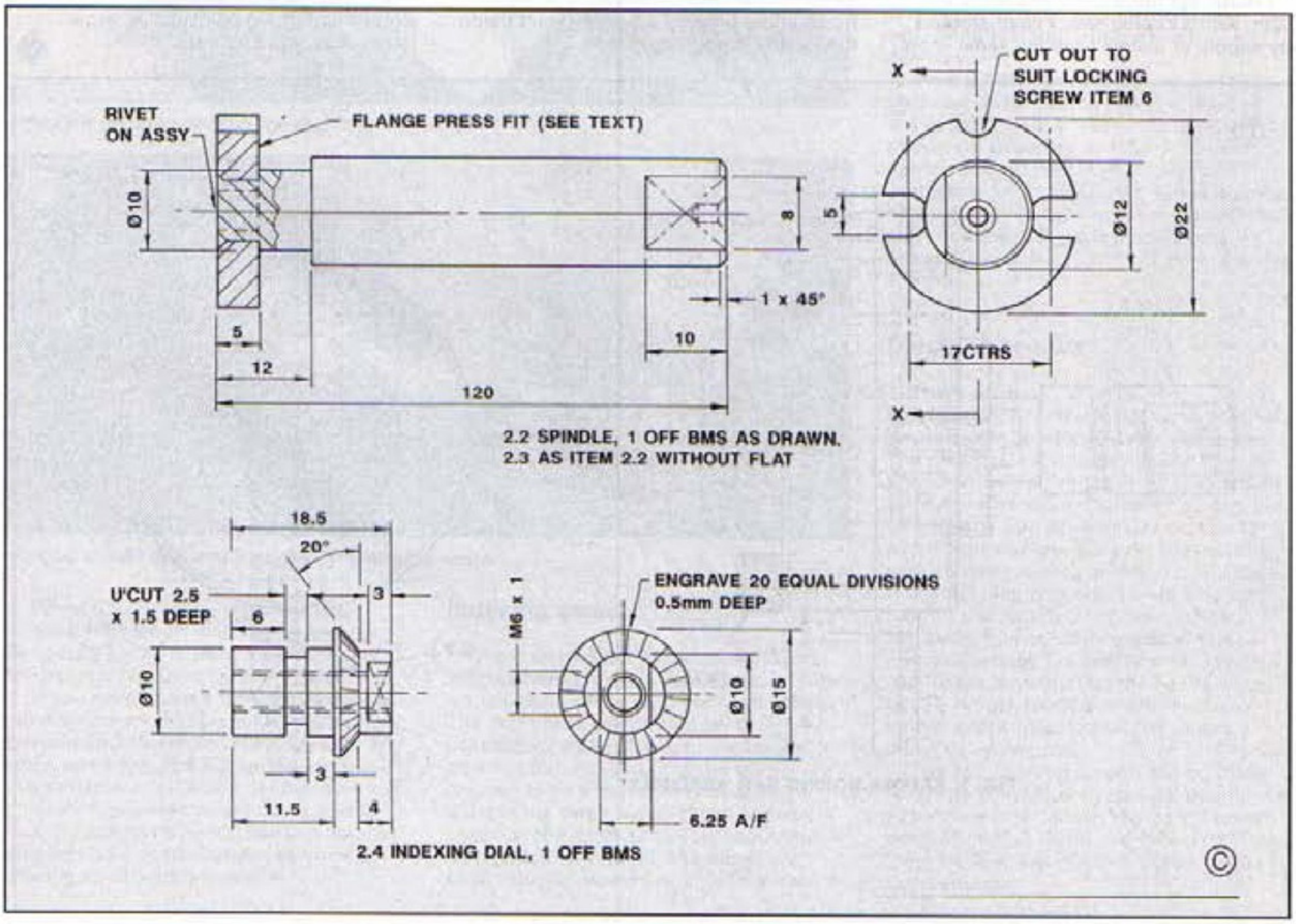


FIG. 2. SADDLE BORING BAR ASSEMBLY



2.1 BORING HEAD, 1 OFF DURALUMIN
DIMS IN MILLIMETRES



2.2 SPINDLE, 1 OFF BMS AS DRAWN.
2.3 AS ITEM 2.2 WITHOUT FLAT

2.4 INDEXING DIAL, 1 OFF BMS

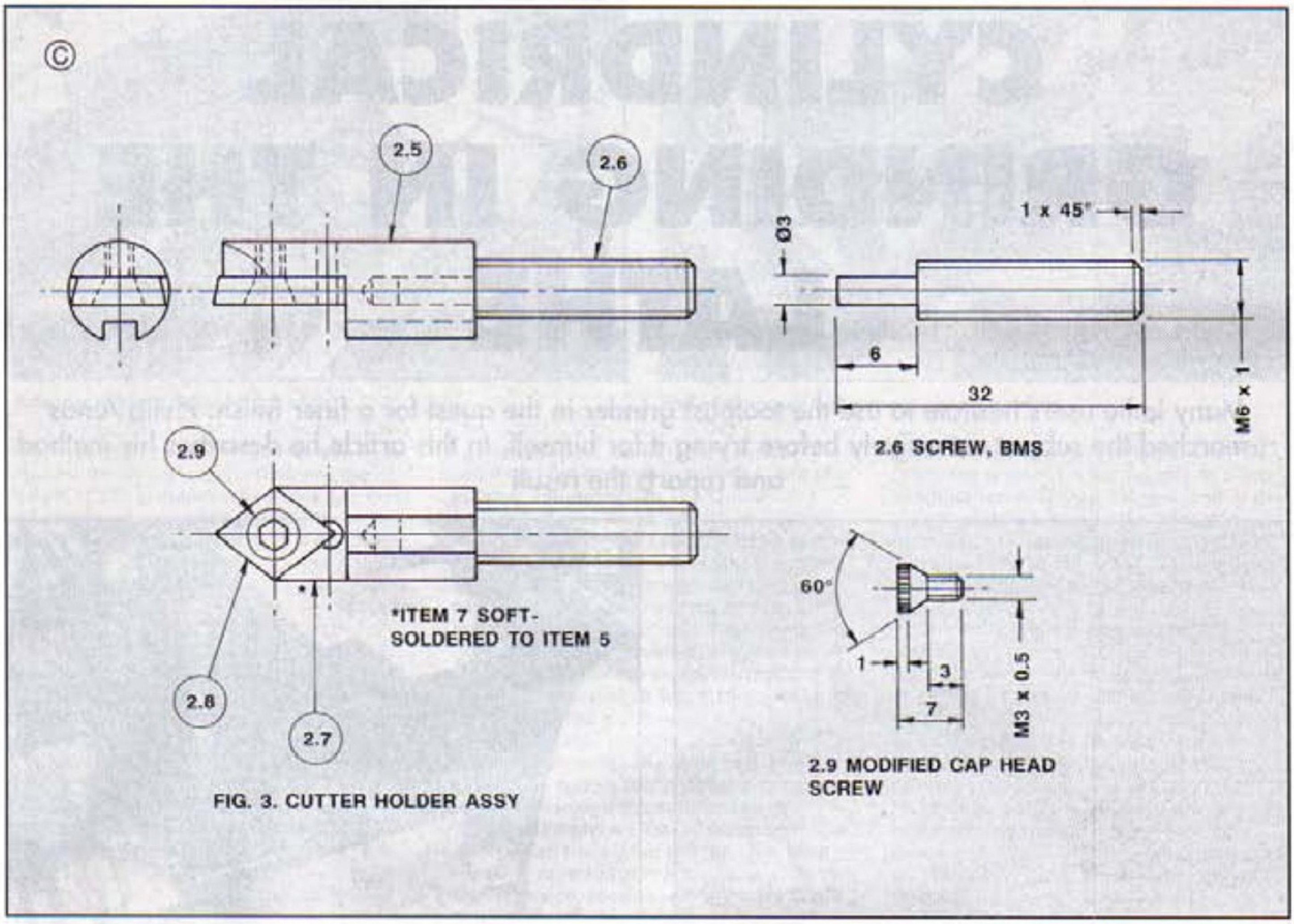
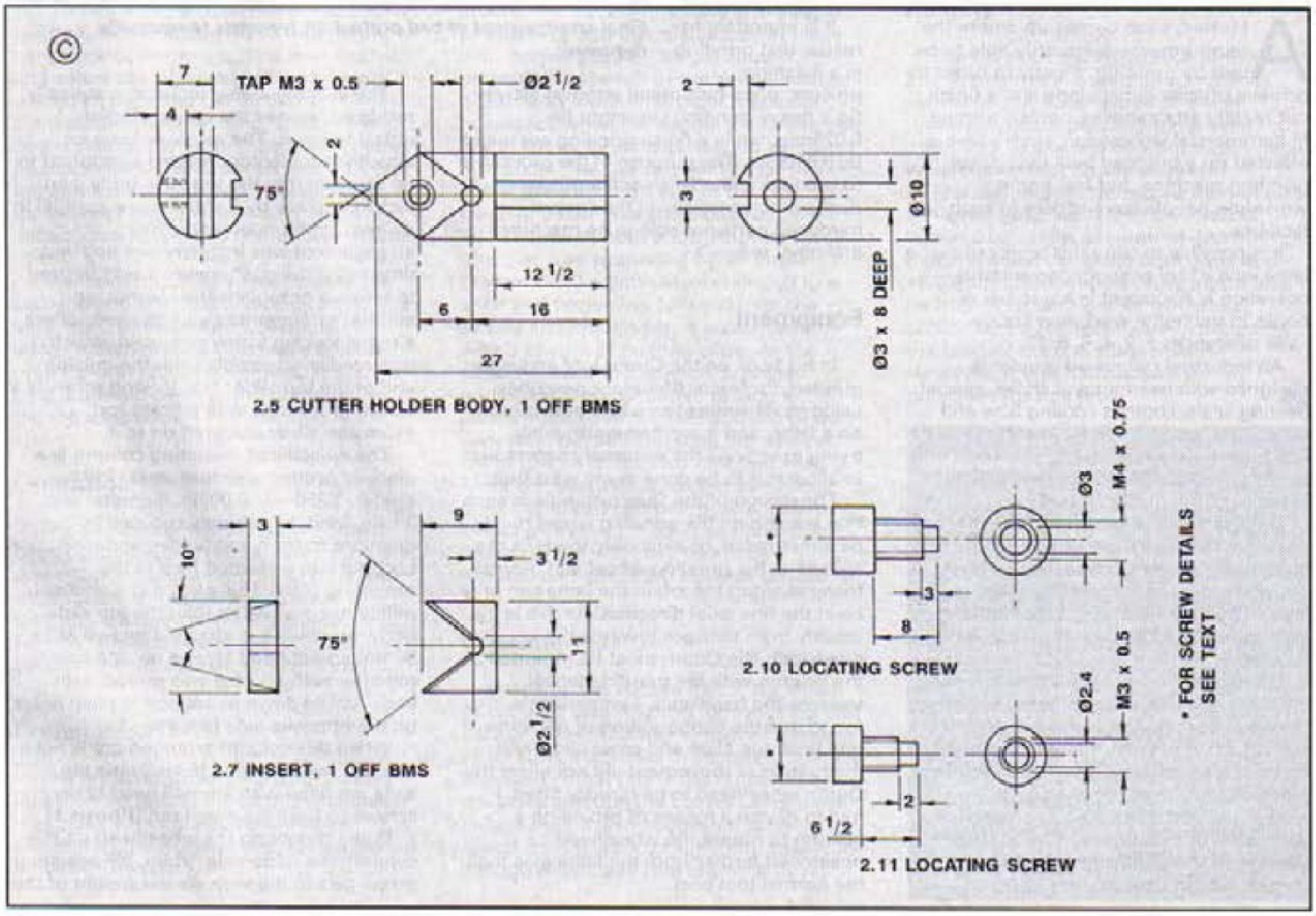


FIG. 3. CUTTER HOLDER ASSY



CYLINDRICAL GRINDING IN THE LATHE

Many lathe users hesitate to use the toolpost grinder in the quest for a finer finish. Philip Amos researched the subject extensively before trying it for himself. In this article he describes his method and reports the result

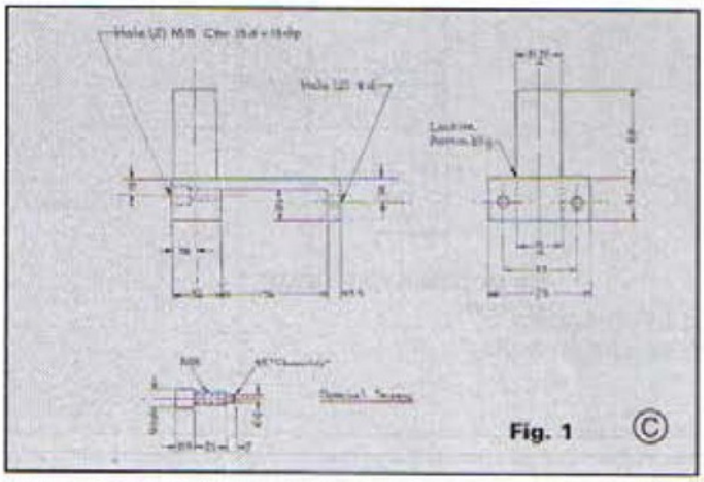
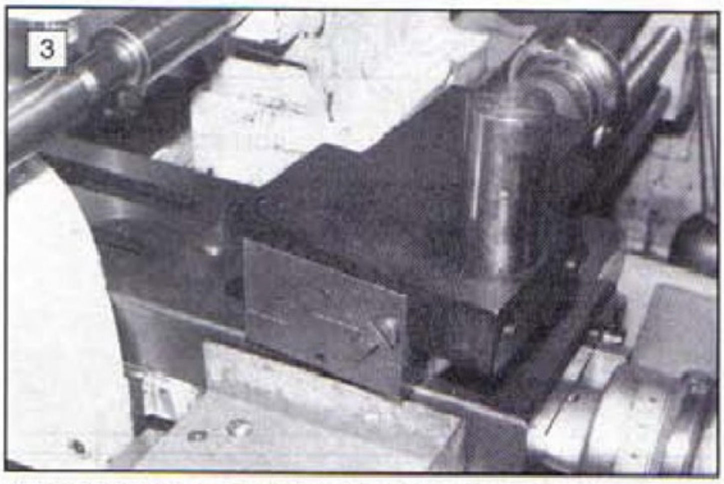


Fig. 1 ©



Final arrangement of bed protection (veranda temporarily removed).

At times, a job comes up where the requirements seem only able to be met by grinding; mostly in order to achieve precise dimensions and a finish not readily attainable by normal turning. In commercial workshops, such a task is effected on a purpose built cylindrical grinding machine, but few home workshop people have access to such facilities.

It is possible to carry this work out on a lathe with a tool post grinder, and this operation is discussed in a number of books in my home workshop library - see references 1, 2, 4, 5, 6, 7.

An industrial cylindrical grinder is designed with overhanging slides, special bearing seals, copious cooling flow and other purpose built arrangements, to ensure that the grinding grit produced only cuts the workpiece and not the working surfaces of the machine itself.

Unfortunately, a lathe has none of these advantages, and its use in grinding operations is hazardous to its well-being. So, while most of the references tell you how to go about grinding in the lathe, they also warn you NOT to do it if it can be avoided.

Many of the references advise covering the lathe bed with cloth or paper to protect the ways from grinding effluent, and placing a tray of water there to catch as much of it as possible. Such arrangements preclude the use of coolant on the workpiece, so the grinding operation is conducted dry. Furthermore, extensive traverse of the saddle introduces considerable problems - see later.

It is important to realise that grinding is a finishing process, not a bulk metal removal activity. So a heavy grinding cut might be 0.025mm, while a finish grinding cut might be 0.010mm. The purpose of the process is to produce a fine finish and a precise dimension, especially in the case of hardened parts not able to be machined in any other way.

Equipment

In his book on the Quorn tool and cutter grinder[1], Professor Chaddock describes using its wheelhead as a tool post grinder on a lathe, and it seemed worth while trying to arrange the necessary accessories to allow this to be done in my workshop.

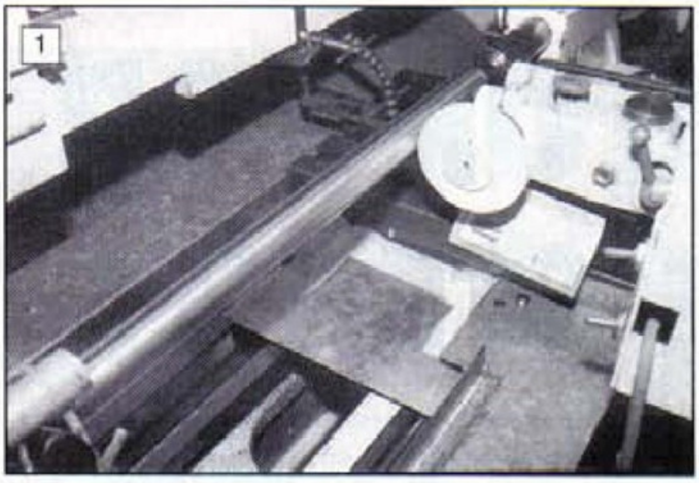
The design of the Quorn spindle is such that loading on the grinding wheel must be either radial, or axial only towards the spindle at the grinding wheel end. Hence traverse along the job in the lathe can only be in the one axial direction. As this is usually from tailstock towards the headstock, the Quorn must be mounted on the column with the grinding wheel towards the headstock. I immediately found that the configuration of my lathe tool post, top slide and cross slide, and their range of movement did not allow the Quorn wheelhead to be directly fitted. I had to devise a means of providing a column to mount the wheelhead, positioned further from the lathe axis than the normal tool post.

The existing 4-way toolpost was easily removed, as was the spring loaded indexing catch. The actual column on which the toolholder rotated was found to be screwed into the top slide body, and locked in place by a small screw parallel to its axis, from underneath. This arrangement was inconvenient and very time consuming whenever it was desired to remove or replace the column, so another arrangement was devised, where a radial locking screw was used, which was readily accessible from the outside end of the top slide. This locking screw is a socket grubscrew with a brass rod extension silver soldered on to it.

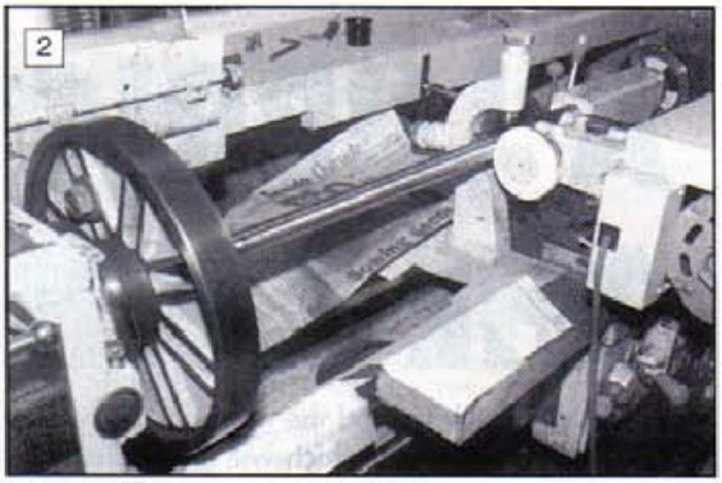
The wheelhead mounting column is a piece of ground stainless steel (T304 grade), 1.250 +0, -0.002in. diameter and $3^3/4$in. long. It is slightly reduced in diameter to form a shoulder, and then Loctited into a reamed hole in the mounting plate. This plate has a channel milled out, just wider than the top slide body, to which it is attached by two M8 x 30mm socket head screws on one side, together with another two screws with ends turned down to engage in plain holes on the opposite side (see **Fig. 1**).

When this column arrangement is not in use, the two threaded holes in the top slide are filled with knurled head brass screws to keep the swarf out **(Photo 1)**.

When mounting the wheelhead on this column, the underside $^5/16$in. NF adjusting screw gets in the way. As the weight of the



Adaptor column fitted to top slide.



Top slide veranda & paper support bracket.

motor causes the wheelhead to rest against the upper adjusting screw, the height of the grinding wheel axis can be adjusted with the upper screw (to match the lathe mandrel height) and then locked in position by the use of a normal 5/16in. NF setscrew replacing the lower adjusting screw.

The Job

A piece of T304 grade stainless steel, 1 1/8in. (28.55mm as measured) diameter and 400mm long was to be reduce to 25.45mm diameter for a length of at least 320mm. The plan was to turn this piece to 25.50mm diameter, and then to grind it to the finished dimension.

Preparation (1)

The first operation was to true up the headstock centre *in situ*, and then to check and adjust the alignment of the tailstock centre. I have a test bar 25.675mm diameter and 600mm long, which has been cylindrically ground between centres by a commercial toolroom. Using this test bar and a dial indicator on the tool post, the tailstock was adjusted so that the deflection was within 0.01mm over 400mm travel.

The travelling steady was fitted to the carriage and adjusted to closely follow the lathe tool. The top slide was angled at 6deg., and then the angle finely adjusted until the tool radial movement, as shown by the dial indicator was 1/10 of that on the top slide scale.

Operation (1)

The workpiece, which had previously been centred at both ends with a BS 3 drill, was mounted and a right hand knife tool used for three roughing cuts, each 0.42mm, and then a round end tool used for two finishing cuts, each 0.13mm. This brought the job diameter to 25. 51mm.

Preparation (2)

The grinding wheel (unmarked, but looks like 60 grit) in the Quorn wheelhead was trued with a diamond and then dressed with a Norbide stick (as suggested by W.M. Thomas[8]).

The tool post, spring loaded index catch and column were removed, and the adaptor column fitted. The Quorn wheelhead was fitted, and its wheel axis height adjusted to match, the lathe centre height. The grinding wheel was arranged with its face parallel to the workpiece surface, and running so that its face moved upwards against the work moving downwards. The travelling steady was set so as to just trail the working area on the job, and the top slide was maintained in the 6deg. offset position.

Considerable thought and effort was put into protecting the lathe bed, and this presented quite a few problems because of the traverse of the saddle (about 350mm). Firstly, a piece of cardboard was attached to the end of the top slide with masking tape to form a 'veranda' over the end of the cross slide ways (**Photo 2**). Next, a piece of cardboard was cut to fit around the travelling steady and saddle projections, and again attached in place with masking tape. This cardboard projected to the left of the saddle for such distance as would not quite reach the headstock when the saddle was traversed to the left as far as was needed for the operation. The flat way for the tailstock is not in use at the left end of the bed, so a piece of paper was stuck down to it with Scotch tape at both ends. Another piece of paper was supported by an angle bracket of 13 x 3mm steel clamped to a shelf and projecting forward over the saddle and cross-slide; it was attached with a couple of bulldog clips. As the saddle moved to the left it, travelled under this piece of paper, raising it somewhat above the bed and out of its own way, but still stopping the vertical fall of grit on to the two rear bed vees. The front vee was protected by several pieces of folded cardboard, arranged to telescope over each other as the saddle moved to the left. They had to be repositioned after each traverse (**Photo 3**).

Operation (2)

Based on the data in Ref. 3, the depth of cut used was 0.02mm for roughing and 0.005mm for finishing —maybe! Because of oil films, slackness in slides etc. all that is certain is that this is the figure set on the scale and that the cut was very small indeed. Ref. 3 also suggested surface speed for the work as 15m/min, which, for this job meant 225 rpm (slowest direct speed) as the nearest available. The reference provides a nomogram to allow computation of traverse speed, and in this case it worked out to about 0.5m/min. However, from previous experimentation it seemed that about 1/3 of this rate gave better results, and so the latter was adopted.

One roughing cut and two finishing cuts brought the workpiece to the required diameter dimension, measuring 25.45mm at one end, 24.455mm at the other and 25.47mm in the middle.

All the paper and cardboard bed protection material was carefully removed, and it was found that virtually no grit had got through on to the bed. The bed was very meticulously wiped over with paper towelling, then oiled, re-wiped and re-oiled. Hopefully no damage has ensued.

Results

The finish of the workpiece after the above treatment ended up somewhat similar to the finest grade of finish turning. It could possibly have been improved by the use of a finer grit wheel, which however I do not possess.

The diameter dimension aimed at was achieved quite well, with a variation within 0.02mm in a length of 400mm—barrel shaped i.e. same both ends and +0.02mm in the middle. This might also be improved with a finer grit wheel and/or improved technique in adjusting the jaws of the travelling steady. However, it was satisfactory for my purposes for this job.

References

[1] *The Amateurs Lathe* - L.H.Sparey (Nexus Books)

[2] *The Quorn Universal Tool & Cutter Grinder* - Prof. D. H. Chaddock

[3] *Precision Grinding Techniques* - Jones & Shipman

[4] *Centre Lathe* - L.S.N.Gupta

[5] *Know Your Lathe* - Boxford

[6] *Metal Turning Lathes* - E.T.Westbury

[7] *Workshop Technology* -Part 2 - W.A.J.Chapman

[8] *Tool & Cutter Grinding* - W.M.Thomas *M.E.* 4 Oct. 1974

A LUBRICATOR FOR THE LATHE STEADY

Alan Jeeves has described the manufacture and use of lathe steadies in these pages. He now brings us an added refinement which will eliminate one of the problems sometimes encountered in their use

When turning in the lathe using a steady, quite a large amount of heat can be generated due to friction at the point where the shoes support the work as it rotates. As the heat increases, so the workpiece expands, the increasing diameter making it a tighter fit within the steady shoes as a consequence. This situation causes even more friction and thus more unwanted heat. The simplest way of relieving this problem is to squirt some lubricating oil onto the work from time to time, using the workshop oil can, usually consuming far more oil than is actually necessary, and getting it all over the place as well. This method may be acceptable for the odd job or two, but if the steady is to be used for more complex applications, especially where the job may be rotating for long periods, and both hands are needed on the lathe controls, an improved lubrication system may have to be considered.

One way of overcoming this lubrication problem is to fit a Sight Feed Lubricator to the steady. This is a fitting comprising of an oil reservoir (made of transparent material in order to clearly indicate the level of oil contained therein), and an adjustable brass needle valve which allows a pre-determined measure of oil to drip out of the reservoir via a small hole in the underside and onto whatever is being lubricated. The reservoir is filled with oil and the valve carefully adjusted to supply oil at the desired rate of flow. To avoid adjustments having to be made each time the lubricator is used, a second over-riding valve is incorporated into the system. This simply has 'on' and 'off' positions, so that the regulated amount of oil remains the same when this valve is switched off and back on again. The bottom outlet of the lubricator is screwed (usually with a male BSP thread) to allow it to be fitted to its mounting. When set up, the lubricator provides a very neat and effective method of drip feed lubrication.

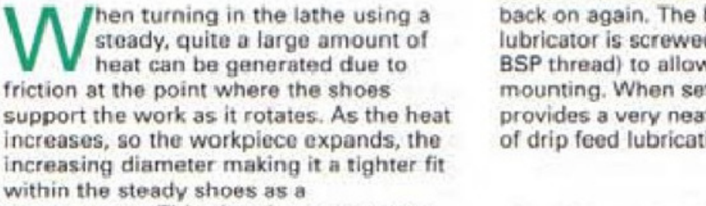
Acquiring a lubricator

All this mention of brass work, sight glasses and valves tends to conjure up an image of a costly unit. In the past, these lubricators were made from cast brass or gunmetal, had glass reservoirs and brass filters and were highly polished. Today, these would be quite expensive items. Fortunately, modern production methods and materials now make these products relatively cheap, and suitable fittings are imported from the Far East. These have pressed brass parts and mass produced turned components, which are complimented by acrylic sight 'glasses'. Many engineers' factors supply such items, one stockist being Graham Engineering. (Midlands) Ltd., who carry stocks of different sizes at surprisingly low prices. There is, therefore, no need to scour the secondhand sources, where old British made examples can often be found, re-polished and marked 'collector's item'.

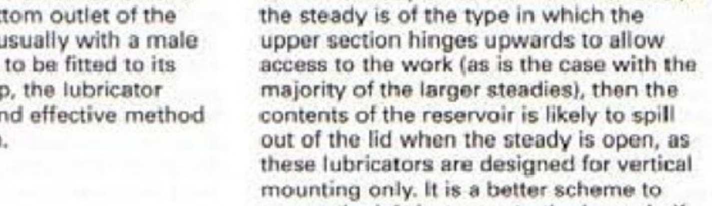
Having purchased a suitable lubricator, all that remains is to fit it to the steady.

Mounting the lubricator

It would seem to be a straightforward matter, simply to mount the lubricator up above the steady, so that light machine oil can fall directly on to the work. However, if the steady is of the type in which the upper section hinges upwards to allow access to the work (as is the case with the majority of the larger steadies), then the contents of the reservoir is likely to spill out of the lid when the steady is open, as these lubricators are designed for vertical mounting only. It is a better scheme to mount the lubricator on to the lower half of the steady, by means of a simple bracket which is long enough to keep it far enough above the work to allow gravity feed. On larger steadies, it may be an advantage to make the bracket adjustable



A pair of sight feed lubricators.

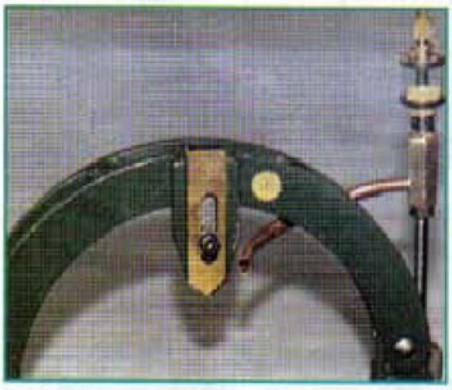


The lubricators - one open, one closed

Lubricator mounted on steady - rear view.

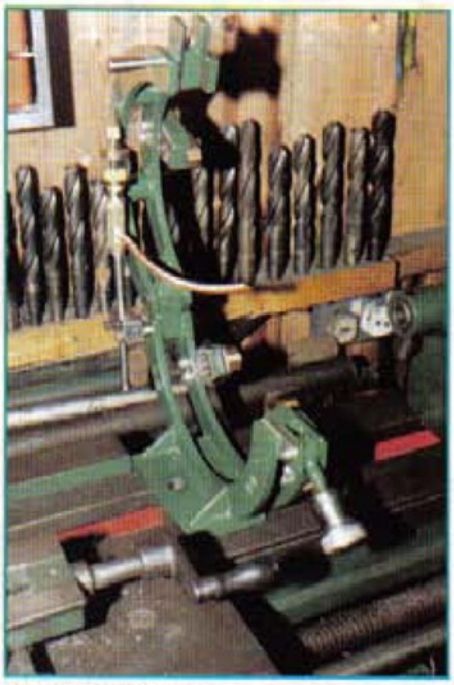
in the vertical plane to accommodate different diameters of work. This may avert the need to keep having to bend the copper feed tubes.

As a good starting point, a mild steel block **(Item 1)** is screwed to the base section of the steady (in this particular example). This block is provided with a through hole to allow for height adjustment, and is fixed to the steady lower main frame as high up as is possible. A tapped cross hole is included to take a thumb screw for securing the pillar onto which the lubricator is mounted. By releasing the thumb screw, the pillar can be raised or lowered as required. The pillar **(Item 2)** is simply a



Front view

Steady fitted to lathe



Steady when open

length of stock diameter bar which is threaded at one end to allow it to be screwed on to a brass fitting **(Item 3)**, which is used to connect the lubricator to the copper feed tube. The brass fitting is drilled and tapped blind at the opposite end (in this case 1/8in. BSP) for the lubricator to screw into. A hole is also drilled to break into this tapped hole, of the same size as the outside diameter of the copper feed tube, which is soft soldered into place. This done, the parts can be assembled and the copper tube easily bent to shape, soft copper (supplied in coils) being chosen its ease of bending.

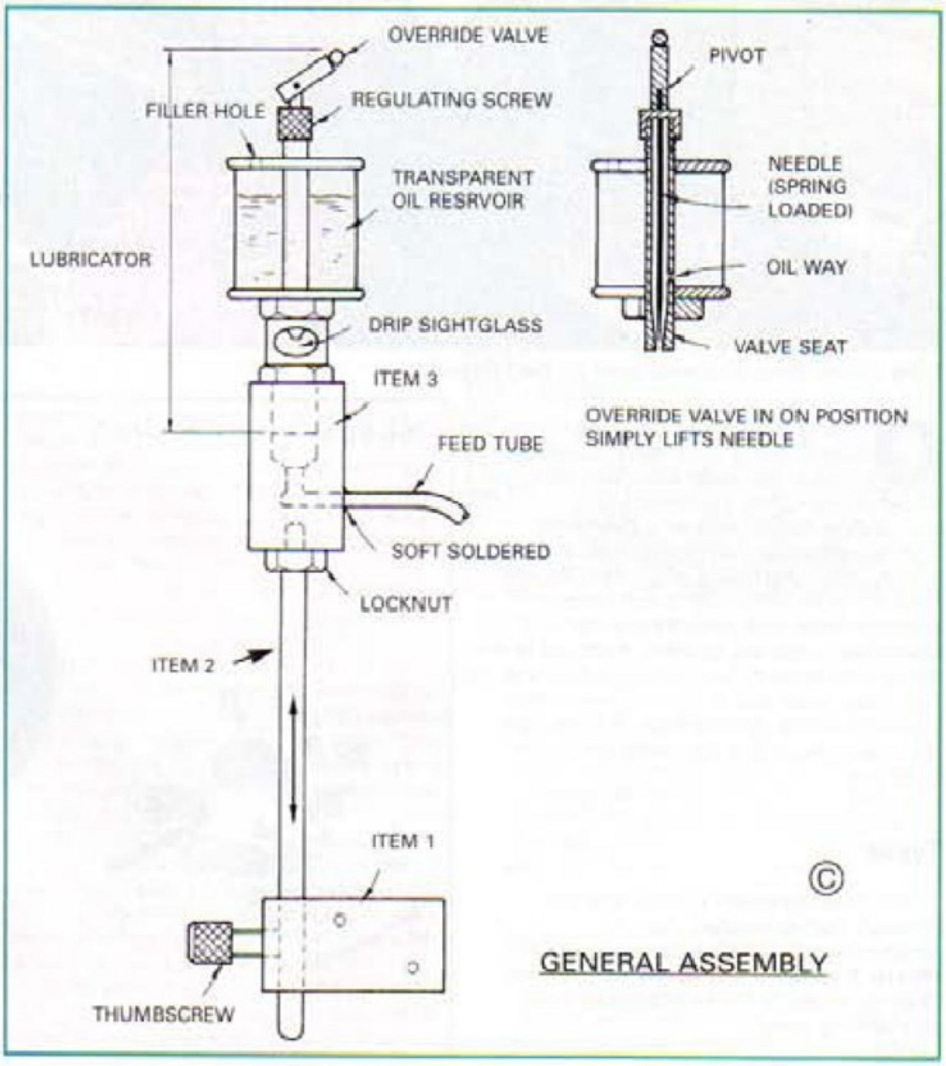
Using the lubricator

Whenever a job which requires the use of the steady is set-up in the lathe, the lubricator assembly may be attached to the steady and adjusted to the most suitable position. It should be arranged such that the oil falls onto the work in the vicinity of the steady shoes, thus lubricating the 'track' in which they run.

The oil reservoir is filled from a standard oil can, and the rate of flow set. If the job is overheating rapidly, a little more oil should be allowed to reach the work. It may, of course, also be necessary to reduce the flow. If the machine is stopped for any reason, say to measure the work, then the oil drip can also be halted, simply by throwing the over-ride valve to the closed position, opening it again just before the lathe spindle is restarted.

Supplier

Graham Engineering (Midlands) Ltd., Alpine House, Roebuck Lane, West Bromwich, West Midlands, B70 6QP Tel. 0121 5253133



A BEGINNERS GUIDE TO THE LATHE

Part 5 | The faceplate

Harold Hall turns his attention to a method of workholding which, while being very versatile, needs thought and care if it is to be used successfully and safely

A Tee slotted faceplate being used on the tailstock.

Of the four common methods of work holding, i.e. chucks, between centres, faceplate and mandrels, using the faceplate is the most demanding. Its purpose is to hold work that cannot usually be held satisfactorily by any other method, and is often, the last choice method. Even so, it is a method which is employed quite frequently, finding as much use as other methods in many workshops. The challenge in its use is in the infinite variety of workpieces that it may be called upon to hold. It is also the most dangerous and demands great care in its use.

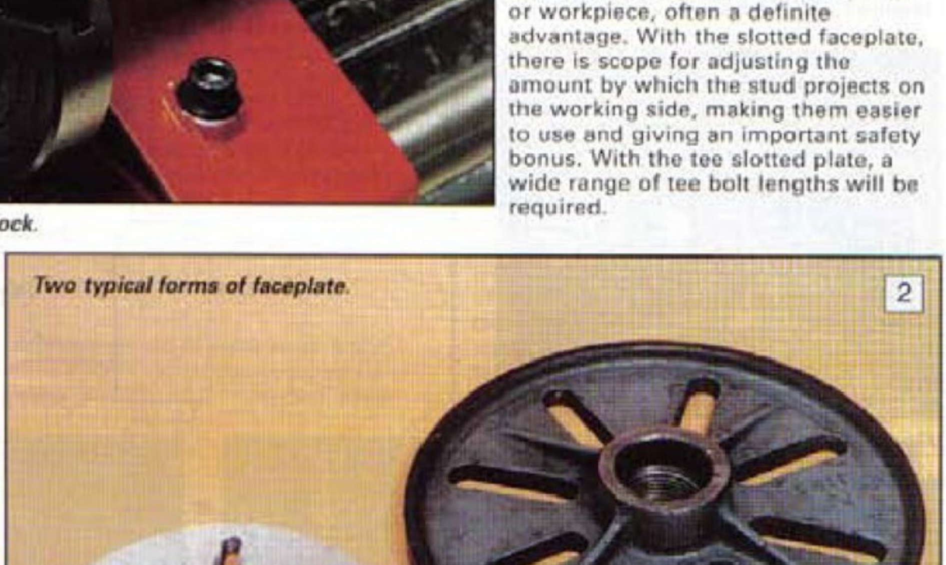
Types

The most common faceplate is the through-slotted version, though faceplates with tee slots can be obtained. **Photo 1** shows a typical example, in this case, mounted to the tailstock and used as a drilling table.

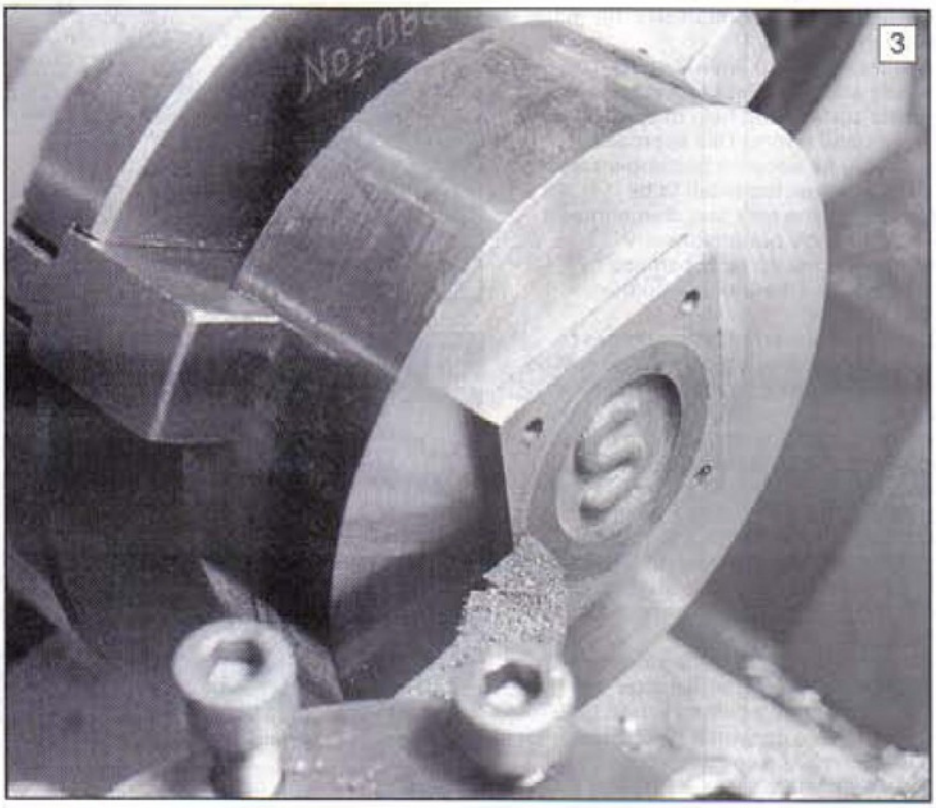
The advantages of one type over the other are small for most applications. The through slotted plate has slots that stop short of both the outer edge and the inner bore, while in the tee slotted version they will run from the edge through to the centre hole. This will give more scope for positioning the clamping studs on the tee slotted plate, though the through slotted plate is likely to have more slots.

A single spanner would be required when using a tee slotted plate leaving one hand free to hold the clamp and or workpiece, often a definite advantage. With the slotted faceplate, there is scope for adjusting the amount by which the stud projects on the working side, making them easier to use and giving an important safety bonus. With the tee slotted plate, a wide range of tee bolt lengths will be required.

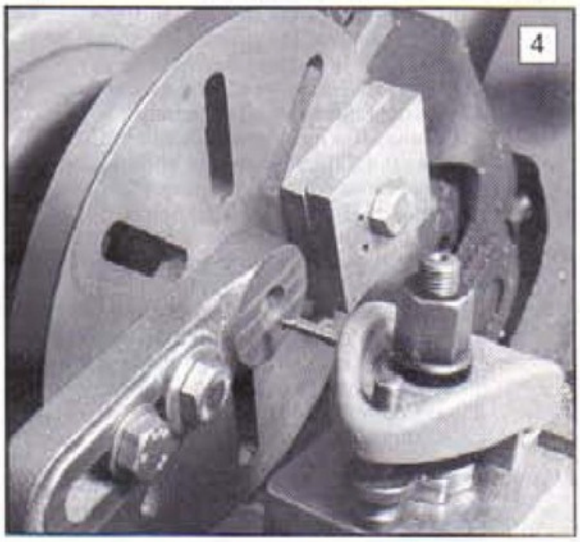
Two typical forms of faceplate.



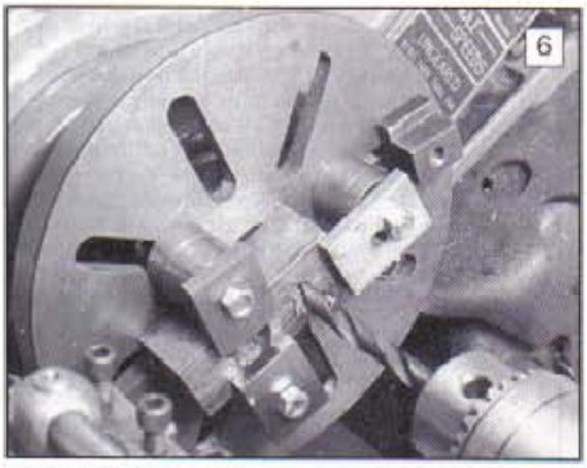
Machining a small valve chest cover whilst mounted on a disc faceplate using adhesive.



Typical faceplate project. Note the two screws are captive in the workpiece, providing a secure mounting.



Mounting a large casting on the faceplate. Note the fixings are well spaced for secure mounting.



Where fixings do not pass through the item being mounted, unlike those in Photos. 4 and 5, three fixings are preferable.

Bob Loader, in his article on making a tee slotted faceplate[1], commented that some lathes are supplied with faceplates that are smaller than the lathe in question would accept. This is an economy measure which is difficult to justify, especially for the smaller lathes. Perhaps over 100mm centre height there may be some justification for alternative plate sizes.

Most face plates will be made from cast iron and have stiffening webs on the rear. Others, probably the smaller sizes, may be made from aluminium alloy. **Photo 2** shows two plates, the larger of cast iron the other, aluminium alloy. The smaller one has been made sufficiently thick to avoid the need for stiffening webs, a distinct advantage on a small plate.

For lathes with a gap bed, the manufacturer will probably supply a larger plate, up to the maximum that the gap will take. This will be of limited use, as the width of the gap will limit what can be held. It will be useful for some jobs, depending on the type of work undertaken.

Another form of faceplate, perhaps not considered as such by some, is the disc of steel held in the three or four jaw chuck. Components are mounted on this, probably using adhesive of some form. The face can be lightly machined each time it is used, to ensure that it is running true. **Photo 3** shows a component being faced using this method.

Any form of adhesive is a possible candidate, depending on the nature of the operation. Two part epoxy is very effective and after machining, the adhesion can be destroyed by the application of heat. It is not ideal in view of the time taken for the adhesive to set. Superglue is worth trying as it can be ready for use very quickly.

Very good for many applications will be double sided adhesive tape, the type that uses a very thin carrier, about 0.04mm. thick. The valve chest cover in **Photo 3** was fixed using double adhesive, a method I use extensively. The thicker type, with a plastic foam carrier, while very effective, especially for items whose faces are not flat, is likely to cause problems due to its flexible nature.

A similar disc, with a few suitably placed tapped holes, will hold smaller workpieces, much in the same manner as a slotted plate. Compared to a standard faceplate, this could carry smaller components due to the absence of a large centre hole.

Accuracy

When it comes to accuracy, the face can be tested for true running by rotating the lathe by hand and noting errors using a dial test indicator. Do this towards the edge to avoid the slots. The other test is to see how flat it is. Do this using feeler gauges and a good quality straight edge across its width. However, machines, like any mechanical component, will be made to a tolerance, often plus and minus, the cross slide cannot therefore be guaranteed to be precisely at right angles to the lathe's axis. Faceplates are likely to show some deviation from the flat. A slightly concave result is considered better for parts made on the lathe, rather than a convex one, as this will produce better mating between flanges and the like. In view of this, lathes are toleranced towards the concave direction. As a result, your faceplate is likely to be slightly concave, whether mass produced on another lathe in the factory, or surfaced on the lathe on which it is to be used.

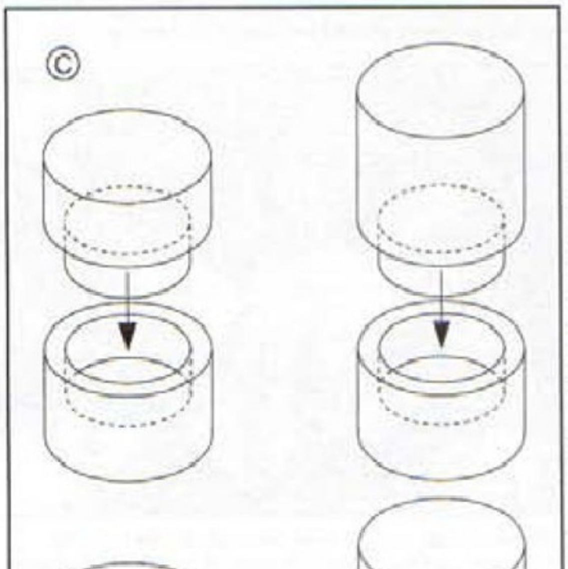
If the plate has a slight wobble, then it will need resurfacing on your lathe. If the error is only regarding flatness, then careful testing with a dial test indicator, while traversing the cross slide, will indicate whether it can be improved by surfacing. Before proceeding, consider the readings very carefully, ensuring that re-surfacing will produce an improvement and not make the situation worse.

Using

Having acquired your faceplate, putting it to use is the main hurdle, with safety a major factor. First consider if the plate is large enough for the task in hand, the more borderline, the greater the scope for problems. It is not just sufficient to say that the job is smaller than the faceplate; there must be room for adequate clamping. The more this is restricted, the greater the difficulty and the temptation to accept inadequate clamping. It is essential that there is no skimping in this respect, as should the work come loose whilst being machined, the possibilities are frightening. At best, time will be wasted; at worst, the workpiece will be damaged. Much worse would be damage to the lathe, but greater than these is the likelihood of serious personal injury. Please do not take chances!

A common operation will be the machining of castings, frequently of irregular shape, and producing intermittent cuts. Because of this, there is much scope for the workpiece to be forced from its clamps. Mild steel workpieces will have similar problems, but their more regular shape and smoother surfaces will minimise these to some extent.

Having decided that the proposed operation is acceptable, next consider the face being placed against the faceplate. If a casting, at best it will have a rough but essentially flat face. The roughness can be reduced using a suitable file, helping to avoid damaging the faceplate surface. Probably the casting face will not be flat; test this on a surface plate or similar. If it rocks this must be attended to, for if used in this form the casting, and or the faceplate, will become distorted. However, the distorted workpiece will return to shape after releasing from the faceplate and may result in an error in the machined surfaces.



A thin card (say 0.3mm) between faceplate and workpiece will protect the faceplate surface and help to compensate for very small errors. This approach should only be adopted to compensate for errors almost too small to be detectable by the rock test. Sometimes it will help to carry out preliminary machining of the surface, perhaps by milling, prior to mounting onto the faceplate.

Next, the method of clamping has to be established. A common method will be a clamp bar resting on the workpiece at one end and with suitable packing at the other. A clamping screw at some point along the bar should ideally be closer to the workpiece than to the packing, though this is not always possible. Essential though, is that the packing should be very slightly higher than the item being held. Both diameter of the clamp studs and cross section of the clamp bars must be adequate for the task.

Except under very simple situations, say machining the outer diameter of a disc whilst held by a central screw, never attempt to make do with a single fixing. Two fixings may be considered acceptable in some cases, especially if the fixings are captive within the part being machined, typically as in **Photo 4**. **Photo 5** also shows a casting being drilled while held with only two fixings. This can be considered adequate on three counts. Firstly, the non arduous nature of the operation, that is drilling a small hole. Secondly, the fixings are in part captive in the lugs on the casting and thirdly, the two fixings are at opposite ends of the casting.

From these points we learn three lessons:-

1 Consider the nature of the operation to take place; is it particularly arduous?

2 Study the shape of the workpiece; can it be used to advantage?

3 Most important, ensure the fixings are evenly spread around the workpiece.

Do **not** rely on fixings on one side only unless a simple operation, such as that in **Photo 4**, is being carried out. In many cases, especially where clamp bars are used that are outside the periphery of the workpiece, three fixings should be considered a minimum for security of the workpiece. **Photo 6** shows an example, in this case using a clamping system of which more details later in the article.

Balance

Having correctly positioned the workpiece and applied the clamps, the next stage is to turn the faceplate by hand, to ensure that the many projections present adequately clear all relevant parts of the lathe. Testing for clearance to the lathe bed is only part of the consideration, do remember that if the saddle has to be advanced, that this and or the cross slide may foul some part of the assembly during the operation.

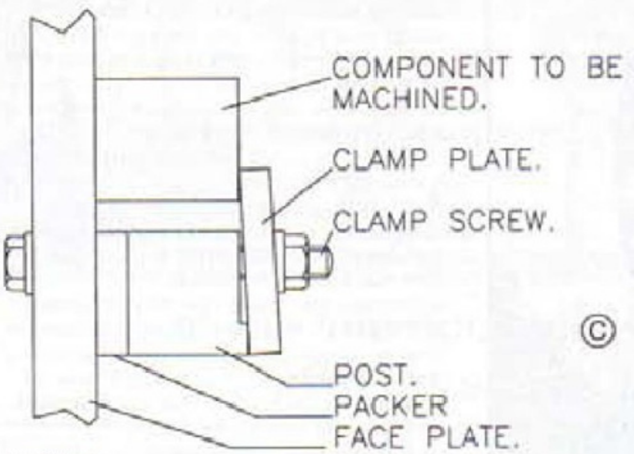
With this done, there is still one vital adjustment to be carried out. Due to the irregular nature of the set-up, it is highly likely to be out of balance, and vibration may be a severe problem. Some action has to be taken to reduce out of balance to an acceptable level. Testing for out of balance is not easy, and to do this the spindle must be allowed to rotate as freely as is possible. If, as is most likely, the lathe is belt driven, remove tension from the belt and move it totally clear of the pulley on the lathe spindle.

Typical faceplate clamps.

A set of faceplate dogs that permit total access to the front face, also precise positioning of the workpiece.

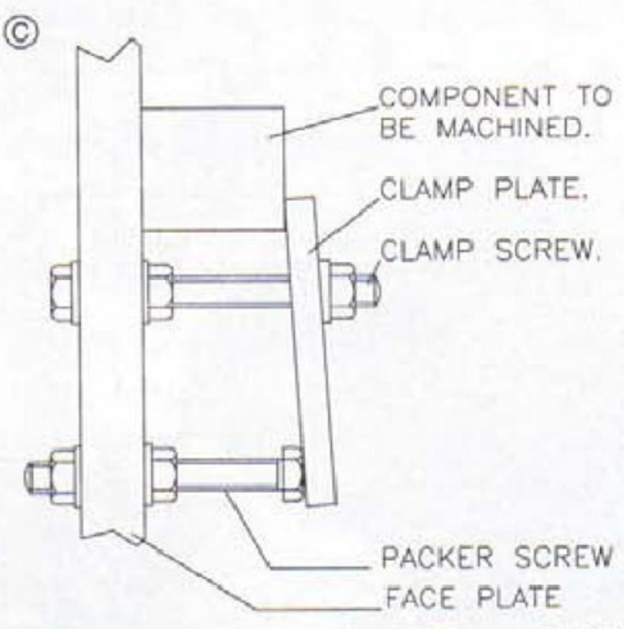
If the assembly is way out of balance, it will rotate to the position where the heaviest side rests at the lower position. If the out of balance is less severe, then it will be necessary to spin the spindle allowing it to stop of its own accord. Doing this many times should indicate a pattern where the resting position is more frequently around one position. From this the heaviest side can be estimated. Armed with these observations, weights can be added, with the aim of achieving a balance. Repeat the tests to confirm that a balance exists. Added weights can be moved out, or towards the centre, using the faceplate slots for fine adjustment of balance. **Photo 4** shows two square pieces of BMS having been added, and **Photos 5 & 6** show tee nuts being used for the purpose.

With weights added, it will again be necessary to make sure that the assembly will rotate without coming into contact with any part of the lathe. If all is well, make a last check to see that all clamps are securely tightened before the lathe can be finally run under power. If an unacceptable level of vibration is present it will be necessary to recheck using the tests as above. Unfortunately, due to the friction in the lathe spindle bearings, it may be difficult to determine a more precise result, other than by trial and error. This can be time consuming. Running at the slowest practical speed for the task in hand will help to minimise vibration.



NOTES.
1. PACKERS AND POSTS ARE MADE IN A NUMBER OF DIFFERENT HEIGHTS WHICH TOGETHER CAN CATER FOR ALL HEIGHTS OF WORKPIECE WITHIN THE RANGE.
2. HOLE FOR CLAMP SCREW IN THE PACKER IS A CLEARANCE HOLE BUT IS TAPPED IN THE POST. THIS ENSURES POST IS CAPTIVE BEFORE APPLYING THE CLAMP PLATE TO THE WORKPIECE.

FACEPLATE CLAMP SYSTEM. SK3.



SCREW USED AS PACKER. SK.2

Some further comments

Having dealt with the basics, I will continue with more detailed comments. **Photo 7** shows some proprietary cast clamps for use on the faceplate, plus some of comparable size made from mild steel strip. Both will require some form of packing placed below the clamp at the non workpiece end. This can be seen at the rear of the faceplate in **Photo 8**.

The choice of packing is of utmost importance; if this becomes loose while running it could be shot into the air. Firstly, the packing should be just higher than the workpiece itself. Unless the packing is purpose made to stack, as shown in Sk.1, it should be a single piece, do not be tempted to make up the height by using several random size pieces. The packing, must have a large enough footprint to be stable. Using a screw, nutted on either side of the faceplate, is a good method, providing it is of sufficient diameter, and a slot is available at a suitable position. The advantages of this method are twofold, firstly the height can be adjusted precisely, and secondly, by using nuts on either side it is captive. Making the clamping screw captive with a nut is also worth considering, see Sk.2.

The clamps seen in **Photo 6** have both the clamp screw and packing captive, and are very easy to use. While they do not always meet the ideal of having the clamp screw nearer the workpiece, their compact nature often makes it possible to use more clamps. The principle is illustrated in Sk.3 and has been featured in the magazine[2].

So far, we have considered as methods of securing the workpiece, screws through the workpiece (as in **Photo 4**), and clamp bars with stud (as in Photo 6). Another method, illustrated in **Photo 9** has two distinct advantages:-

1 They can, under some circumstances, hold the component to be machined while still leaving the top free for machining over its whole surface.

2 They can be used to make fine adjustment of the position of the workpiece.

Of course, securing any component for machining does not have to be limited to one method. Where convenient, a combination of methods may be the best approach.

Secondary mounting

Sometimes it will be helpful to mount another device onto the faceplate, onto which the part to be machined is then mounted. **Photo 8** shows a small angle plate being used in this way.

The well known Keats angle plate in **Photo 10**, is another device for mounting onto the faceplate. This is very useful for mounting round and square items, often items that are too large for the three or four jaw chucks. Making a Keats has featured in the magazine, cast iron versions made from proprietary castings [3][4] and a fabricated one[5].

As an alternative to a Keats, square and or round posts can be used. Under some conditions, say on a milling machine table, a high degree of precision can be attained by the use of round posts, see article in Issue 26[6]. Unfortunately, due to the concave nature of the faceplate this level of precision cannot be guaranteed. Even so, the result should often be more than adequate and worth considering.

Another secondary mounting is provided by facing the faceplate with a piece of wood. This can be fixed with wood screws from the rear, using sufficient to ensure that it does not move when in use. A major advantage of this approach is that the face can be machined to help locate the workpiece; also, wood screws can be used to hold the workpiece, using any of the above methods. These are not restricted to positions of the slots, any part of the wooden block being able to accept a wood screw. As there is no need for a hole in the centre, as there is in a metal faceplate, central fixing will be a possibility.

Use on the tailstock

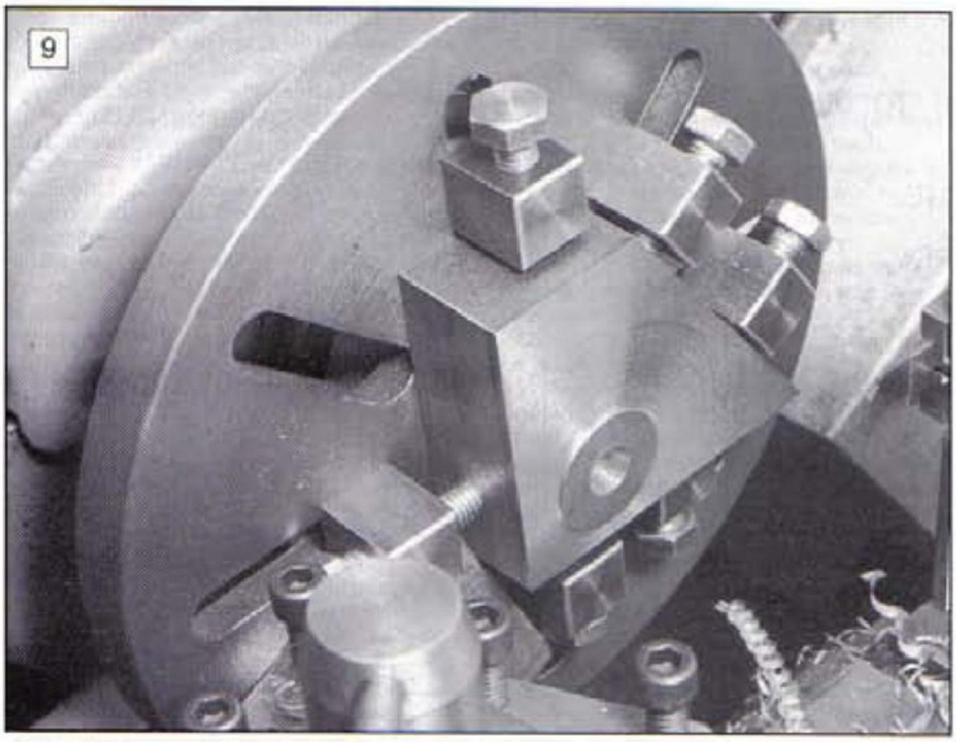
Some lathes have the same mounting on the tailstock as they have on the lathe spindle. In this case, any headstock mounted device such as, three/four jaw chucks, collet chucks and faceplates, can be mounted on the tailstock. **Photo 1** shows such a situation, where the lathe is being used to cross drill a length of round bar. This permits the lathe to be used for drilling where the owner does not possess a drilling machine. This procedure is frequently illustrated in the excellent articles by Bob Loader.

If your lathe does not provide the facility for mounting the faceplate onto the tailstock, an adapter could be made, or for some lathes, purchased.

Use elsewhere

The faceplate can, with advantage, sometimes be transferred to other machines using suitable adapters, say to a dividing head or a rotary table. With a simple mounting arrangement, it may be possible to use it on the drilling machine. One idea frequently proposed is to carry out some turning operations on a component mounted on the faceplate, then to remove the faceplate, complete with workpiece, and to transfer it as one unit to another machine for a second operation. Alternative uses, both on the tailstock and elsewhere, are many and beyond the scope of a beginner's article.

9



Secondary mounting arrangements are sometimes added to the faceplate, in this case a small angle plate.

However, these brief comments are intended to get the user thinking along these lines.

Safety

The subject of safety has already been referred to, but is so important as to warrant additional emphasis. Potential danger to the operator is lurking in two major ways. Firstly, though probably the lesser, is that of either the workpiece or a clamping device being thrown whilst the lathe is running. To guard against this, consider the clamping arrangement carefully, paying particular attention to the following:-

1 Ensure all clamp screws are securely tightened, but not over tightened.

2 Wherever possible, make items captive so that they will remain on the faceplate even if they become loose.

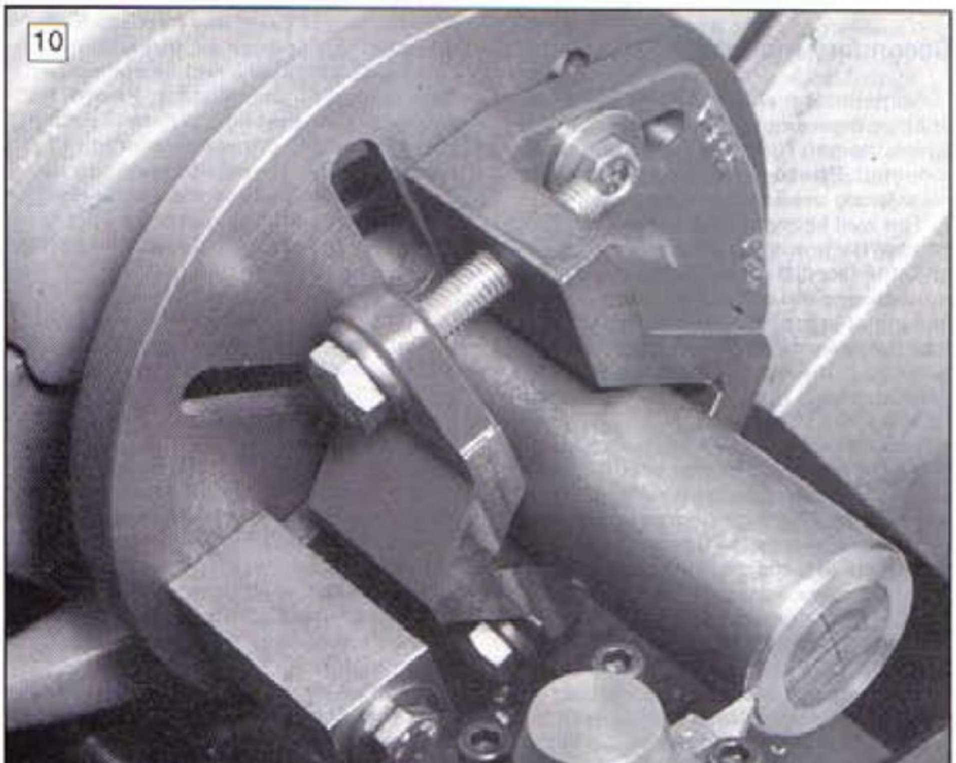
3 Position clamps such that the cutting action tends to force the workpiece against the clamp rather than pulling it free. Extra support pieces may be helpful here, their purpose not being to clamp the workpiece but to restrain it against possible movement.

If helpful, use a combination of clamping methods.

More likely, and probably more dangerous, is for the lathe operator to get caught up with some part of the rotating assembly. While, if the workpiece has been securely mounted, that aspect of the operation can then be largely forgotten, giving regard to the dangers of the rotating assembly is an ongoing requirement. One lax moment and disaster can strike. Other than continual vigilance, there is little that can be done to prevent such an incident. However, attention to unnecessary projections from the assembly in the first place is an essential factor to be considered. In this direction, clamp screws are the most likely problem, but action can sometimes be taken to minimise the risk.

When setting up the assembly, chose screws/studs of an appropriate length. Attempt to limit the front projection by leaving any excess behind the plate, rather than on the workpiece side. If all else fails, cut the ends off any projecting fixings; it is better to shorten your valuable studs, rather than to have them shorten your fingers.

10



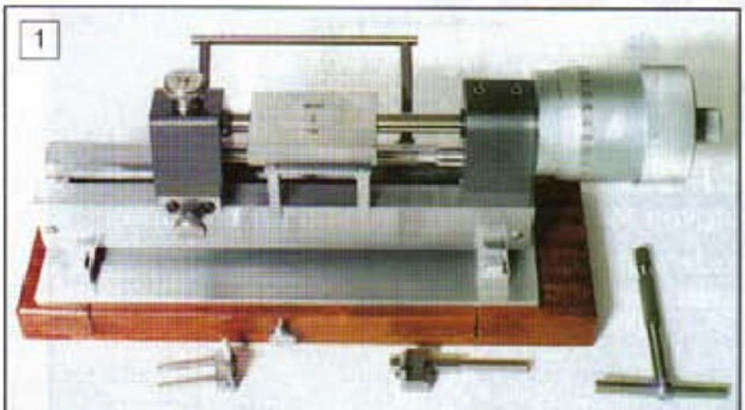
Keats angle plates are good for holding items too large for the chucks available.

References

1. **Fabricated faceplate for the Unimat. *M.E.W.* Issue 25 page 43.**
2. **Faceplate and angle plate clamps. *M.E.W.* Issue 20 page 24. Updated:- *Toolmakers clamps and milling operations.* *M.E.W.* Issue 25 page 67.**
3. **A Keats angle plate. *M.E.W.* Issue 3 page 48.**
4. **A small Vee angle plate. *M.E.W.* Issue 39 page 44**
5. **An economic angle plate. *M.E.W.* Issue 8 page 28.**
6. **Making a precision angle plate. *M.E.W.* Issue 26 page 38.**

THE 66th MODEL ENGINEER EXHIBITION

at The International Model Show, Olympia, London 29th December 1996 - 4th January 1997



1. *Derek Winks of London has entered this bench micrometer in Class A5*

3. *Geoff Allen of Wortley, Sheffield designed and constructed this versatile compound table which has won major awards whenever it has been exhibited.*

2. *Based on a design published in M.E.W. No.8, this clock wheel depthing tool is by Anthony Pedley of Totnes, Devon*

4. *Soon to be described in M.E.W., this bandsaw blade welder is the work of Peter Rawlinson of Ashford, Kent*

Final preparations are now in hand for the International Model Show at Olympia. The Model Engineer Exhibition forms a major part of this Show, which embraces all aspects of the hobby of model making.

Because of the proximity of the Christmas period, the show will open this year on the Sunday, and will continue until the following Saturday evening. Judging, which traditionally takes place before the show opens, will this year be carried out on the Sunday, so visitors may catch a glimpse of the judges at their deliberations. May we ask that visitors leave the Judges to their work, they all have a large "Case-load" to get through. Please note that this year the late night opening is on Friday 3 January, until 8pm. another departure from the norm.

The engineering section of the show will again be located towards the rear of the main hall, where the Competition and Loan display sections will be situated, together with the majority of our model engineering trade supporters. The Society of Model and Experimental Engineers (SMEE) will, as always, play a major role in our section of the exhibition, with their display stand, workshop and passenger carrying miniature railway. A new feature this year will be a second workshop operated by The Southern Federation of Model Engineering Societies, which will be manned by experienced model engineers from member clubs, who will be pleased to discuss visitors' workshop problems, and if possible give practical demonstrations of how to overcome them.

More use is to be made of the balcony area this year where, in addition to the popular Olympian Railway, the majority of the Club exhibits will be located.

The large boating pool will again be in the main hall, and this year the car track will also be in the same area. Both attractions will this year feature seating so that visitors can enjoy the demonstrations in a modicum of comfort.

One of the successes of recent years has been the development of the model flying facility in the National Hall. This will continue this year with, hopefully, a number of record attempts taking place during the week.

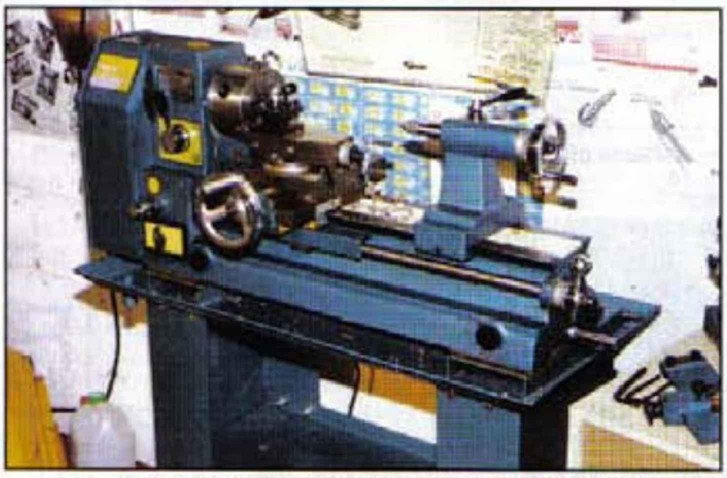
As always, the highlight of the show for many will be meeting friends old and new. For many modellers it is one of the opportunities of only about two or three in the year when they have the chance to meet up with friends from opposite ends of the Country (or perhaps, the world). Come and join them and admire the best of craftsmanship that members of our fraternity can offer. We hope to see you there.

We Visit

Paisley Machine Tools and The Engineers Emporium

Whilst travelling about the Country, the Editor has taken the opportunity to call on two suppliers who cater for the readers of M.E.W.

One corner of the Paisley Machine Tools showroom. The object on the left is a fork-lift truck, which is used as the 'lift' to transfer items to the upper floor.



The 'Nu-Tool' lathe with some of its accessories. The combined lathe/mill version can be seen in Photo. 1.

PAISLEY MACHINE TOOLS

For many years, the model engineering press has carried advertisements for the Matosa rotating lathe centre. It would be easy to assume from the name that these are the product of a Far East organisation, like so much of the equipment on the market today.

A journey earlier in the year through the delightful countryside of rural Sussex presented the opportunity to visit the premises of the vendor of these centres, and to be convinced that the smaller type in the advert, which proclaims British made is indeed true.

Following detailed instructions, which were as precise as a production manufacturing process, a turning to the left, round a telephone box in a lay-by on a B class road took us down a lane to a yard which contains a building which is a cross between a barn and one of those country garages of dim and distant memory. The greeting from proprietor Reg. Paisley was as civilised as the surroundings - the immediate offer of a seat and a cup of coffee! While relaxing after the journey, it was possible to verify the truth of the advertising, because we were surrounded by a small group of machines humming away at the various operations involved in the manufacture of the centres, as everything except the heat treatment process is done in-house.

Much of the machinery has been adapted by Reg. to carry out the manufacturing operations required in the most efficient manner, with home-made attachments tailored to the job in hand. This is no surprise, because Reg. has spent his whole career in the engineering industry, for much of this time dealing with special purpose machine tools.

During our discussions, the secret of the name emerged - simply MAchine TOol SAles, and nothing to do with the Orient!

The second object of the visit was to have a look at some of the new machines on offer in the adjoining building, which operates under the Paisley Machine Tools banner. After much evaluation, Reg. has decided that the best value for money in lathes is offered by the 6in. centre height Nu-Tool NTL300/P unit, which he currently has on offer, fully equipped, at £695 VAT paid and delivered anywhere on mainland U.K. The equivalent combined lathe/mill unit is also available, at £820. Reg's. choice of this supplier is influenced by quality control considerations. He is aware that, with a number of machines to basically similar designs being imported, it would be all too easy for 're-badging' to take place to alleviate supply difficulties, with a consequent loss of control.

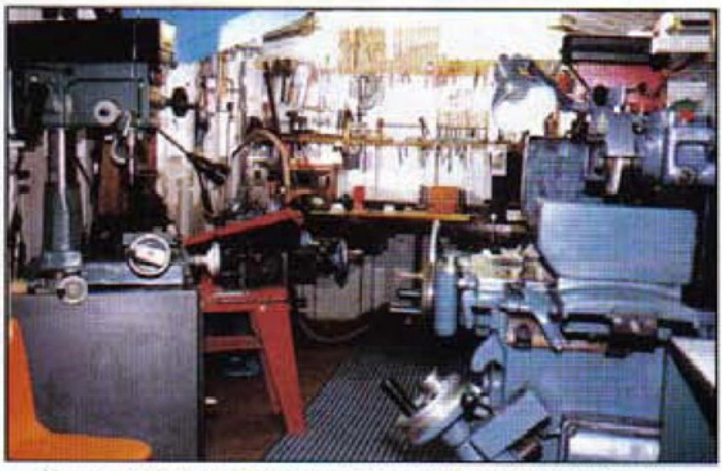
Other manufacturers' items, particularly saws and tool cabinets by Sealey, are much in evidence, as are files of letters from satisfied customers and magazines containing write-ups and advertisements for the equipment on offer. The location and nature of the business are such that potential customers are advised to telephone to set up a visit, when they will receive the 'personal treatment', as I did.

Before we left, I was intrigued to examine a couple of items produced in wood, on machinery supplied by Reg. in

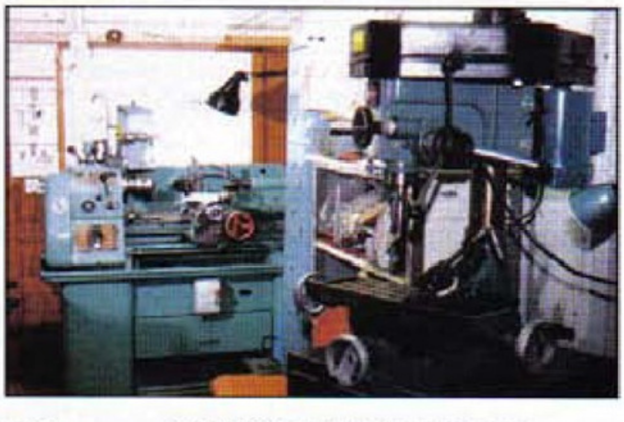
Advertisements and magazines decorate the showroom.

Attractive examples of items produced on machines supplied by Reg. Paisley

Reg. demonstrates the 'hands on' approach in his own well equipped workshop



Above and below : Two more views of Reg's. home workshop



previous years. These are the work of Jim Waters of Hurstpierpoint, a craftsman of eighty-plus.

This wasn't actually the end of the visit, because the next leg of my journey took me past Reg's. home, where I had the opportunity to see his own workshop. As will be seen from the photos, this is comprehensively equipped, as one would expect. Engineering isn't just a job to the proprietor of Paisley Machine Tools and Machine Tool Sales, it's a way of life - if not life itself.

Paisley Machine Tools, Sparks Lane, Brook Street, Cuckfield, Sussex RH17 5JP Tel. 01444 413122 and 01422242266

THE ENGINEERS EMPORIUM

The second visit was also to the premises of an engineering enthusiast and businessman, but in a different part of the country. The Engineers Emporium is supervised by Adrian Grimmett and his charming wife, Fay, to say nothing of two small boys, an Old English sheepdog and a selection of cats! It all takes place on a farm at Bramcote in Warwickshire. Again, the instructions had to be very precise, because the farm is approached along a half mile long unmarked track which traverses open arable land. After crossing a cattle grid, I was re-assured by the sight of a 'gate guard', much in the style of those redundant fighter aircraft outside RAF stations, but this time in the shape of a huge belt driven drilling machine. Its elegantly shaped castings were silhouetted against an autumn sunset, as artistic as any piece of conventional sculpture.

Seated in Adrian's book-lined study cum office, again with a welcome 'cuppa', we were surrounded by some of the items which form part of the stock in trade of the business - engineering models of all types. Completed and part-finished locomotives from 'O'gauge to $7^1/_4$ in., traction engines, marine and stationary steam engines, i.c. engines, aircraft - all branches of modelling are present, and customers come from all over the world.

As darkness fell, we took a quick trip around the farm, accompanied by one of the cats. Although the setting is remote, there are no worries about security, because the area forms part of the patrol route for guards from a nearby military establishment. Unwelcome intruders are likely to encounter a reception which could possibly be termed hostile!

The farm buildings house the other part of the stock, secondhand machine tools of all types and sizes, attachments, accessories, small tools and equipment of every description. Condition varies from near-perfect to 'basket cases'. Items may be sold 'as seen' or with reconditioning work carried out, prices varying accordingly. If a machine is beyond salvation, it may be 'reduced to produce', so machine tables, changewheels, tailstocks, handwheels and all manner of other items pack the shelves which fill the buildings. If any reader of M.E.W. has a machine which has a part missing or beyond repair, contact The Engineers Emporium because they may have one, or will put you on their card index in case one turns up.

Unfortunately, at the time of my visit, photography was impossible. Outside it was pitch black (no street lamps here), and inside the stores, there wasn't room to swing a camera, leave alone a farm cat!

Before I left, I was requested to sign the Visitors' Book and to inscribe a comment. I likened the establishment to Aladdin's Cave, to which I feel certain that I shall return, especially when I need that elusive part for some machine tool.

L.A. Services Ltd., The Engineers Emporium, Bramcote Fields Farm, Bramcote, Warwickshire CV11 6QL Tel. 01455 220340

TRADE COUNTER

SANDVIK'S NEW COROMILL 245 FACEMILL AT HALF PRICE!

Our friends at Greenwood Tools have come up with rather a special offer for readers of *M.E.W.*

The new 50mm diameter CoroMill face mill has a 45 deg. approach angle, making it ideal for use on light spindled machines with low power - its high-shear positive rake means that it works well with as little as $^1/2$hp.

This is the first face mill machined from hardened steel, and its reliable design includes an indexable shim for damage protection. Self-locating pockets give foolproof insert positioning, and a 2mm wide land on the inserts gives mirror finishes, even when used at high feed rates. This extremely precise cutter is easy to use, and combined with H13A carbide, can cut steel, stainless steel, cast iron, aluminium and other non-ferrous materials including copper, bronze and plastics.

Strong square inserts give four cutting edges each, and a 22mm dia. ISO standard mounting hole gives maximum versatility (Morse Taper and R8 arbors are readily available from a number of suppliers).

Sandvik's list price for the cutter kit, complete with H13A inserts, keys, spare screws and a tube of Molycote is £196.87. Greenwood's offer will mean that the first 50 customers will be able to buy one of these cutters for £98.43 plus packing and postage.

Greenwood Tools, Sherwood House, Sherwood Road, Bromsgrove, Worcs. B60 3DR Tel. 01527 877576 Fax. 01527 579365

ROOM TEMPERATURE METAL BLACKING COMPOUNDS

Metalblak cold blacking compounds are available for iron and steel components, Zincblak for zinc plate and zinc diecast and Brassblak for copper and brass items. In the liquid form, the process consists of a four tank dip system, with a water wash between each. For iron and steel, an alternative cream system is available.

The individual materials can be obtained in quantities of 100ml, 500ml, 1ltr and 5ltr, with complete kits of the four concentrated solutions also available in each of these sizes. The kit prices include VAT and delivery, and start at £9.95 for the 100ml kit.

Delway Technical Services, 192 Seabank Road, New Brighton, Wallasey, Wirral L45 5AG Tel. 0151 639 3201

COMPREHENSIVE MACHINE TOOL EQUIPMENT CATALOGUE FROM ROTAGRIP

The 1996/7 Catalogue from Rotagrip consists of 256 well illustrated pages, detailing thousands of industrial standard items ranging from T-nuts to multi function CNC machines. While this Catalogue is aimed primarily at industry, and a number of the items are beyond the scope of the average home workshop, many will be of interest to those seeking high quality fittings and accessories for lathes and milling machines.

Prices for the catalogued items are contained in a separate list, the latest edition being dated November 1996.

The Catalogue is available from Rotagrip for £3.00, inclusive of postage.

Rotagrip Ltd., 16 - 20 Lodge Road, Hockley, Birmingham B18 5PN. Tel. 0121 551 1566 Fax. 0121 523 9188

PHOENIX PRECISION PAINTS

The name of Bob Shephard of Cheltenham has long been associated with the supply of authentic colour enamels for models. Now trading as the Phoenix Paints Company, Bob is now able to supply not only the materials, but also Railway Company colour cards and Livery Data Sheets. Over 20 years of research have gone into ensuring that the materials and information are as correct as possible, with many individuals and organisations such as British Rail having provided valuable assistance. Unlimited access to the G.W.R. livery panels from Swindon Works makes it possible to settle some of the arguments over the correct paint schemes for that Company's stock. Also recently re-introduced to the Phoenix Paints range are the popular traction engine colours and, of interest to many will be the self-etch primer, which is particularly useful for brass items.

Much helpful information is contained in Bob's book, *The Finishing Touch - The How's and Why's of Painting Models*, which was first published in 1976, and was revised in 1990.

Phoenix Paints Company (and Livery Data Services), P.O. Box 359 Cheltenham, Glos. GL52 3YN Tel. & Fax. 01242 575326

FEIN SANDER/SAW KIT SPECIAL OFFER

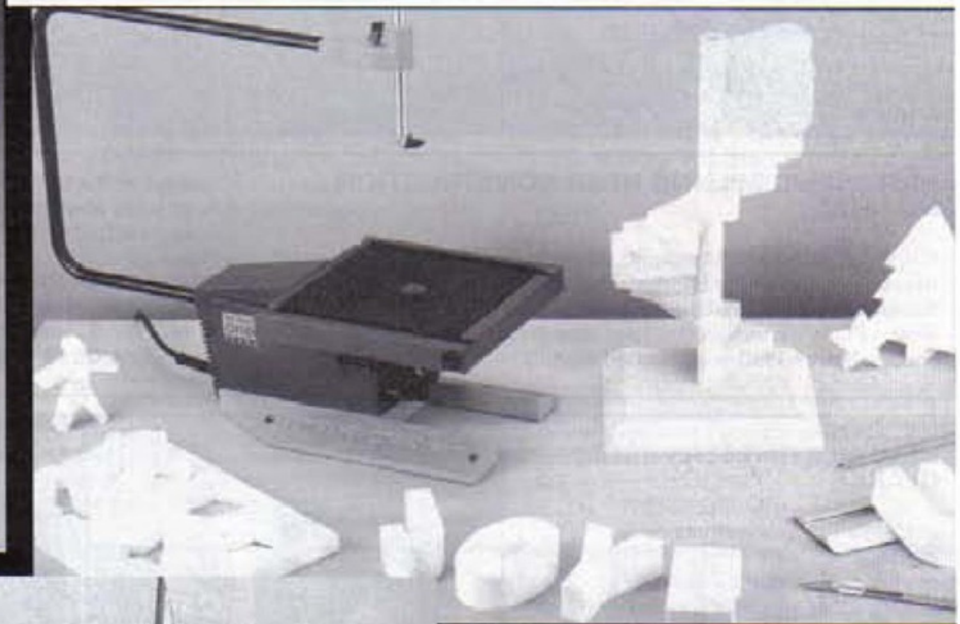
Fein power tools have a high reputation for quality, but they have never been cheap. Their detail sander, for instance has retailed at over four times the price of similar DIY equipment. CSM Just Abrasives of Brighton have now negotiated a special price for the Multitalent Sander/Saw Full Kit, and are able to offer the MSFX636-11 unit plus a full kit of accessories for £199.95 including VAT and delivery.

CSM Just Abrasives, 95 - 96 Lewes Road, Brighton, East Sussex BN2 3QA. Tel. 01273 600434 Fax. 01273 600937

LOW COST BENCH DRILL FROM REXON

The Rexon Company, established in this Country in February last, is adding steadily to its product range. The latest item to come to our attention is a 1/2in. capacity bench drill press, which is equipped with five speeds and has a 2in. spindle travel. Available for a limited period offer at £54.95, the RDM-30AT represents extremely good value for money.

Rexon Ltd., Freepost NEA 116, Rotherham, South Yorkshire S61 4BR Tel. 01709 361158



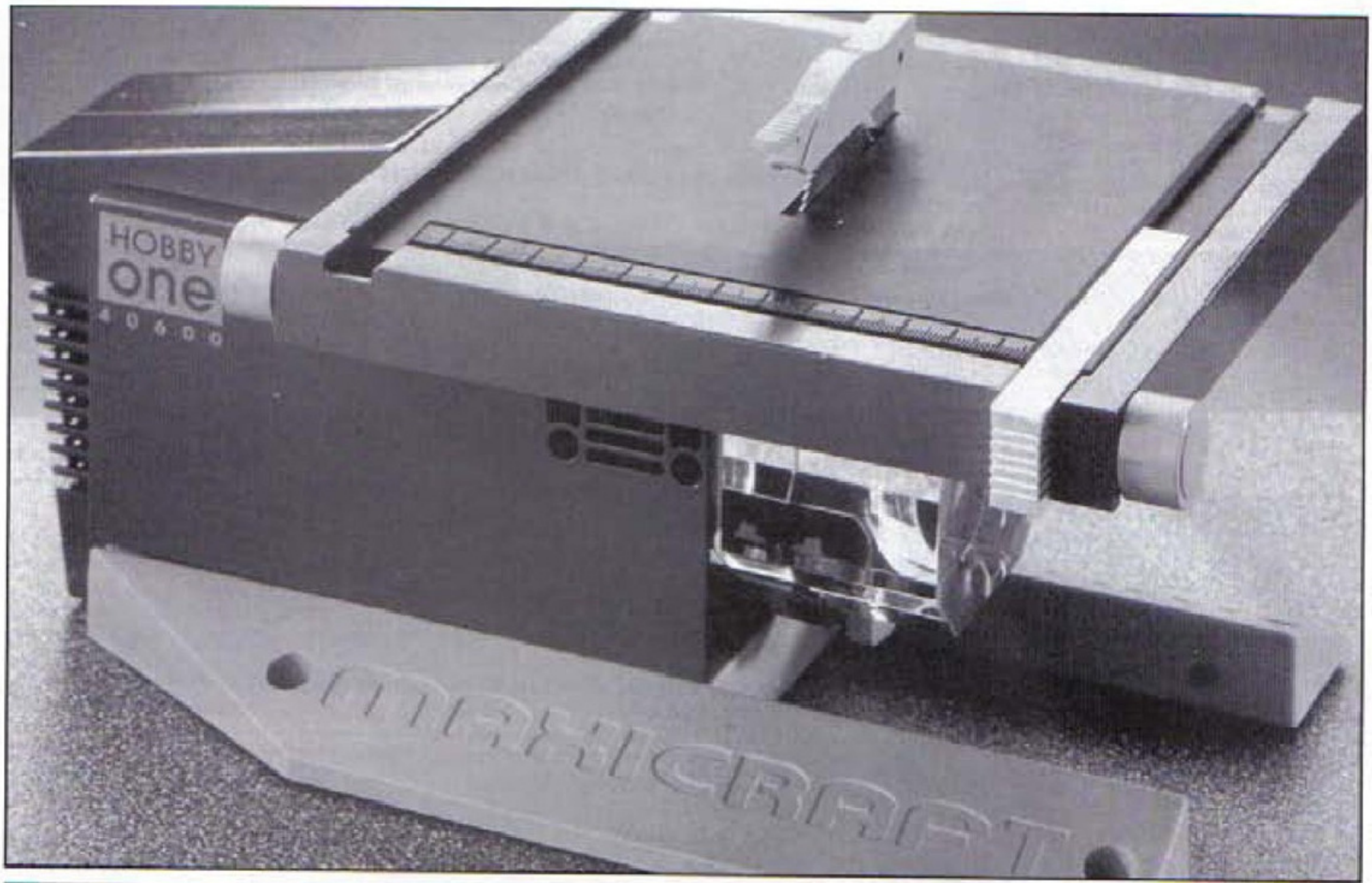
MAXICRAFT 230 VOLT TOOLS AVAILABLE IN THE U.K.

Following a reciprocal agreement between U.K. small power tool manufacturers Minicraft and their French counterparts, Maxicraft, three of the latter Company's tools have been launched into the U.K.

The range consists of a Flexible Power Tool (Ref. 75002), a Bench Circular Saw (Ref. 40060) and a Hot Wire Cutter (Ref. 43900). These are obviously aimed at the lighter end of the modelling and craft hobby, but all being 230 volt units, should avoid many of the criticisms which are levelled at the low voltage tools in this range.

Recommended Retail Prices are:- 75002, £149.99 - 40060, £99.99 and 43900, £99.99

Minicraft, 1 & 2 Enterprise City, Meadowfield Avenue, Spennymoor, Co. Durham DL16 6JF Tel. 01388 420535



MOTORISED MILLING HEAD CONSTRUCTION MANUAL

In *M.E.W.*, Issues 34, 35 and 36 we published a description of the motorised milling head which Mark Figes designed for his Senior M1 milling machine. The drawings are available from the Nexus Plans Service under reference WE 64 at £15.75 for the four sheets. Mark has now published an augmented version of the articles in the form of a construction manual. This is available both from Mark and from Hemingways, who supply some of the materials for the kit. The price of the 38 page manual is £9.95 post free.

M.A. Figes, 1 Bridge Cottages, Bridge Road, High Kelling, nr. Holt, Norfolk NR25 6QT

N.S. & A. Hemingway, 30 Links View, Half Acre, Rochdale OL11 4DD Tel. 01706 45404

NEW MULTIMETERS FROM CLARKE

Clarke Power Products have introduced a new range of 11 top quality multimeters. From DIY to professional specification this new range of multimeters combines hi-tech performance and accuracy and accuracy with great value for money.

These Multimeters will measure AC/DC volts, current, resistance and capacitance. The range stretches from pocket meters to digital and analogue clamp meters, the new range includes bench top/portable units with protective holster, a pen probe meter with features such as logic test, bar graph display, audible continuity test and other features to cope with most applications.

Prices range from £6.95 for an analogue pocket meter to £64.95 for a professional multi function meter with dual display, auto ranging, bar graph data hold and protective holster.

For further information on specific models in the range please contact Ross Burnard at Clarke International, Tel. 0181 986 8231.

LINKUP

- Reader to reader service
- help
- queries
- small sales
- wants
- & its all free!

Would readers wishing to use this facility please note that the maximum total value of items accepted in a 'For Sale' entry is restricted to £50. To advertise goods of a greater value, please refer to our Classified Advertisement Department (Tel. 01 442 66551 Fax 01442 66998)

FOR SALE

● 'ERMA' 'SEC-OP-MIL' bench machine. Can be used for surface grinding or milling. Very adaptable machine. Single phase motor, Push Button starter. Weight 112lb. Maker's illustrated specification available. £50 plus p&c.
Tel. 01322 330556 (Kent)

● 48+ piece Imperial set of British made slip gauges £50. (Immaculate hardwood box also available, phone for details)
Tel. 01895 236203 (nr. Heathrow)

● Jones & Shipman drill vice £20
Geoffrey Ford Tel.01432 357460 (Hereford)

● Gears and special pulley for Pike back gear for Drummond round bed lathe.
Change wheels, 8 spline bore, 20, 30, 35, 60, 63 & 65 teeth.
Change wheels 3/4in. bore with keyway, 55, 60, 75, 127 teeth.
J.A.H. Wallace Tel. 01905 820341 (Worcester)

● Zyto headstock (bare), 3 3/8in. centre height £25
Tel. 01432 269951 (Hereford)

● Pooles lathe comprising bed, saddle, tailstock, leadscrew etc. plus a headstock **which is not of the same centre height.** Headstock includes step pulleys and electric motor with pulleys on hinged bed. £35 (Buyer collects)
G..Siddall Tel. 01422 882122 (West Yorkshire)

● *Model Engineer* magazines Volumes 93, 94, 95, 102, 125, 126 (1st 3) plus 6.11.87 to 2.6.94 (incl) and odd ones (total 437). *Engineering In Miniature* Issue 1 to September '88 (114 in all). Any reasonable offer or part exchange for small air compressor (air brush), small 4-jaw or power table feed for Taiwanese Vertical Mill.
G. Keal Tel. 01977 674434 (West Yorkshire)

● Swivelling vertical slide will fit Myford ML7 Series £25.
G. Entwistle, 37 Leyton Drive, Bury, Lancs, BL9 9TS, Tel: 0161 796 8462.

WANTED

● Set of external chuck jaws for 41/4in. Pratt self centring chuck. Jaw width 0.542in.. Consider complete chuck if Myford fitting.
Tel. 01684 574169 (Malvern)

● Adjustable angle plate to fit small vertical miller.
Also, can anyone help me with information about a Raglan miller I have recently purchased. The only information I have is that which is on the machine, which is simply—Raglan Vertical Miller, Raglan Engineering Co Ltd., Raleigh Street, Nottingham, and an instruction to operate the variable speed control twice a day.
I am most concerned about lubrication and operating instructions and also the availability of spares, as I understand the company has now gone out of business.
G. Entwistle, 37 Leyton Drive, Bury, Lancs, BL9 9TS, Tel: 0161 796 8462.

● A pair of gear wheels for a small set of bending rolls. Bore, number of teeth and width of face not critical, but P.C.D. 1in.
G..Siddall Tel. 01422 882122 (West Yorkshire)

● Spare parts for an Atlas lathe, or information as to where to obtain.
D. Collins Tel. 0181 241 1023 (Surrey)

● I would like to contact anyone who may have used the Black Box supplied as an add-on for use with the Spectrum P.C., to control stepper motors (as advertised in *Model Engineer* No. 3813, Nov. 1987, page 640).
Also, can anyone supply me with details of the overhead arm locking mechanism for the Aciera F1 milling machine?
R.T. Boyle Tel. (from UK) 0035361452649, (from Ireland) 061452649 (Limerick, Ireland)

● Handbook or maintenance manual (or photocopy) for Raglan 'Little John' lathe.
Also information leading to purchase of vertical head for Adcock & Shipley horizontal milling machine, Model 1AG.
B. Jenner, Wybergh Cottage, Warcop, Cumbria CA16 6NX

● Manuals and drawings for U-boat armament, especially the 8.8cm SKC 35 deck gun, in order to construct 1/4 scale replica.
S. Trendall Tel. 01344 774886 (Berkshire)

● For a friend in Australia, manual for Woodhouse and Mitchell (Brighouse, Yorks) milling machine model 3H-WM 369
N. Bradley, Well House, 3 Chapel St., Bottesford, Notts., NG13 0BY Tel./Fax. 01949 843485

● Information on the whereabouts of A.A. Tools, formerly of Ashton-under-Lyne, manufacturers of a metal bender (brake) which I possess.
Robert Langlois, 295 Hetty St., Port Stanley, Ontario N5L 1C1, Canada

● Backgears and spindle and any other spares for Drummond 3 1/2in. bench model lathe (Year about 1920).
Tel. 01792 885209 (Swansea)

IN OUR NEXT ISSUE

Coming up in the MARCH/APRIL issue, No. 41, will be

A BANDSAW BLADE BUTT WELDER
A major new project from Peter Rawlinson, describing a machine which will enable the bandsaw owner to save money by repairing broken blades or making new ones from stock

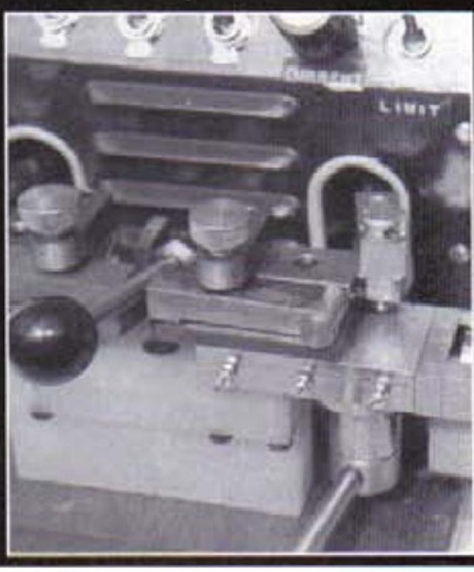
INVOLUTE GEAR CUTTERS
Don Unwin updates his earlier articles by adding the data for 14 1/2deg. pressure angle gears. A resume of the process is provided for new readers

BOXFORD REAR TOOLPOST
This adapter, which allows the toolpost which George Thomas designed for the Myford to be used on Boxford 5in. lathes is described by Mark Figes

PLUS
The winner of the Emco lathe competition.

Issue on sale 21 February 1997

(Contents may be changed)



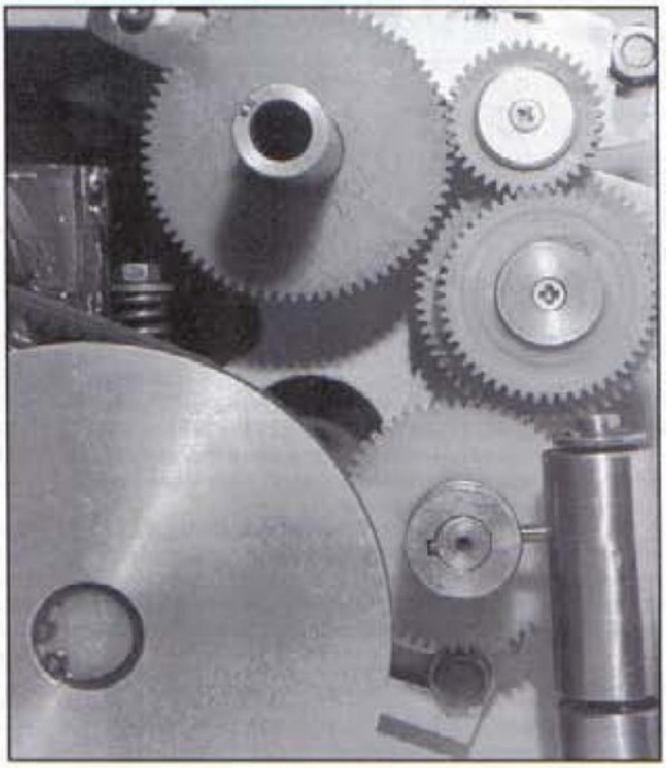
ENHANCING THE HOBBYMAT LATHE

The Hobbymat lathe, manufactured in the former East Germany, and formerly marketed by CZ Instruments has proved to be very popular with our readers. Unfortunately, as a result of a change of business policy by the new owners, this machine is not currently available. E. J. 'Mac' Mackenzie has developed a number of modifications and attachments for the one which he owns, and describes here how to adapt it so that it will cut a wide range of threads, both right and left hand

Tyro days

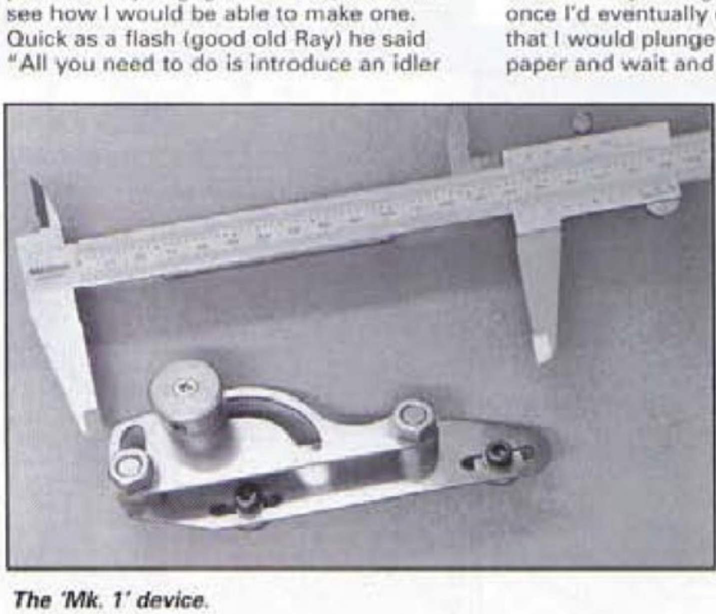
I knew when I ordered my metric Hobbymat MD65 that 26TPI was a thread which was not listed as being within its screw cutting capabilities, and as I frequently used 1/4in. BSF, I was pleased upon receipt of a copy of Peter Jones's Supplementary notes to find it contained a gear train for that thread (and several other unlisted threads too). Any road up, as we used to say around 'ere, I accepted that C.Z. had missed a few, and addressed myself to a series of minor enhancements of the lathe, and a very enjoyable time it's been too.

I have been indulging myself in this satisfying hobby for not much more than five years, so practically everything I tackled ended up requiring an improved Mk. 2-3, etc. version. The day came when a rather ambitious (for me) Mk. 1 enhancement required an M10 x 1.0 LH tap, with longer than standard shanks both top and bottom. I studied the handbook and lathe to no avail, and finally confided to one of the experienced engineers at the college night workshop we attended that, with a permanently-engaged feednut, I couldn't see how I would be able to make one. Quick as a flash (good old Ray) he said "All you need to do is introduce an idler into the gear train". Once he'd explained what this 'speaking foreign' meant, and once I'd eventually cottoned on, I decided that I would plunge into this, put pencil to paper and wait and see if a design for a device which could be fitted without too much mutilation of the lathe would evolve. It did, and I only needed to drill and tap one M5 hole in the headstock. The week before I produced my completed effort, (for approval by Ray, of course), a splendidly simple design by J.S. Davis was published in *Model Engineer* of 2 Dec.'94. Needless to say, everybody at the workshop had seen it. I still maintain that I displayed exceedingly good grace in the face of "never mind"s and vague murmurs of "wasn't it astonishing that of all people, I should have so completely forgotten **KISS (Keep it SIMPLE, STUPID!)**".

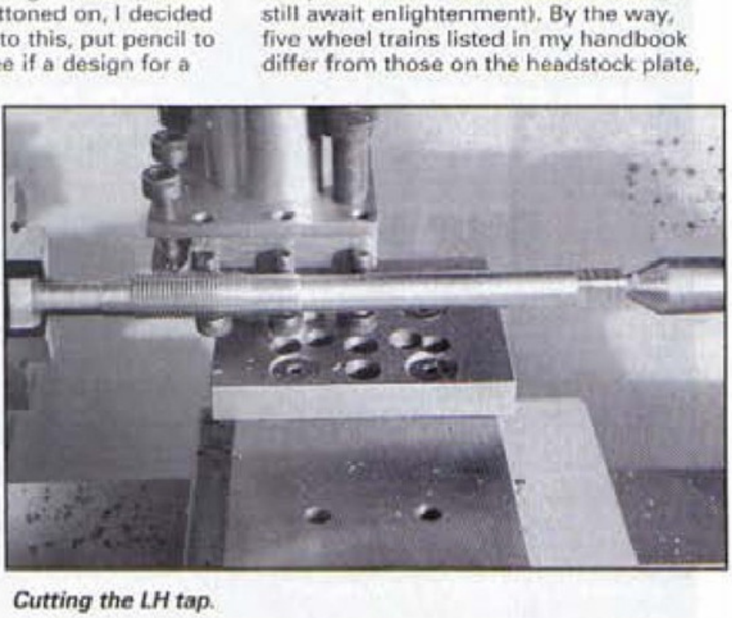


The 'Mk. 1' device set up to cut LH 20 TPI thread.

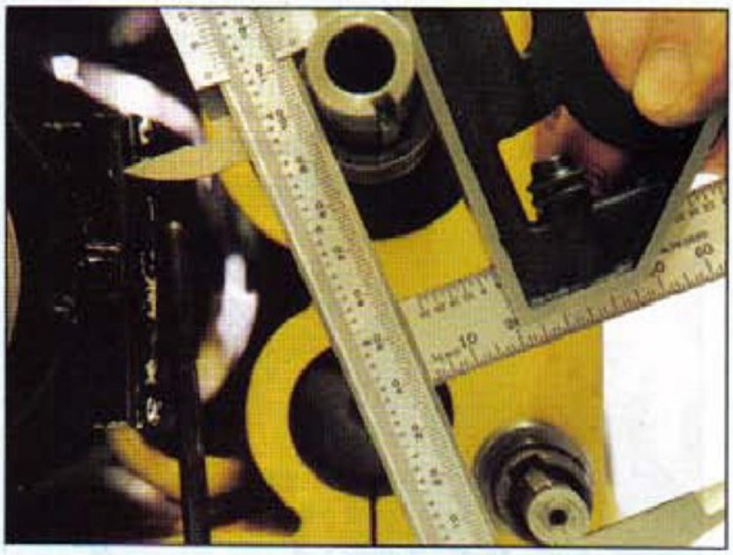
Nevertheless, my device looked right, so it probably was right. Anyway, it worked for all the threads listed by Peter Jones and on the plate on the front of the headstock. I didn't check the Modular range because I don't know the intended use of these. I did get an explanation from a Hobbymat expert at the '95 Stoneleigh Show, and tried to appear sage and comprehending. He was very busy, so I couldn't reasonably expect him to devote any more of his time to what would most likely have been more wasted effort. (I still await enlightenment). By the way, five wheel trains listed in my handbook differ from those on the headstock plate,



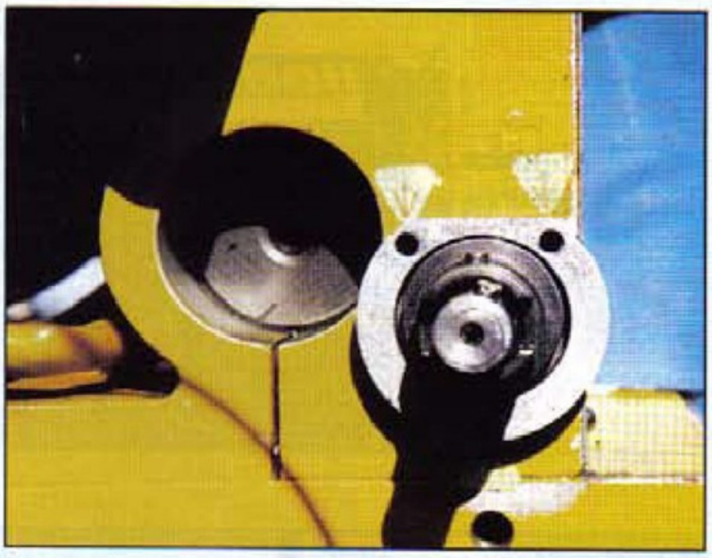
The 'Mk. 1' device.



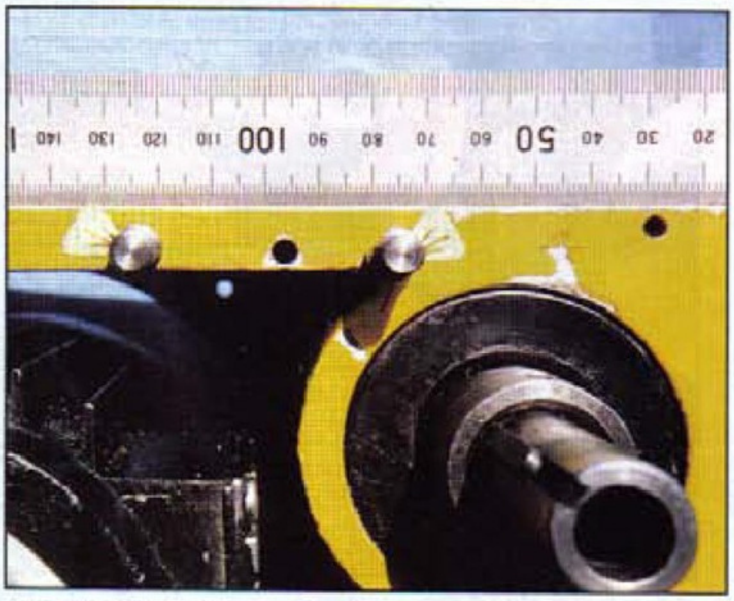
Cutting the LH tap.



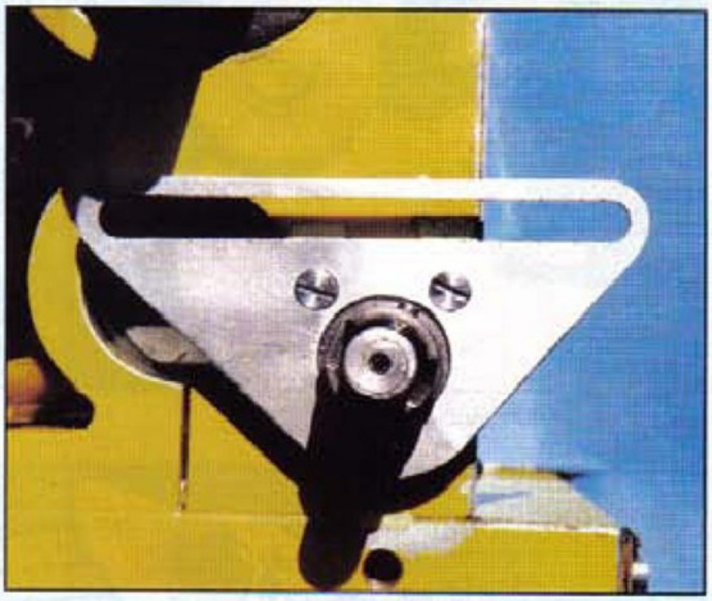
Determining the mandrel and leadscrew centres.



The bearing cover.

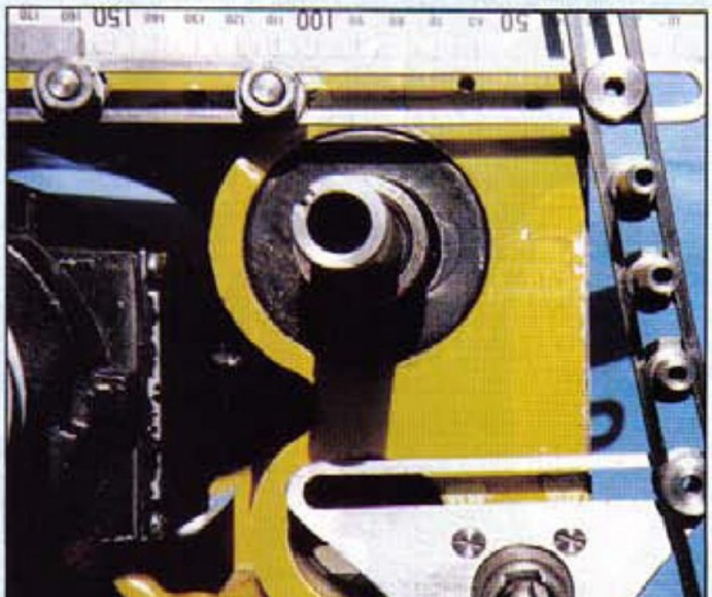


M5/M8 studs for the upper bracket.

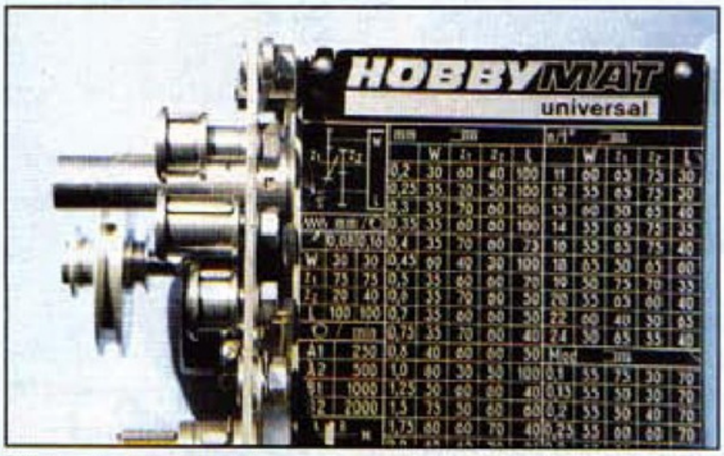


The lower bracket in position outside the bearing cover.

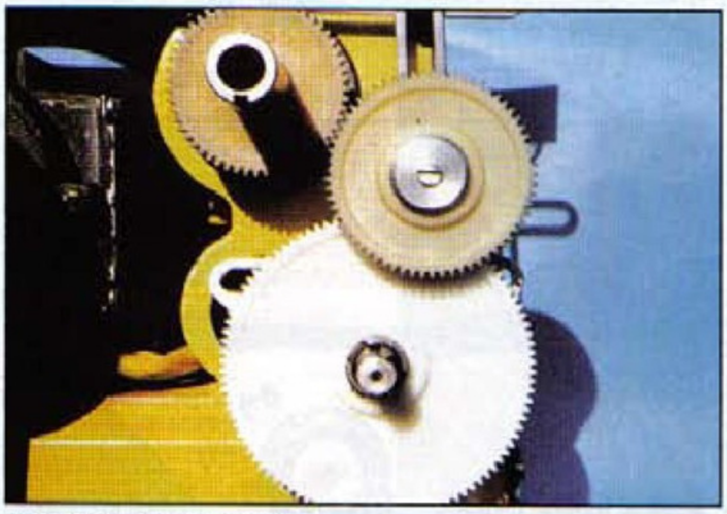
Three M4 holes for the lower bracket.



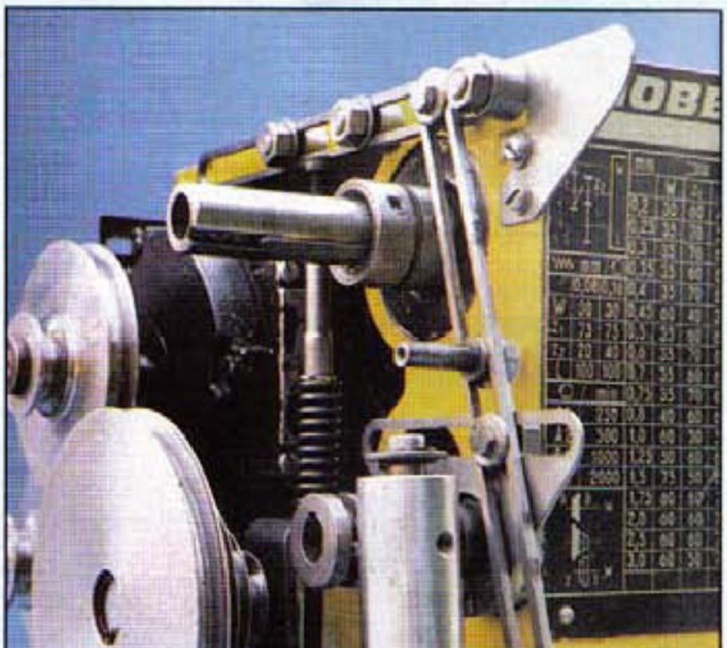
The basic structure, with bush studs.



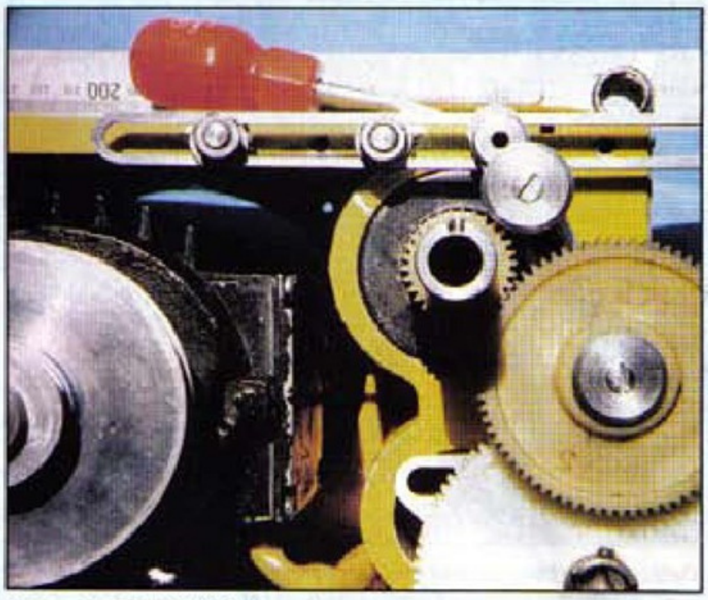
The bush arrangements.



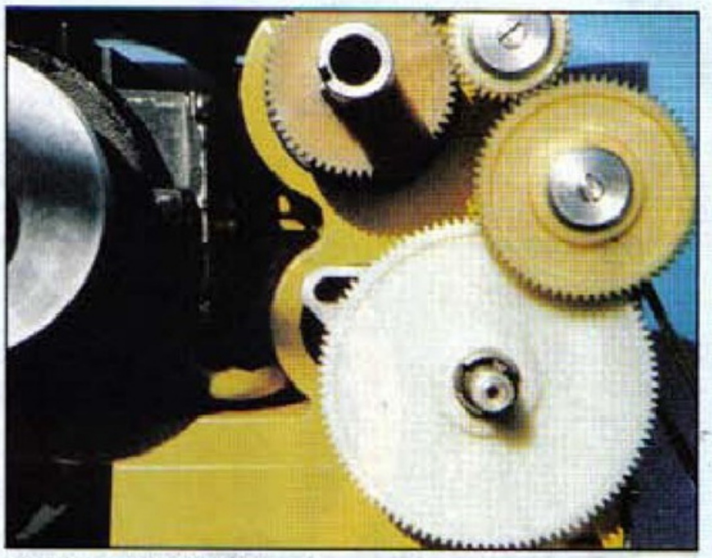
Set up for normal running.



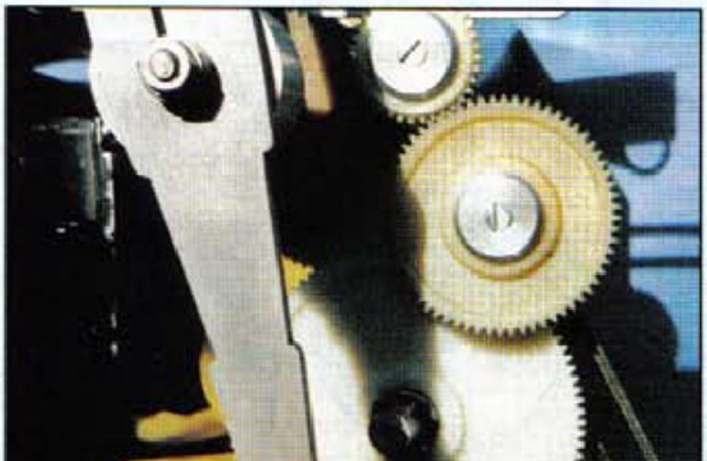
With gear cover lug fitted.



Set up for RH 100 TPI thread.



Set up for LH 100 TPI thread.



With mandrel handle fitted.

namely 18 and 19 TPI, 2.5 and 3.0mm and 0.4 Modular. In my case, those on the plate are the intended ones. If you try to set up the others, all will become obvious, unless, of course, your handbook and headstock plate differ from mine.

LH tap requirement.

Well, as I said, my device worked, and I made my LH tap with the long shanks. I haven't used it yet because I thought I'd save a lot of time and effort by designing the project Mk. 2 before I'd made the Mk. 1. I did design the Mk. 2 and found that I didn't need the two long shanks on my tap and that a M10 x 1.0 LH tap was readily available. On a belt and braces approach I chickened out and bought one.

Now, if you accept the precept that time and effort would be saved as suggested above, could you accept that even more would be saved if Mk. 3 was designed before Mk. 2 was built? Well, whether you do or you don't, that is the current situation. The 5 Jan. '96 issue of *M. E* contained an elegant design for a clockwise-feeding extended tailstock barrel for the Hobbymat, the very same project (The Editor can confirm this) for which I needed my LH tap (is there a message for the manufacturer here?). My design also incorporated a triple-handled capstan feed, with the slight difference that the handles were angled away from the tailstock, a purely cosmetic application. Now, I know that I am a very slow worker, but I've got the feeling I've stumbled into a sequence of 'being overtaken by events' here. The plus side of all this is that there are bound to be some desirable features in J.S.D.'s design that I can pinch for my Mk. 3-4-5 etc. I hope he won't mind, after all, they do say that imitation is a sincere form of flattery.

Screw cutting range

However, in case you've forgotten, this article is supposed to be about threads on the Hobbymat. When I was pondering over the design of my Mk. 1 LH thread cutting device, I kept getting the nagging feeling that I was overlooking something significant. I now realise that I was: when earlier on I said that "I accepted that C.Z etc"., what had really happened was that the attic at the back of the old grey matter had stored the fact that unlisted threads had been found, but had kept the file open, because it had not been established that those found had been the only omissions. Could it be that there were others?

I then realised that, instead of designing my Mk. 1 LH device around the threads listed and those mentioned in the Supplementary Notes, it would have been more scientific to first of all find out if there were any more threads hitherto unlisted. So with pencil and paper, a calculator and a Goon tape, (the same as Bob Loader does), I set to. Some two weeks and several tapes later, I had satisfied myself that gear trains could be set up to cut just about every thread listed in the 'Zeus' tables and a good many more besides, though I have no idea of the latters' usefulness.

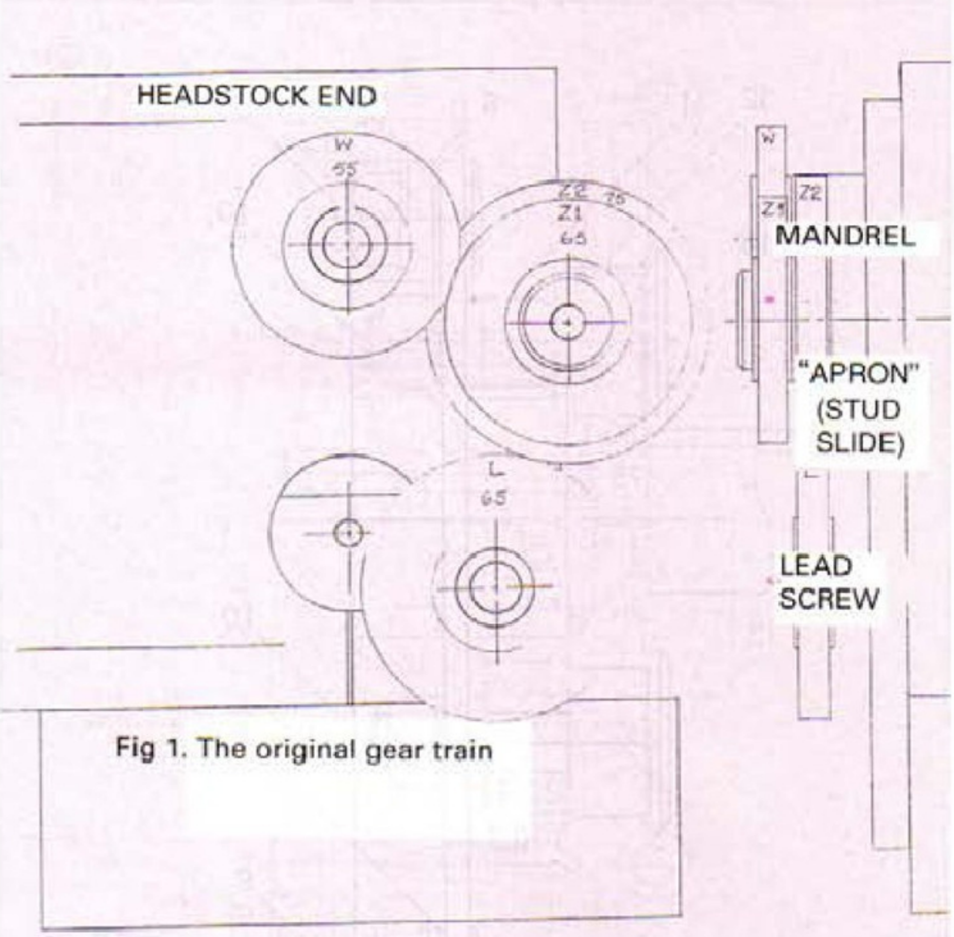
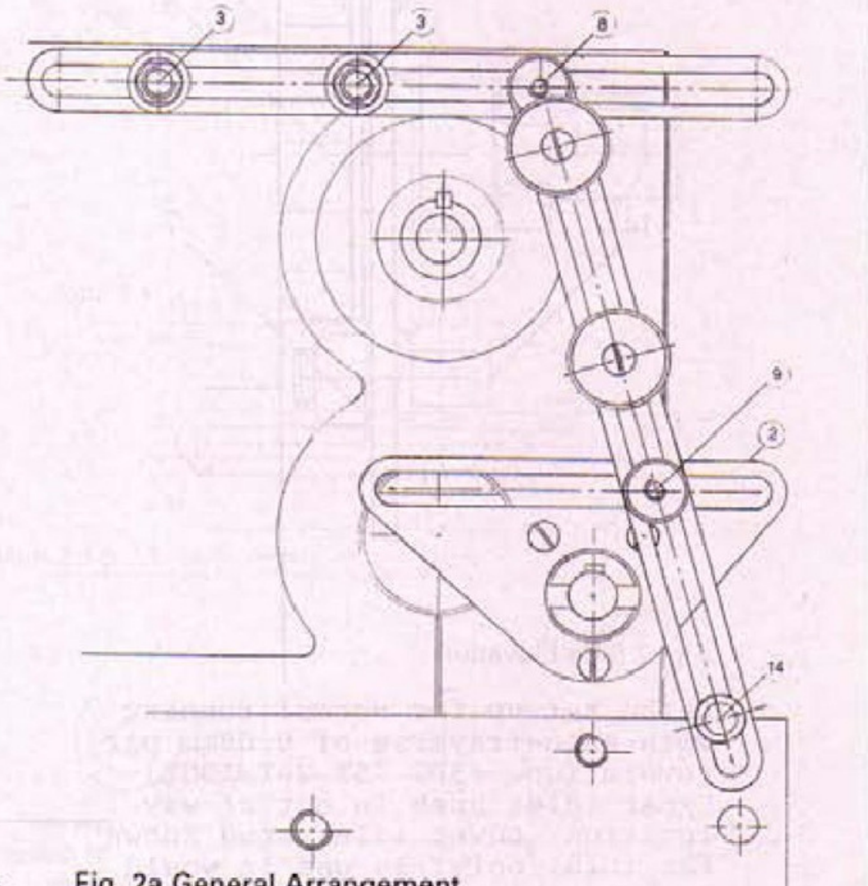


Fig 1. The original gear train



© Fig. 2a General Arrangement End Elevation

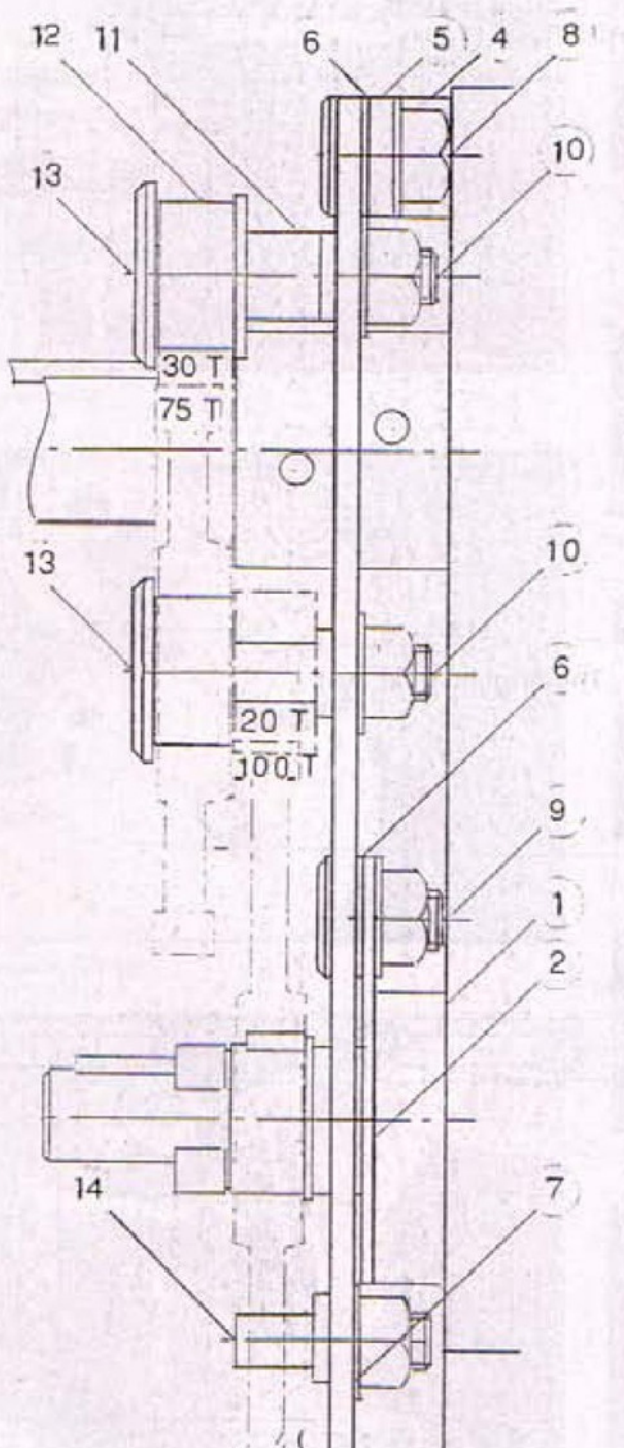


Fig. 2 Side Elevation

Lathe set up for normal running with auto-traverse of 0.08mm per revolution. (30T 75T 20T 100T) Upper idler bush in out of way location. Lower idler stud shown for info. only. In use it would be above Item29.

Moving the motor

I have to point out that, if your Hobbymat is the same as mine, and you want to fit a 100T gear to the mandrel for those threads which require it, you will need to relocate the motor considerably by drilling/filing the foot location holes in the motor plate. If you can live without the ability to set up the trains which require this, don't bother, because if you do you will find you've then got to think of something else to make the gear cover fit properly. You will also have to make some adjustments to various pulley positions, particularly if you have fitted the highly desirable (particularly for fly-cutting) slow speed set up which is available. I would advise against it unless the three threads involved are essential to you, as it really does become quite a bind. I've already decided to restore the motor on my Hobbymat to its original position. Likewise, if you can manage without the 5, 72 and 80tpi wheel trains, you won't need to purchase any extra gears, for either RH or LH threads.

The smaller threads

I don't know about the practicalities of cutting the smaller threads on my Hobbymat. I have managed to cut a 100 TPI external and internal which matched (on a 16mm dia. I hasten to add, and using T C tipped tools with presumably accurate tip geometry), but at about the fifth or sixth assembly/disassembly, I managed to cross and strip the thread. The daunting problem of how to grind cutting tools, and the tiny depths of thread involved effectively steered me away from further experimentation in this area. I'm sure that the horologists and the instrument makers have all the answers on small threads. I know I would appreciate an article which gave some practical hints and tips on dealing with them, as I have some fifty-odd year old drawing instruments in need of restoration

So, although I feel I've proved my calculations, I don't know whether the accuracy of all the factors other than the gear train would permit the cutting of the smaller threads. Having said that, I have now cut several 40 TPI threads on varying diameters with apparent success and scarcely a second thought. I've only recently discovered the M. E . threads, and after using them to overcome several problems, can appreciate why model engineers find them so convenient.

With rare exceptions, the threads shown in the tables can be obtained with several other wheel trains, for obvious reasons I've shown only one here. An exception is in the BA range, where differences between nominal and actual progressive pitches and TPI indicate the need for choice, as I am not aware of the standards used in the fastener industry. Also for obvious reasons I haven't listed the metric thread or modular trains.

Other trains

I have not listed the trains for all the other approx. whole number TPI's possible because I'm not aware of any need for them.

The threads are : 4, 15, 21, 23, 25, 29, 31, 33, 35, 37, 41, 43, 45, 46, 47, 58, 59, 61, 62, 66, 67, 68, 70, 74, 75, 77, 79, 82, 87, 88, 89, 90, 95, 97 and 99 TPI.

This is very likely not an exhaustive list, as they have been manually/visually selected from the tables produced with a calculator.

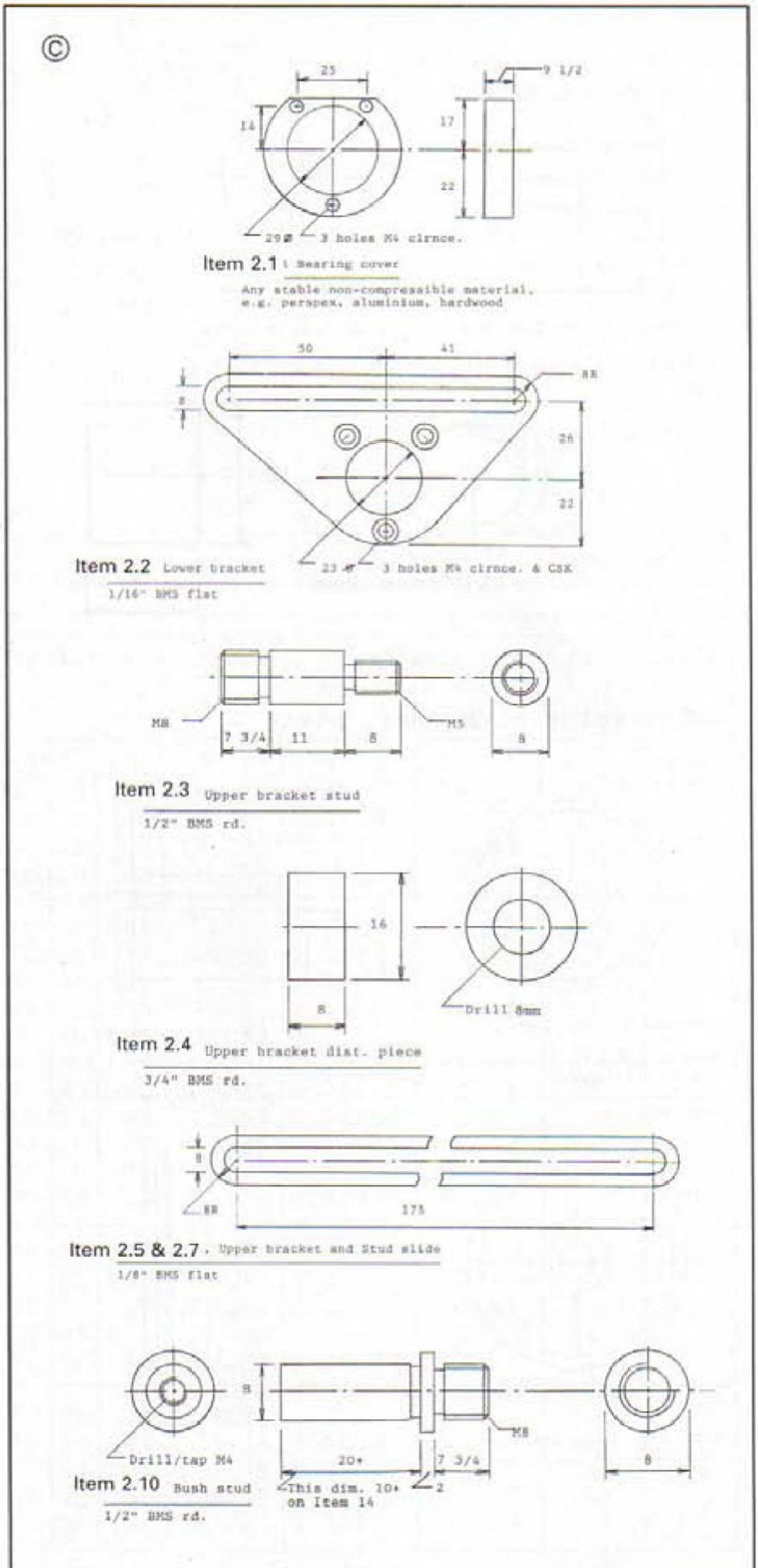
LH device parameters

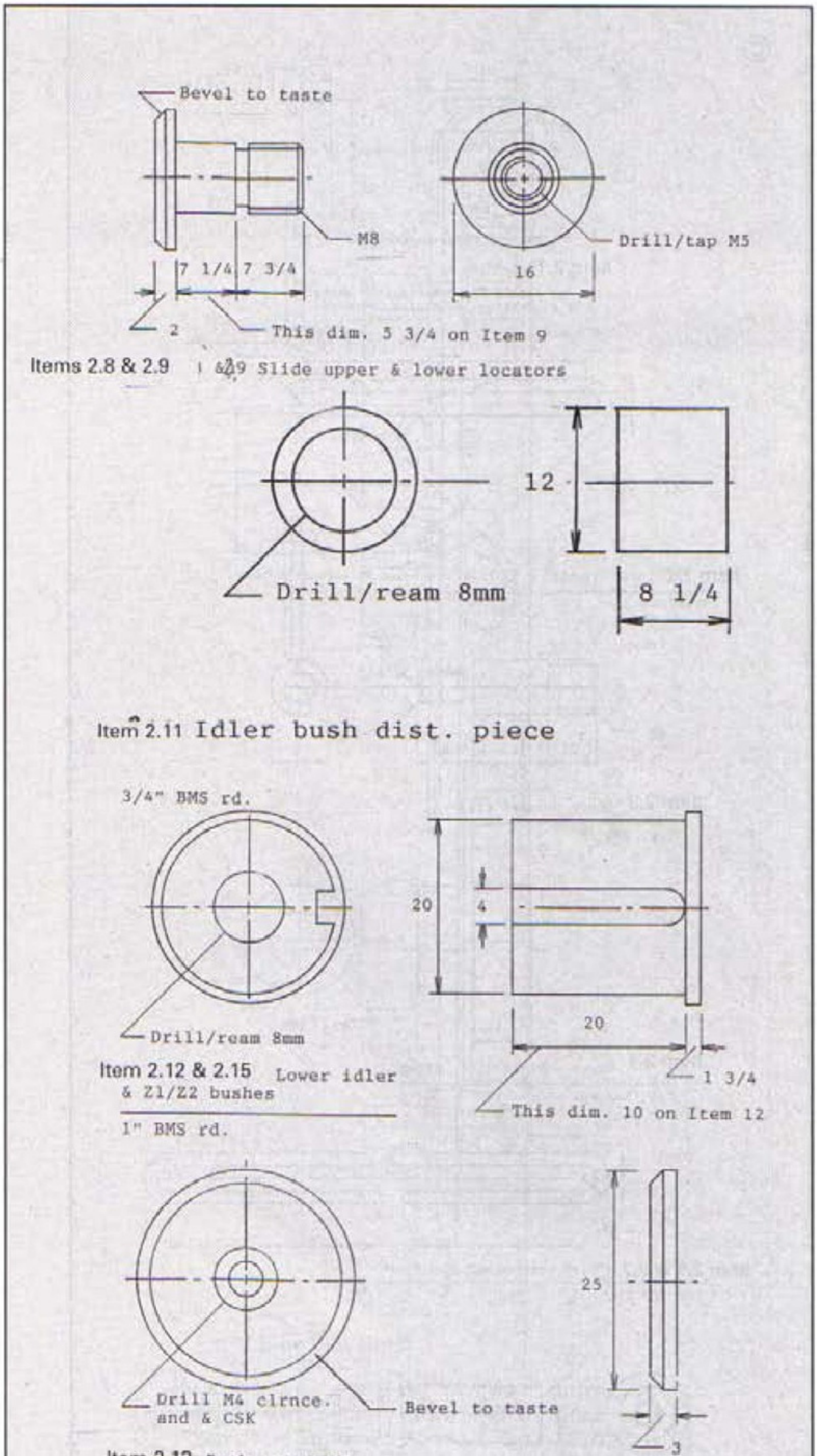
When I got round to thinking about a Mk.2 LH device, I considered that a necessary design parameter was that it could cope with all the trains in the accompanying tables and the metric and modular trains. Another consideration was the space available on the Hobbymat. I wanted to find something which, when not actually in use or screw cutting could be contained within the confines of the gear cover. One of the MD65 features I wanted to dispense with was that of repeatedly screwing a steel M8 set pin in and out of the aluminium base every time there was a change of wheel train or when putting it out of train when autofeed was not required, e.g. when drilling (just another example of my being 'careful' by avoiding unnecessary wear and future expense for gear replacements). The M8 set pin secures what the handbook names as the 'Apron' which I have elected to call the stud slide. I have to say that after some five year's use, it still functions perfectly, it's just that I feel uncomfortable with it. The obvious answer to this was to replace the set pin with a stud, but in further re-design I managed to eliminate the need for that securing location. My Mk.I LH device involved screwing M5 socket cap screws in and out of the aluminium headstock, and I wanted to avoid a repetition of that.

Replacing the 'Apron'

By now it was becoming obvious that I was getting involved in redesigning the means of Z1/Z2 location (the Apron) **(see Fig. 1)**. A further requirement before I could proceed, was to determine the locations of the Z1/Z2 and idler studs for all the RH and LH screw cutting trains. I feared that this would become something like the slogging match I'd had in working out all the gear permutations, and that I had better start pretending to be a real engineer, and try to approach the matter in a methodical, scientific manner.

In practice, everything went smoothly. For those who haven't already tried it, "if one takes two Hobbymat gears and meshes them, then measures the distance between their centres, one will find that it approximates to half the sum of their teeth in mm" (all the real engineers I know talk like that). Armed with this knowledge, it was a straightforward exercise to plot the





locations of the Z1/Z2 stud in relation to the mandrel and lead screw for all the RH Metric, Modular, TPI and BA wheel trains. Arriving at the locations of Z1/Z2 and idler studs for LH threads was less straightforward, and involved the use of a mock-up (two bush studs at 97 1/2mm centres) and a dummy run for each train. The two studs held the 'W' and 'L' gears of the wheel train and between these were interposed the Z1/Z2 combination with a gear selected for an idler. In all cases where possible, the idler was positioned between 'W' and Z1/Z2 but, on several occasions, a set up could only be achieved with the idler between Z1/Z2 and 'L'. Generally the set up could vary within the confines of the acceptable fixed structure outline, so the parameter selected was to have the stud slide angle at the minimum from the vertical as could be obtained. For each set up, the angle of a notional stud slide was marked on the paper on the mock up; also the approximate location of the idler or Z1/Z2 stud, whichever was adjacent to 'W'. When this was superimposed on a plan of the headstock end, it indicated that the stud slider requirements could be readily accommodated on a fixed (though variable at the upper bracket location) supporting structure, within the confines of the gear cover.

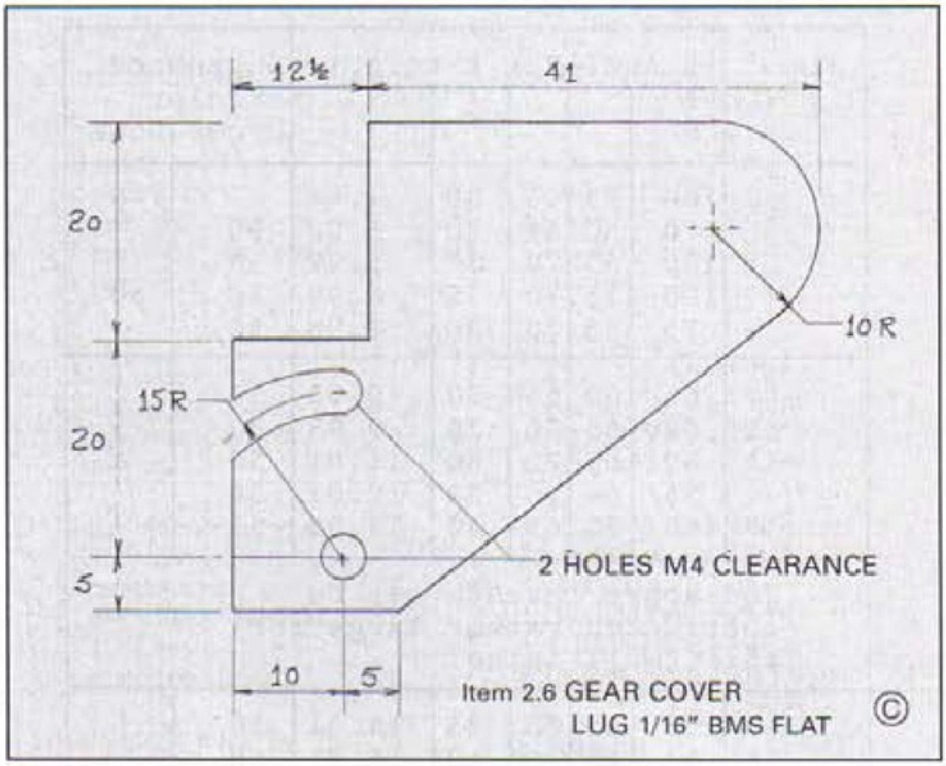
Design philosophy

I now had to decide whether to follow a stricture from a design engineer which I overheard long ago, and which must have impressed me because it's stayed with me all these years. "Always design down to the minimum which will satisfy the functional specification. Anything more is waste", or whether to use more space than strictly necessary, just because it was available. I'm sure the above mentioned stricture holds well in a production environment, but what about if you are building a pair of 12 Bores for the Sultan of Brunei? Surely if you are going to live with, look at and use with pleasure something you are making, it is well worth the extra effort to provide for your future enjoyment. I therefore decided to extend the design features to whatever could be contained within the gear cover.

Apron redesign features

The locations and designs for the upper and lower brackets **(see Fig. 2)** practically presented themselves, as well as the manner of securing them to the headstock, bearing in mind my desire to use studs where possible. The two studs locating the upper bracket require two M5 tapped holes 9mm from the top and approximately 75mm and 125mm (not mandatory) respectively from the front of the headstock. The replacement bearing cover likewise as good as designed itself. The thrust ball bearing it covers is a readily available standard 51102 (dimensions 28 x 9 x 15mm), and one which I have already purchased for another project on the Hobbymat. I had no problem at all with cutting off the lower part of the Apron and using that for the cover, but I realise many of us would balk at that, as I would have at one time. Now, as I know I have no intention of replacing my Hobbymat, I feel free to modify it how I will, as the result will most likely enhance its value anyway. So, to protect the bearing and act as a spacer secured to the lathe headstock, in order to support the lower bracket, what would suggest itself? Any non-compressible material will suffice for this item, providing it is reasonably stable, e.g. aluminium, perspex, hardwood. It also does not require boring accurately to rotate about the bearing, as it is fixed to the lathe headstock. The Apron on my Hobbymat is 9.6mm thick. This dimension is not critical to plus or minus half a mm as there is about 1mm of end float in the bush which carries the lead screw gear, so I've selected a dimension of 9 1/2mm for the bearing cover, and based all the succeeding distances of parts from the headstock on that. So, if you are prepared to cut the bottom off your apron, go ahead, you'll find it quite suitable for Item 2.1.

The lead screw gear bush flange front floats between 18 1/2 and 19 1/2mm from the side of the lathe headstock. This would indicate that the side of the mandrel gear nearest the headstock needs



Item 2.6 GEAR COVER LUG 1/16" BMS FLAT

BA no	Nominal Pitch mm	Nominal t.p.i.	25.4xZ1÷Z2x L =t.p.i. ÷ W					Actual Progressive Pitch	Actual Progressive t.p.i.	Suggested Idler Upper	Suggested Idler Lower
0	1.00	25.40	60	30	50	100	25.40	1.0	25.40		35
1	0.90	28.22	60	40	60	100	28.22	0.9	28.22		30
2	0.81	31.36	35	65	60	40	31.45	0.81	31.36	30	
3	0.73	34.79	75	60	35	60	34.83	0.729	34.83	30	
4	0.66	38.48	55	50	60	100	38.48	0.6561	38.48		30
5	0.59	43.05	55	70	75	100	43.10	0.59049	43.02		30
6	0.53	47.92	50	60	35	55	47.90	0.53144	47.79	30	
7	0.48	52.92	60	50	40	100	52.92	0.47830	53.11	30	
8	0.43	59.07	35	65	60	75	58.96	0.43047	59.01	30	
9	0.39	65.13	65	50	30	100	65.13			35	
"			75	70	20	55	65.19	0.38742	65.56	30	
10	0.35	72.57	35	60	60	100	72.57	0.34868	72.85		30
11	0.31	81.94	65	60	20	70	82.06			30	
"			60	55	20	70	81.49	0.31381	80.94	30	
12	0.28	90.71	60	75	35	100	90.71	0.28243	89.93		40
13	0.25	101.60	30	60	50	100	101.60				35
"			70	55	20	100	99.79	0.25419	99.93		30
14	0.23	110.43	30	65	35	70	110.07	0.22877	110.03	40	
15	0.21	120.95	30	50	35	100	120.95			40	
"			50	65	20	75	123.83	0.20589	123.37	30	
16	0.19	133.68	50	70	20	75	133.35			30	
"			60	65	20	100	137.58	0.18530	137.07	40	
17	0.17	149.41	55	65	20	100	150.09			30	
"			50	60	20	100	152.40	0.16677	152.30	30	
18	0.15	169.33	35	70	30	100	169.33	0.15009	169.23		40

Nom. t.p.i.	25.4xZ1÷Z2x L =t.p.i. ÷ W					Suggested Idler Upper	Lower
4 1/2	100	35	60	30	4.44		40
* 5	70	30	65	30	5.02	60	
6	100	55	70	30	5.99	50	
7	100	35	70	55	6.99	75	50
8	75	55	70	30	7.98	50	
9	65	50	65	30	9.02	55	
10	60	55	70	30	9.98	50	
11	60	65	75	30	11.01	50	
12	55	65	75	30	12.01	50	
13	60	50	65	40	13.03	55	
The above threads may be considered rather large for this small lathe.							
14	55	65	75	35	14.01	50	
16	55	65	75	40	16.01	50	
18	65	50	65	60	18.04	55	40
19	40	65	65	30	19.05	35	
20	55	65	60	40	20.01	30	
22	60	40	50	65	22.01	55	35
24	50	65	55	40	24.01	30	
26	55	65	75	65	26.02		30
28	55	65	75	70	28.02		30
30	55	65	60	60	30.02	30	
32	55	60	65	75	31.97		30
34	40	75	70	50	34.02	30	
36	50	65	55	60	36.02	30	
40	75	65	55	100	40.02		40
42	50	65	55	70	42.03	30	
44	75	40	20	65	44.03	30	
48	50	55	35	60	47.90	30	
50	55	65	60	100	50.03		35
55	30	65	60	60	55.03	35	
56	50	60	30	100	55.88	35	
60	30	65	55	60	60.04	35	
64	30	70	60	65	64.21	35	
# 72	40	65	40	70	72.23	30	
$ 80	35	55	35	70	79.83	30	
100	55	65	30	100	100.06	35	

* Extra 30T required.
# " 40T " .
$ " 35T " .

The 5,56, and 80 tpi wheel trains may be a little loose as their W/Z1/Z2/L centres are equal to that of the mandrel and lead screw, 97 1/2mm.

to lie between 28 1/2mm and 29 1/2mm from the headstock, assuming your gear hubs are approx. 10mm thick.

Accessories

The design dimensions for bushes, bush studs and bush retainers closely follow the basic Hobbymat design. You may well choose to use some of the originals. I decided to cut a pair of 8mm A/F spanner flats on the upper bracket studs, though they may be secured with a couple of nuts. On the prototype bush studs, I included a 10mm dia. section to ride in the stud slide, with 8mm A/F across one diameter, thinking to prevent rotation of the stud when securing it in the slide. This only resulted in 'bellying-out' the sides of the slide and required the addition of a restricting washer. Later experiment indicated that the flats were not necessary, so I reduced the section riding in the slide to 8mm dia. and obviated the need for the milling/filing operation and the restricting washers.

A further modification was that required for the combined 20T gear and Z1 bush. Mine measured greater than 20mm in length, and I had to face the nylon gear end down until I obtained a length which prevented it being 'nipped' between the stud flange and the bush retainer when the latter was secured.

The design of the stud slide was really quite straightforward. For a while I tried to find a 'best fit' arc which would suit the stud location area outline, and then reminded myself about **KISS**, a straight slot would be easier to chain-drill and file, so use it. It would fulfil all the RH and LH screw cutting requirements and, with some imagination, may be modified to allow the introduction of six-wheel trains, and what new areas for the experimenters to investigate would that open up? After my earlier two week bout with a calculator, I am definitely not going down that road, but I don't mind forecasting that someone will, if they haven't already.

I drilled and tapped Items 2.8 and 2.9, the slide locators to assist with finishing and with a possible future modification in mind; it is not strictly necessary.

'User-friendly' mod.

A rationalisation resulting from some impatience at having to employ two spanners and two screw drivers to change a wheel train was as follows. I substituted M4 cross head screws for the 'Phillips' type to secure the bush retainers, and opened out the item 8 on the handbook drawing, the 'stud bolt', to accept a M8 set screw, so that I now only require one cross-blade screwdriver and one 13mm A/F spanner. I think perhaps a better solution would have been to substitute a 'Phillips' type grub screw for securing the mandrel pulley retaining collar and retain 'Phillips' (or 'Pozidrive') screws for the bush retainers.

I use a mandrel handle for all my screw cutting. I don't like the thought of what might be happening to the electrics if the motor forward and reverse method is employed, despite it being a capacitor start motor (I think).

It may be found that a lot of frustration due to the loss or mislaying of the feather keys in the design can be avoided by a judicious application of 'Loctite' or 'Superglue'.

Conclusion

I am able to use the 'Set-over' method of screw cutting because I have fitted quadrants on either side of the cross-slide to allow the top slide to be swivelled round to an angle of 30 deg. to the workpiece, which is one half of the ISO Metric thread angle. If you wish to cut Whitworth (27 1/2deg.) or British Association (23 3/4deg.) you will find that the top slide fouls the cross-slide feed handwheel. You will then have to either reduce the diameter of the hand wheel or redesign the cross-slide and/or top slide feeding arrangements. I have chosen the latter course, a project which is almost completed and will, hopefully form the subject of a future article. The screw cutting method I use employs the cross-slide quadrants and a mandrel handle, devices which require very little workshop time to make and will quickly become indispensable. A commercially produced mandrel handle is available from the same source as the slow speed attachment. I used 1 x 1/8in. BMS angle for the quadrant.

When cutting the threads required in this design, I used the method described by the late George H. Thomas in his book *The Model Engineer's Workshop Manual*. If the cutting started to look a little rough, and for the final couple of passes, a dab of neat cutting oil definitely helped. When approaching the final cuts, I would try the thread gauge I made, an approx. 8mm long piece of about 5/8in. dia. BMS, drilled and tapped M8 x 1.25 and finished with the bottoming tap I use. I also chose to cut a pair of 13mm A/F spanner flats on it, just in case. If pieces wouldn't accept a standard nut, to avoid scrapping a workpiece on which I had expended a considerable amount of time, I applied some fine grinding paste, a 8mm. nut, a 13mm A/F. spanner and some back and forth work with the mandrel handle. It may sound like a garage job, but it works. I'm considering adopting this method where interchangeability of parts isn't necessary, say for a feed screw, and wonder if it can be considered acceptable.

Notes

Although I've used fractions of millimetres in the drawing dimensions, it's as well to point out that, where a bush has to be a nice running fit on a bush stud, this will be better obtained by using your own judgement; also that same bush stud needs to be marginally longer than the bush, so that the bush isn't clamped against the stud flange when the bush retainer is secured.

No	Part		Cutting List
2.1	Bearing cover		Any suitable material
2.2	Lower brkt.		1/16in. BMS flat
2.3	Upper brkt. stud	2 off	1/2in. BMS rd. x 26 3/4mm
2.4	Upper brkt. dist. piece	2 off	3/4in. BMS rd x 8 1/4mm
2.5	Upper brkt.		1/8in. BMS flat x 191mm
2.6	Spacer	2 off	M8 "thin" washer
2.7	Stud slide		1/8in. BMS flat x 191mm
2.8	Slide upper locator		3/4in. BMS rd. x 17mm
2.9	Slide lower locator		3/4in. BMS rd. x 15 1/2mm
2.10	Bush stud	2 off	1/2in. BMS rd. x 29 3/4mm
2.11	Idler bush dist. piece		1/2in. BMS rd. x 8 1/4mm
2.12	(Not shown) Idler bush		1in. BMS rd. x 11 3/4mm
2.13	Bush retainer	2 off	1in. BMS rd. x 3mm
2.14	Lower idler bush stud		1/2in. BMS rd. x 19 3/4mm
2.15	Z1/Z2 bush		1in. BMS rd. x 21 3/4mm
2.16	Gear cover lug		1/16 Bits Flat 54mm x 45mm
	M8 bright nut		6/7 req'd
	M8 (Thin) washer		6/7 req'd
	M4 x 20mm cross head CSK screw		6 req'd
	Feather key 4mm x 20mm		1 req'd
	Feather key 4mm x 10mm		1/2 req'd

I.S.O.				Modular	
Pitch mm	Suggested Idler	Pitch mm	Suggested Idler	Pitch mm	Suggested Idler
0.2	35	0.75	30	0.1	35
0.25	30	0.8	30	0.15	35
0.3	30	1.0	55	0.2	30
0.35	30	1.25	30	0.25	30
0.4	30	1.5	40	0.3	40
0.45	30	1.75	40	0.4	50
0.5	30	2.0	40	0.5	30
0.6	30	2.5	40	0.6	40
0.7	30	3.0	55		

Suppliers

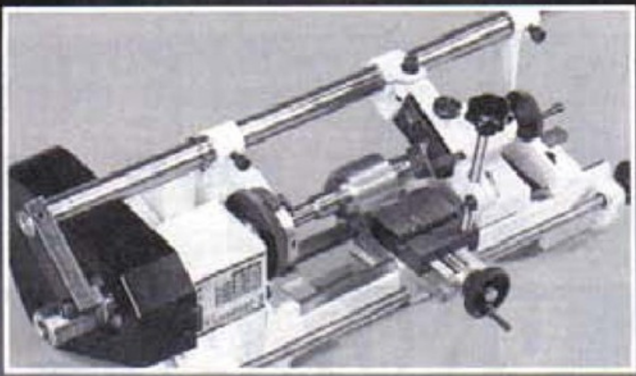
Materials :- G.L.R. Distributors Ltd. Unit C1, Giddings Rd., Hoddeston, Herts., EN11 0NT

Slow speed attachment, Mandrel handle:- Essel Engineering. Cavell Rd., Billericay, Essex, CM11 2HR

Spares and service:- Hobbymat (U.K.) Ltd, PO Box 310, St. Albans, Herts., AL3 6DH. Tel. 01727 765767. Fax. 01 727 765896.

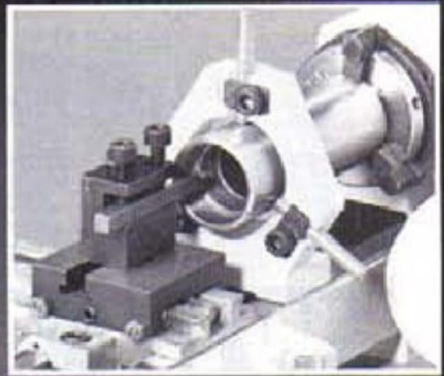
Taper turning

External and internal tapers up to 40mm long can be turned using the accessory top slide. The desired taper angle can be adjusted exactly on a graduated scale. The top slide has a built - in toolholder. The adjustable dovetail guide provides accuracy



Thread - cutting

Thread - cutting attachment for internal and external threads up to 50mm dia. The rigid guide arm, the strong cutting arm and the sturdy lathe bed ensure extreme accuracy. Our range of accessories includes formers and guides for 9 metric and 14 inch thread pitches.
Our tools assortment includes 2 thread - cutting tools.

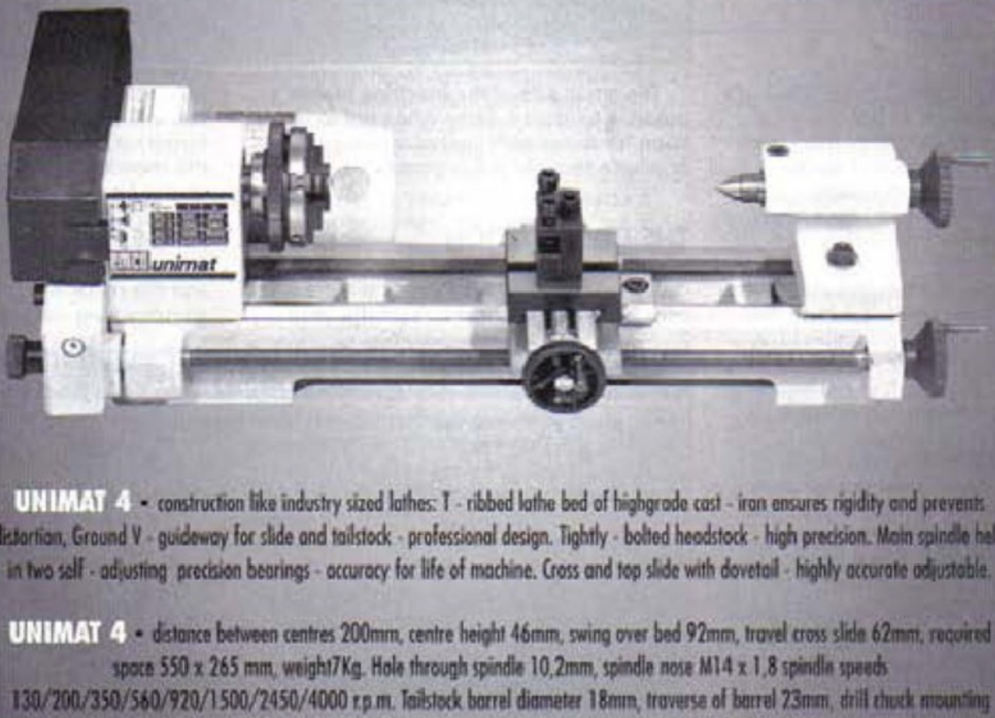


Steady rest

The use of the 3 point steady rest is recommended when working on long and tubular workpieces and for facing long workpieces (the illustration shows an internal turning operation on a long tube). The closed construction of the steady rest guarantees the best possible support

unimat 4

the small universal machine tool



UNIMAT 4 - construction like industry sized lathes: T - ribbed lathe bed of highgrade cast - iron ensures rigidity and prevents distortion, Ground V - guideway for slide and tailstock - professional design. Tightly - bolted headstock - high precision. Main spindle held in two self - adjusting precision bearings - accuracy for life of machine. Cross and top slide with dovetail - highly accurate adjustable.

UNIMAT 4 - distance between centres 200mm, centre height 46mm, swing over bed 92mm, travel cross slide 62mm, required space 550 x 265 mm, weight7Kg. Hole through spindle 10,2mm, spindle nose M14 x 1,8 spindle speeds 130/200/350/560/920/1500/2450/4000 r.p.m. Tailstock barrel diameter 18mm, traverse of barrel 23mm, drill chuck mounting M 14 x 1, Two - speed ac/dc motor 95 W with radio interference suppression, drive via belt pulleys, belt guard

UNIMAT 4 - wide range of accessories available compatible with the Unimat 3

emco

EMCO PRO MACHINE TOOLS LTD
32 Tresham Rd, Orton Southgate
Peterborough, PE2 6SG
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Cambridge	Tel No: 01453 833185	Tel No: 01727 832793	Tel No: 0121 554 5177
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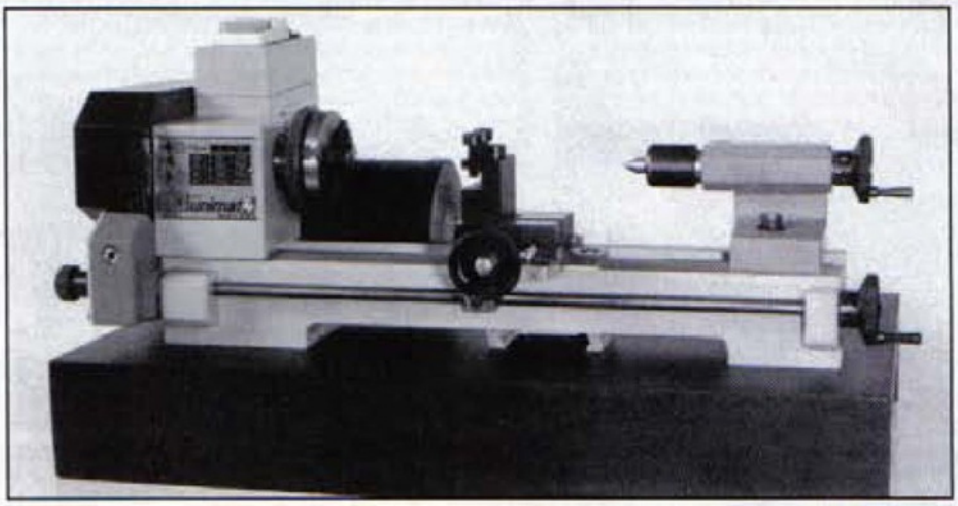
SEE US ON STAND B19 + B21 AT THE IMS

GREAT FREE COMPETITION

WIN A UNIMAT 4 LATHE

Your chance to win one of the first off-the-line Unimat 4 lathes from the famous Emco stable. Just answer the simple questions below, complete the rest of the details and send your entry to: Unimat 4 Competition, *M.E.W.*, Nexus house, Boundary Way, Hemel Hempstead, Herts, HP2 7ST. The first all - correct entry drawn after the closing date will scoop the prize.



The Unimat 4 is a small lathe, ideally suited to the needs of the hobbyist; demanding precision engineers such as model engineers, watch and clock makers, R & D prototype engineers, indeed for anyone with a need for a small precision lathe capable of a variety of functions.

One of the most successful small lathes on the market was the Unimat 3 from the same stable, this ceased production in 1989, its disappearance was much lamented, and the gap it left in the small machine tool range was never adequately filled.

Enter then the Unimat 4, a relaunch of the very successful Unimat 3 design, but upgraded to meet new CE standards. The design now incorporates a continuously rated electric motor, a no volt release starter as standard (to prevent the lathe re-starting accidentally after an interruption in power supply) and a raised emergency stop switch.

The bed is one piece, tee ribbed cast iron, with precision ground Vee guide ways, giving unmatched rigidity. It accepts 200mm between centres and swing 96mm over the bed. Speed range is from 130 - 4000rpm.

The Unimat 4 retains the same spindle and tailstock as used on earlier models enabling owners with tooling etc. for the earlier models to interchange with the Unimat 4.

As would be expected of a machine of this calibre there are a large range of accessories to broaden its use, including: 4 jaw chuck, collets for general use and for watch and clockmakers, automatic power feed, tool grinder, quick change toolpost, machine vice and cutter arbor. New accessories in the range include a set of 3 scale slip rings for the handwheels and a vertical mill and drilling slide.

The small size of the machine makes it possible to stow it away when not in use, a boon for those with limited space available or where security is a problem.

THE COMPETITION

The prize is the Unimat 4 as pictured here. Answer the questions on the form below, if you do this at the M.E. Exhibition you will find boxes for your completed forms on the Emco stand, where you have the chance of inspecting the machine, and on the Nexus magazine sales stand adjacent to the main entrance. Otherwise post your entry to the address above. Closing date for entries is 23 January 1997 and the result will be announced in an upcoming issue of *M.E.W.*

WIN A UNIMAT 4 LATHE (Tick box with your answer)

1. In which year was the first Unimat lathe manufactured?
☐(a) 1947 ☐(b) 1955 ☐(c) 1965

2. How many Emco turning machines have been produced to date?
☐(a) 100000 ☐(b) 200000 ☐(c) 300000

3. What is the bed construction of the new Unimat 4?
☐(a) Hollow round bed bars ☐(b) Solid ground bed bars
☐(c) Tee ribbed casting with precision Vee guide ways

4. What is the diameter of the 3 jaw chuck supplied with the Unimat 4?
☐(a) 50mm ☐(b) 55mm ☐(c) 65mm

5. Which model Unimat replaced the Unimat 3?
☐(a) Unimat Basic ☐(b) Unimat 4 ☐(c) Unimat SL Universal Workshop

Your Name..

Address (inc. postcode)..

....

....

Daytime tel. No.. Evening tel. No..

Which of the following Emco machine tools do you use?
☐ None ☐ Compact 5 ☐ U3 ☐ Emcomat V8P ☐ Maximat V10P
☐ FB2 Mill ☐ Compact 8 ☐ Basic ☐ Unimat SL ☐ Maximat Super 11
☐ Other (please specify)..

Name and address of your local supplier of machine tools and supplies.

....

....

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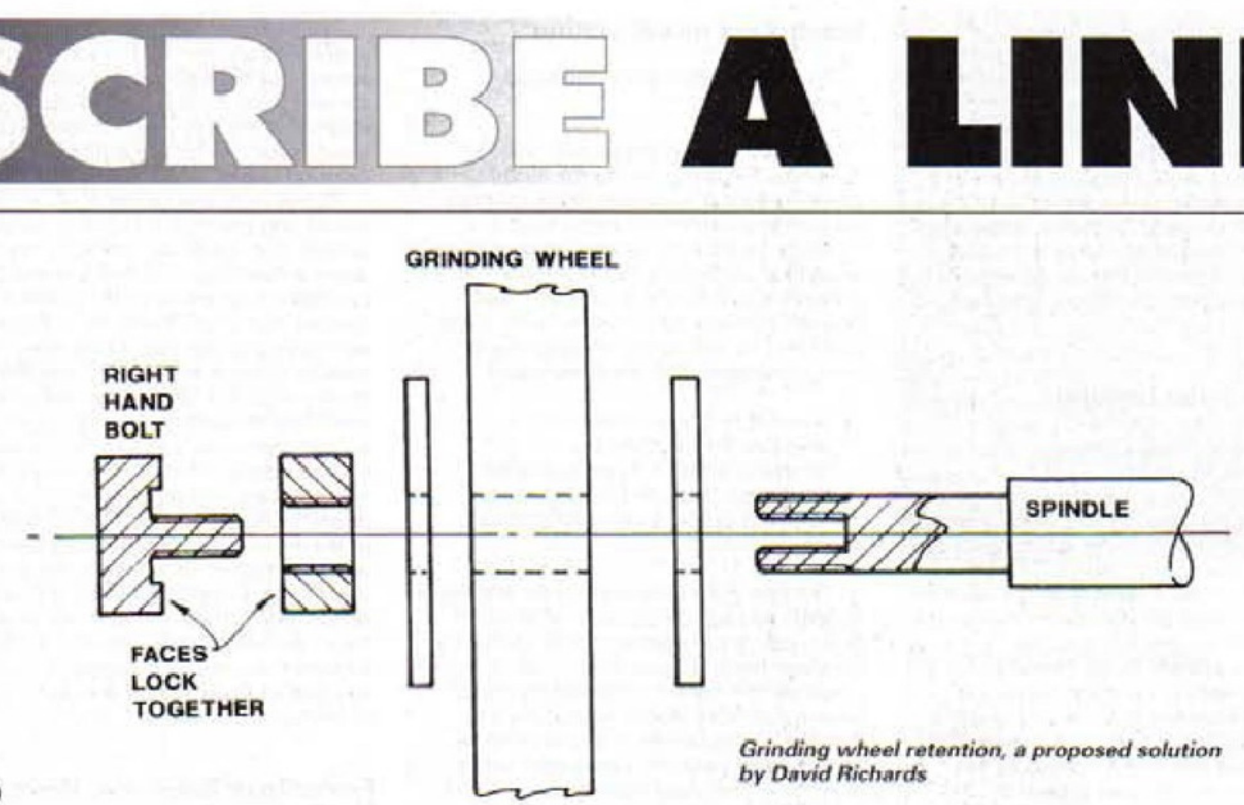

Grinding wheel retention, a proposed solution by David Richards

©

Abbreviations - and the future of the Data Book

From Harold Hall, Berkhamstead, Herts

During 42 years in the control gear industry, I became very familiar with the terminology used, both at the operator and maintenance interfaces (push buttons etc., manuals and drawings). One term was 'Inch', used when a push button caused the machine to run only when it was pressed. This enabled the machine to be rotated little by little as the button was pressed repeatedly.

For 30 years I worked for a firm supplying variable speed equipment for the printing and paper trades, a very large proportion being exported, and to practically every country in the world. Many were non-English speaking, and the operators' controls, at least, had to be in the language of the user. Long lists had to be produced for the translator; among the simple terms would be Start, Stop, Faster, Slower, Inch and many others. On one occasion, when the returned list was examined, it was found that the translator had translated the term 'Inch' as 25.4mm. From this I learned the need for terminology to be as universal as possible, including eliminating all but the commonest abbreviations, something I tried to consider for this magazine during my time as Editor, in view of its international readership. The problem is not just one for the non English speaking countries. Most will be aware of the UK 'dustbin' and the US 'trashcan'.

Why do I tell this story? Well, readers may not be aware but I have continued to look after the data book since passing on the job of Editor to Geoff Sheppard. With the initial scope of the databook coming to a conclusion in a few issues, I have discussed with Geoff where, if anywhere, we go from here. Apparently, requests have been made, particularly from non U.K. readers, for a Glossary of terms appropriate to this magazine.

This may seem an easy task, but for me it is not easy to visualise what creates a problem for others. Because of this, I would request that readers write in with a list of their problem terms, ***even if now resolved****. This will give me a basis on which to proceed. If we get a sizeable number of replies, and I hope we do, it may be difficult to acknowledge them all, as I am sure you will understand, but the more we receive, the more complete will be the final result. Please do write in to help with this project. Only the list of words is required and not their meanings, unless of course you come up with an obscure one which you consider I may not know myself. Please mark the envelope for my attention, as this will help Geoff by avoiding the need for him to redirect them.*

Incidentally, the term 'Inch' has largely been replaced by 'Jog', much more descriptive of the actual operation provided.

Grinding wheel retention

From David Richards, Muswellbrook, New South Wales, Australia.

I have a slight problem, which one of the readers may be able to help me with.

I need a tool and cutter grinder rather urgently, and intend to build one, basically the same as the one built by Derek Brooks and described in Issue 16. I intend to use three wheels, a cup, a saucer and a plain disc of 75 or 100mm diameter, mounted on a spindle driven by a belt and electric motor. I want to run the wheels both clock-wise and anti clock-wise.

My problem is this - How can I mount the wheels so they do not go into orbit, when the machine is reversed?

The only thing, I can come up with is opposite threads of different pitch, locking one against the other, as shown in the diagram.

Editors note:-

David has raised a problem which has been niggling away in the back of my mind for some time. Good practice in the mounting of grinding wheels tells us to mount the wheel in such a way that if slip occurs between the wheel and the driving spindle, the 'lag' in the movement of the wheel relative to the spindle will cause the retaining nut to tighten. Thus we have the convention, clearly seen on off-hand grinders, of 'left hand thread on the left, right hand thread on the right'.

When using a tool and cutter grinder, the rotation of the wheel must always be such that it keeps the cutter being sharpened against the tooth rest. There are some circumstances in which, to achieve this, it is necessary to reverse the direction of rotation. We now have a situation where a single threaded retainer, mounted on the axis of rotation, must be (theoretically) incorrect in one direction.

A quick check of a number of published designs of small tool and cutter grinders shows that they all incorporate this form of wheel mounting, and the majority feature reversing motors. Industrial units of reputable make also have the same arrangement. A friend who has a vast amount of experience in these matters suggests that two reasons why the configuration works in practice are that the cutting loads are very light and that there are no interrupted cutting situations as are often experienced in lathework.

The length of time spent running 'in reverse' is usually very small.

One safeguard (if space permits) is to fit a locknut, which is what David's proposal is, in essence. It is sometimes difficult to judge the right 'feel' of the securing load with a locknut, something which is essential when mounting a grinding wheel, and neither is there any self-tightening ability, but at least, the wheel should not be able to come off!

Readers' views on this topic would be welcomed.

More on lathe braking

From Peter Dawes, Orange, New South Wales, Australia

Apropos the braking of motors again, Syd Clark of Queensland, Australia rang me up on seeing my letter in M.E.W. *on braking. He drew attention to the method of braking using DC injection. This is an old and well known method. He described a system he had seen years ago on a machine used for balancing parts. He described it as having about a (?) 20mF capacitor to hold a charge that was dumped into the windings of the motor when the AC was turned off. He said it worked well. The capacitor was charged through a single diode via a resistance formed of a tungsten lamp of about 20watts. The lamp only controls the rate at which the capacitor recharges. The size of the capacitor determines the braking effect.*

Unfortunately, in my experiments, I haven't been able to get the brake to work effectively with the values he quoted. It seems to need well over 100mF to begin to have any effect, even on a small motor. I find that with a 3/4hp motor, at least 200mF would be needed. Now, the catch is that you have to use 400V-rated AC motor 'running' capacitors because they are charged to a working voltage of about 340V DC (1.414 x the rms AC voltage). Such capacitors cost about $1 (50p) per microfarad, so to get 200mF is going to cost $200 (£100) before you even start to make anything. Admittedly, the rectifier is cheap, but a contactor with make and break contacts that is required to switch the AC off and the DC on, comes to about $70. Adding in a fancy mushroom-top emergency red push-button, and a box to house everything brings the rest of the parts to at least another $100.

The principle of DC braking is well know. A Mr Jayne discovered it by accident and wrote it up in M.E. *a long time ago. Normally the DC is obtained from a separate supply, via a full wave rectifier, but that means a transformer is needed to isolate the DC from the AC supply. While a single rectifier in a half wave configuration avoids the transformer, it cannot supply a smooth DC voltage. Adding large high-current, high-voltage capacitors to store a charge solves that, but only at a price. If anyone knows a source of cheap heavy duty capacitors, please let us know.*

So these problems make the DC injection method either rather difficult or rather expensive to implement in practice.

Electroless nickel plating

From Glynne Hughes, Seascale, Cumbria

Perhaps other readers may wish to have the following recipe for nickel plating using a non-electrolytic method, and in return offer me some help.

Some years ago, when I worked in an analytical laboratory, we used this process successfully to protect brass Bunsen burners which were being badly corroded by the fumes of Aqua Regia being evaporated in the fume hood.

Dissolve in 1 litre of water:-
30 grams Nickel Chloride
10 grams Sodium hypophosphite
100 grams Sodium citrate
Adjust to pH 9-10 using Ammonia solution

The optimum temperature for plating is approx. 90 deg. Centigrade, at which temperature the plating rate is about 0.5 thou per hour. All you have to do is fully immerse the object in the solution and keep hot. Metal should be polished to achieve a good surface, and should be cleaned and carefully degreased using acetone or cellulose paint thinner. Don't use nail varnish remover since this contains lanolin in acetone. Also be careful not to touch the degreased metal with the fingers, otherwise you'll get a nickel plated fingerprint. When plated, the work can be polished to a high shine, and in my opinion gives a rather better finish than electroplating.

It is possible to plate steel, copper and brass; sometimes it is necessary to initiate the reaction by touching the immersed object for a few seconds with a clean copper rod, in the case of steel, or with a clean steel rod in the case of brass or copper. I believe an electrolytic couple is set up, which catalyses the process. You can tell when the reaction has started by the evolution of hydrogen from the object being plated.

What help do I require?

Since I've retired, I no longer have access to chemical reagents, so I'm hoping that someone can tell me where it is possible to buy small quantities as the ones above, so that I can do some nickel plating myself.

Gas-Air Blowtorches

From R. Harbron, Stokesley, Middlesborough

I read with some interest your comments regarding the use of Natural Gas in the workshop. I've often wondered why it isn't more widely used, it being somewhere around half the price of LPG

Before going any further may I remind readers that ***UNDER NO CIRCUMSTANCES*** *must compressed air be used on any gas torch or burner without a proper anti-blowback valve being used; this is to prevent air being fed back into the gas supply, and failure to observe this* **would be an offence** *and would, I understand result in what could prove to be a costly exercise, purging the air out of the system.*

I've been retired from British Gas for 14 years, and am not up to date with fuel prices, but the best way of working out comparative costs is to find out how much it costs, say per 100.000 BTUs. That would take care of the difference in calorific values of the fuels.

To return to the use of Natural Gas, I would suggest that a firm like Amal (the people that made carburettors) be approached; that is if they are still in business. I have one of the Gas/Air torches that your reader from Scotland was asking about and, in addition I have a smaller version and a large and small burner unit. For some time now I've been intending to build a normally aspirated burner that could be used for making up a small furnace, which I think might have some appeal. I must confess I use propane, but I suppose that if I had a piped air line that I could just plug in, I wouldn't bother much with propane. If you have a supply of natural gas and the proper equipment, I would say go ahead. It's an excellent idea. I am not a gas engineer, but was a showroom manager, so I had to know what I was talking about to advise the public.

From Dave Robinson, Ware, Herts

In reply to the letter from Mr.Will Noble, Forres, Morayshire.

I am not surprised by the fact that Mr.Noble ran into problems in attempting to make an air/gas blowpipe using natural gas. This is due to the big difference in flame speed compared to the old town gas: this is something like town gas at around 300 ft./sec. to natural gas at around 20 ft./sec. and liquid petroleum gas at around 30 ft./sec.. (all at appropriate air/gas mixtures). This wide difference in flame speed means that in the type of burner using air/town gas, it is almost impossible to obtain a stable flame of the sort required, due to the velocity of the mixture being much faster than the rate of burn.

This does not mean that it cannot be done, or even that it is too difficult. Burners giving a hot concentrated flame on air/natural gas or on air/LPG are used by people in the glass business and by makers of brazing and silver- brazing machines. In the sort of area that we would be using, the best bet is to use a technique known as 'flame retention by retention flames'. This means that the gas mixture at the business end of the torch is divided so that a ring or fringe of low velocity gas is formed at the base of the main flame, to hold it on the end of the torch. The usual form that we would use would be a round flame, although all sorts of variations for special purposes may be made, such as strip or flatflame burners. It may take a little experimentation to get the size and proportion of flame that you want but, as always, when you have some idea of where to go it is much easier. I made up a burner a few years ago which gave me a pencil type flame about 1/2in.dia. at the base and between 1 1/2 and 4in. long, which I have used on small brazing jobs such as tipping lathe tools.

When experimenting with or using premix, then it is essential that a condition cannot arise whereby air, at higher pressure than the gas can force it's way back up the gas supply. This means that valves or high resistance must not be present after the point of mix and, very importantly, the air must be mixed with the gas by means of an injector (scentspray) mixer, so that the passage of air has the tendency to pull the gas through, rather than exert a pressure on it. This is similar in many ways to an oxy-acetylene blowpipe. This may sound very complicated, but in fact once you have an idea of how to do it, then, with a little experimentation you can tailor a blowpipe to suit your needs.

From Alec Barnham, Long Eaton, Nottingham

It was interesting to read the letter from Will Noble seeking information on gas/air torches and your editorial comments on the same.

For the last 15/20 years, I have possessed a natural gas-air torch supplied by A. H. Wilkes & Co. of Stourport-on-Severn (Model No. NG/B2-2). This is approximately 12in. overall length, and is well engineered and nicely balanced. The nozzle is 1in. dia., the air supply tube is 3/8in. bore, and the gas supply tube is 1/2in. bore. Each supply tube has its own thumb operated valve, similar to the old oxy-acetylene torches. The nozzle has a proportioning screw, to regulate the gas/air mixture. Maximum air pressure is 15lb/sq. in., and recommended natural gas supply pressure is 6in. water gauge.

Since reading of Will Noble's interest, I have attempted to contact the makers, but have been unable to trace them. It is assumed that, like so many of the old established British manufacturers, they are no longer trading.

Home manufacture of such a torch should be within the capabilities of model engineers with turning and brazing capabilities.

From K.R. Jefferson, Plymouth, Devon

I have some information that may be of help to your reader, and a little background which may be of interest.

Many years ago, as a young draughtsman with few resources and less cash, I needed to join some pieces of metal together, so silver-soldering seemed to be in order. For heat, I removed the spring and ball from a standard grease nipple which I then fixed in the end of a pipe with a household gas tap for control. Connected to a house gas supply and lit up, I know it should not work, but it did, and for many years did all I asked of it.

Then came bigger lumps to join and more heat was required. Two copper pipes, one of about 1/2in. and the other 5/16in. dia were joined so that the nozzle appeared as two concentric holes. Once again controlled by old gas taps were a normal gas supply and air provided by a cylinder vacuum cleaner. Cheap silver solder was no problem, as K.R. Whiston used to give sticks of Easyflo No.2 as discount on orders.

Next came North Sea gas, as it was then known, and all appliances had to be modified. Consternation arose when I insisted that my two torches needed the 'treatment'. The Industrial chappie was sent for, and the result was that two gleaming new torches of the latest design made by A.H. Wilkes and Son of Stourport arrived (whether they still trade, I know not). I was told that a non-return valve in the air line was needed. The logic behind this escaped me, but if that was what was wanted, that was what they had to have, so I knocked one up and fitted it. Then the powers that be decided that the valve should go in the gas supply, and the cost would be many pounds. I of course, demurred, and told them that as it was their mistake in the first place, they would have to supply free of charge.

A six inch diameter valve is still fitted in my garage where I have a gas supply, but now sadly, unused as the rubber tubes originally available from Woolworths and needed to reach the middle of the garden for safety, are perished and of course, illegal. On top of this, all the paraphernalia is inconvenient to assemble, so in the main, I use a standard propane torch.

Purely as an experiment, I rigged the gas/air torch to use propane, blown by the trusty vacuum cleaner, and this appeared to work quite well. Perhaps one day, I will get round to trying a grease nipple torch with natural gas, and then propane.

I don't believe in 'It won't work' until I have tried it.

From Harold B. Newman, Bricket Wood, Herts.

Your note on air/gas torches prompts me to write concerning my own experiences, which may be of interest.

A good few years ago, when planning my workshop prior to retirement. I saw the need for some form of heating and, at the M.E. Exhibition, then at Wembley, a firm called Flamefast had a stand. They had a range of blown air torches for both high and low pressure air, and jetted for propane/butane or natural gas.

I decided that, although the initial cost was higher, the two sizes of torch would cover all ones' needs, without having to buy a series of burners. Also, of course, one can adjust the flame over a wide range, and from hard to soft, with no hot burners to change!

My torches use propane or butane, and have a low pressure blower (a vacuum cleaner in reverse would do), and I have never regretted my choice.

I enclose a copy of the Flamefast leaflet, but I don't know whether they are still trading. The last advert. I saw was from agents Campden Workshops, 84 Campden Mews, London NW1 9BX.

Incidentally, as a result of my workshop being featured in M.E.W. No. 18, I had one letter enquiring about gas/air torches, to which I replied as above.

Finally, as I have a narrow workshop, and Don Young's Lucky 7 is over 5ft., I have a problem working from one side to the other, or even underneath. I am in the process of making an overhead gantry, which may also be of interest.

Editor's note

While I have not been able to find any trace of A.H. Wilkes and Son, Flamefast are, happily, alive and well, trading as EFM Flamefast. Their address is Labtec Street, Swinton, Manchester M27 8SE Tel. 0161 793 9333 Fax. 0161 728 2233. They manufacture a wide range of hearths, furnaces, kilns and welding benches, as well as torches.

Their Product Data Sheet No. 17 covers the Adapto T2 and T4 Gas/Air Torches, while Data Sheet no. 20 refers to the Alcosa 3070 & 3038 Gas/Air Blowpipes. Non-return valves are covered by Data Sheet No.21.

QUICK TIP

Securing Morse tapers

If a Morse taper refuses to 'stick' in its socket, a light sprinkling of chalk dust on the offending shank will often do the trick

Andrew Curl

QUICK TIP

Removing broken centre drills

If the tip of a centre drill breaks off in the job, it can often be trepanned out with its own shank, simply by grinding a 'V' shaped notch between the flutes, below where the tip was originally. Even if after drilling with this modified shank, the tip is still in place, it is at least easier to get at with a scriber.

Andrew Curl

Getting a broken centre drill tip out

If you are unfortunate enough to break the tip off a centre drill when centring a job in the lathe do not despair, especially if the job is to be subsequently drilled and bored. Reverse in the chuck, centre carefully and drill through from the other end, take it cautiously as the pilot is about to break through and often you will find that the broken tip precedes the drill out of the hole.

Ted Jolliffe

QUICK TIP

Tapping in the lathe

Grind a small flat on the round section of a tap, about 1/2in. from the square end. This will form a firm location for the tap wrench. Support the tap with the tailstock centre or in the tailstock chuck closed only enough to allow the tap to rotate. Hey presto!— square tapping.

John Crozier

WHAT'S IN A NAME

Frequently, articles contained in these pages quote the names of Engineering giants of the past. Many of these names are familiar to all of us, but occasionally, one crops up which is not so well known. Derek Pearce looks back at the achievements of three of these stalwarts of metrology.

It would seem that the construction and use of accurate measuring instruments and precision tools is becoming a popular subject for articles. Names are appearing that I am sure most people have not heard of, unless they have been closely associated with precision engineering. In Bill Morris's article: *A Fiducial Indicator for a Bench Micrometer* (*M.E.W.* No 35 pp 30-34) he mentions three metrologists, namely E.M. Eden, F.H. Rolt and A.J.C. Brookes. These three were contemporaries at the National Physical Laboratory, and were responsible for significant advances in their field. The following brief notes recall some of the highlights.

Eden E.M. 1873-1934

Eden joined the National Physical Laboratory in 1915 and was there only 3^1/2 years, which is quite remarkable when you consider his extensive contribution to precise measurement. Up to the end of 1915, the only optical method of examining screw threads and plate gauges in this country was by microscope. Eden soon realised that projection was the answer, and he designed a number of both horizontal and vertical projectors. The screw projectors were the most complicated, having micrometers and the ability to rake the light source.

He then turned his attention to the mechanical measurement of screws, and designed the first floating micrometer machine, which in a later design of his included a fiducial indicator that enabled a known measuring force to be applied. These machines had the great advantage that now only two wires (cylinders) were required to measure the effective diameter of screws. This is British practice today for highest accuracy screw gauges, whether parallel or taper.

Eden, throughout his time at N.P.L., designed various fiducial indicators; mechanical, optical, and one where the measuring force could be varied. This was fitted to a novel bench micrometer having two dials, geared to one another, for easy reading of the micrometer. The variable force fiducial enabled a series of measurements to be made under different forces, and then by extrapolation, a size could be given at zero measuring force.

Pitch measurement was quite tedious in 1916, and after making several experimental machines, Eden, in collaboration with A.J.C. Brookes, produced a pitch machine of such good design that it was still being made in 1980 by Herbert Sigma Ltd. The machine was interesting in that the measuring system was based, like so many of Eden's designs, on spring strips, levers, kinematic principles and the Abbé principle of alignment. Professor Abbé (partner in the firm of Carl Zeiss) simply stated that the line of measurement must coincide with the line of the scale or other dimensional reference. An ordinary hand micrometer complies with this principle, whereas a vernier sliding calliper does not, as the scale is not in line with the axis of measurement at the jaws.

I suppose Eden is mainly remembered for his super-simple design of 'Millionth Comparator', and Bill Morris's article (*M.E.W.* No 35 pages 30-34) mentioned previously, shows the principle of using parallel spring strips and two reeds, which Eden used in his comparator. The only practical difference between the fiducial and the comparator was that, at the end of the needle in the comparator, there was a small ring, and stretched across this was a single strand from a spiders web (Quite an art collecting and laying down a single strand from a spiders web, but much more difficult laying down two strands that have to be parallel for a microscope). A light source, lens and a mirror enabled an image of the strand to be projected on to a scale. It was necessary to have a small paddle in an oil dash pot to dampen oscillation of the needle.

The story is told that Eden, Rolt, and Bloxam (in charge of Workshop) constructed the comparator in a few hours, and that the machine was in use for a number of years at N.P.L., finally being presented to the Science Museum. This design of comparator eventually became known as the 'Eden-Rolt Millionth Comparator' and proved to be most reliable, with many still in service some 50 years later.

Rolt F.H. 1883-1973

F.H. Rolt joined the N.P.L. in 1912, and remained there until he retired in 1953, having served as Superintendent of Metrology Division for the latter seven years. It has been said of him that he was the cornerstone of Engineering Metrology, besides being involved in leading and advising on the various branches of measurement. He was personally concerned with apparatus to measure screw threads for pitch of large screws, 'drunkenness' of threads and continuous autographic recording of pitch errors. He was responsible for the Master Lathe of the country for correcting master leadscrews.

Rolt's 'Straightness by the Inclination Method' using a sensitive level on two feet, or a mirror on two feet in conjunction with an autocollimator (optical angle measuring instrument), enabled straightness of a surface to be measured without having to refer to a standard flat surface. This method he extended, by taking measurements in the pattern of a Union Jack, to measure the flatness of surface plates.

He played a very important part during the Second World War with the Ministry of Munitions, and also sat on many committees both before and after the War. Rolt will also be remembered by metrologists for his most important and highly sought after book *Gauges and Fine Measurements*. This was published in two volumes, but unfortunately he never finished a third volume on screw threads.

Brookes A.J.C.

Brookes joined the N.P.L. around 1918, and was involved in the task (which I am sure most of us would think impossible) of somehow transferring the size between two lines on a yard line standard to the overall length of a yard end standard. He came up with the idea of having a 35^1/2in. long bar, lapped on either end, onto which two lapped blocks, ^{1}/2in. wide, with lines engraved midway on each block, could be wrung. One could now compare, with two microscopes, the composite bar with a line standard yard bar. From measurements of all combinations of ways to wring the ^{1}/2in. blocks, it is possible to find out the length of the 35^1/2in. bar plus one ^{1}/2in. block, i.e. a 36in. length. By a series of comparisons with an accurate comparator, it was possible to deduce the smaller sizes, e.g. to obtain a 12in. bar, three bars are made, inter-compared, and then wrung together and compared with a 36in. length bar, and so on for the smaller sizes. Brookes designed a special jig for lapping length bars, plus a comparator which used a highly sensitive spirit level with two ball feet to compare a standard length bar with a length bar under test. A difference in length of about 0.0001in. of the two bars could produce a difference in level reading of about 1^1/2 inches. This meant that one could estimate the millionth of an inch.

As length bars can be used horizontally, Brookes had two raised bands at the Airy points of support, so that the end faces of the bar were parallel, even though the bar deflected under its own weight. Sir George Airy's formula for the separation of supports is 0.577 L, where L is the length of the length bar.

In 1920, J.E. Sears Jnr., Superintendent of Metrology Division and A.J.C. Brookes patented their method of producing highly accurate block gauges (slip gauges). Only a few months later, Hoke in America patented his machine method of producing block gauges of square shape, with a hole in the centre of the block. Johansson produced his first set of 102 block gauges in 1896, and kept his method of manufacture a closely guarded secret for many years.

The N.P.L method (Sears & Brookes) of producing block gauges relied on hand methods, both in the grinding and lapping processes. Eight gauges of one size were fixed, two per corner, on a small rectangular magnetic chuck. The chuck, with the block gauges, was placed on a surface plate, and then passed randomly, by hand, under a grinding wheel mounted on a slide above the surface plate. Having ground both sides of the blocks, they were then lapped on a grooved lapping plate that had been worked so that it produced a flat surface. Final lapping for parallelism and size was achieved by a special sequence of positioning of the blocks, but in this instance the blocks were wrung onto a flat chuck, and not held by magnetism.

Brookes, I'm sure, will be remembered by metrologists for his comparator 'The Brookes Level Comparator' and, like instruments of his contemporaries, this has lasted the test of time.

Hopefully I have given some idea as to the background of people one can only describe as backroom Scientists and Engineers. I must admit, however, that I have, in my small way, only scratched the surface of their achievements.