MODEL ENGINEER

CENTENNIAL CELEBRATION COLLECTION

9 771460 282008 02

FOR ENTHUSIASTS · BY ENTHUSIASTS

Vol 1 No.2 £2.99

2: WORKSHOP DEVICES

Published by
Nexus Special Interests Limited
Nexus House, Boundary Way,
Hemel Hempstead, Herts HP2 7ST
Tel: 01442 66551
Fax: 01442 66998

EDITORIAL

Editor
D.A.G. Brown

Consultant Technical Editors
Mike Chrisp
Ted Jolliffe

PRODUCTION

Designer
Jeff Hamblin

Production Administrator
Theresa Davis

Printed by
St Ives Andover

Origination by
The Colour Edge

SALES

Group Advertisement Manager
Diane Farnham

Advertisement Manager
Allison Weatherill

MANAGEMENT

Divisional Director
Tony DeBell

Business Manager
Stuart Cooke

Circulation Manager
William Pearson

SUBSCRIPTIONS

UK £29.90 for 10 issues (1 year)
Europe and Eire £39.00
(Surface mail) - £42.00,
USA $65
Subscription/Back Issues
Orders Hotline
Tel. 01858 435344
Enquiries Hotline
Tel. 01858 435322

FOR ENTHUSIASTS BY ENTHUSIASTS
NEXUS

ISSN No. 1460-2822

CONTENTS

Article references are given as Vol Page (Year)

Introduction.

My own introduction to Model Engineering was while at school in the 1950's. I had already demonstrated a great interest in railways as a small child and had made the usual progression through toy train sets to scratch building of small locomotives in 00 gauge; but as an impressionable teenager, I was strongly influenced by two men who kindled the fire of enthusiasm within me; my housemaster, besides bringing mathematics to life as a really good teacher, taught me good design practice and intrigued me with his great collection of long case clocks which, when he retired from his spacious school house to a cottage in Godmanchester, he had to reduce in height to get them to fit the limited headroom! So I learned that modifications to fit the surroundings were possible; perhaps it was an early example of lateral thinking.

The other man to have a profound influence on my interests was the school physics laboratory technician. He had a small workshop in the laboratory building with a treadle lathe on which he built and modified Fletcher's trolleys, spectroscopes, Kundt's tubes and other wonders of the scientific world. He taught me how the lathe worked and took me home on the odd free afternoon where his wife plied me with tea and scones, while he lent me copies of a little blue 9d magazine called Model Engineer. He proudly showed me the medal he had won at the Exhibition for his 1/4 scale model furniture; I well remember the Windsor Wheelback chair, beside the fullsize version in his sitting room.

So I started reading the Model Engineer, with a funny man called LBSC, who I discovered lived in Purley, not far from my Surrey home; and Edgar Westbury, a large jolly man, with whom young boys did not argue, as I discovered when I joined the Sutton Model Engineering Club during the holidays. But it was Martin Cleeve and Duplex who fired me the most with their writings each week. They represented a goal at which to aim.

So, it was with much pleasure that I picked up the challenge from the Editors to compile this present volume. Having given me a loose rein on its content, I started to consider what should be included and what should be left out.

One fortunate accident of fate is that I am custodian of the Model Engineer collection belonging to the Stamford Model Engineering Society, so that has made reference convenient and comfortable. I suppose that I was instrumental in consolidating this collection so that we now have a complete set of all the volumes since 1946. So, armed with this phenomenal piece of history, I could set to work and examine everything that has been published over the years, but concentrating on the last half century.

Just consider what has happened during the early years of the hobby and how it has developed over the years: when the first issue appeared during the closing years of Queen Victoria's reign; wages were extremely low and free time scarce. The primitive lathes were treadle driven and rather feeble by modern standards. Accessories had to be home made, since they were simply not available on the domestic market. So the early years described many articles which today we take for granted.

The great watershed came after the Second World War with the launching of the Myford 7 series lathes, whose definitive designs have completely revolutionised the approach to model engineering. In more recent years we have seen other types of machine become readily available and affordable in the home workshop.

Against this background, a trawl through the archives yields an immense load of articles, written by a large number of people. It is surprising how some of the subjects have been repeated, even by the same authors and within a few months of their original publication; this seemed to happen most during the 1950's. It has also been enlightening to observe the concentration of workshop articles over the years: it started off with relatively few contributions in the first post-war years, when even the paper on which the magazine was printed was rationed, thus not only restricting the circulation but also the page area. Then followed good steady progress until lean years in the 1960's when the format and publication frequency had to be changed drastically. But surely the golden years were during the 1970's and into the 1980's when so much material flowed from the pens of the "Greats", notably George Thomas, Dennis Chaddock and Duplex. Sadly they are no longer with us and presentation standards of workshop articles have certainly had their ups and downs since their demise. But take heart! After a low period a few years ago I see the arrival of interesting new techniques and subjects with which to celebrate a new century.

Having examined what is available from the past issues of the Magazine, I could now group the articles into three basic areas: major machines, techniques and skills, and workshop tools and accessories. It is easy to see that to do justice to major machines such as Cutter Grinders, Engraving Machines, Milling Machines and Drilling Machines, only a few could appear in a short work of 96 pages. So these have been passed over and a decision had to be taken on which of the two other areas should be covered.

There has not been space to include workshop techniques and skills in this present volume, so I must reluctantly pass over the excellent writings of Tubal Cain, D.J.Unwin and Terry Aspin (Chuck), thus leaving out techniques such as ornamental turning, gear-cutting and foundry-work which might easily form the subject of another volume uniform with this one.

In selecting tools and accessories to be published I have applied some simple criteria:

1. They must in general not be available commercially, or else there must be some overriding reason for making them at home.

2. Construction must be possible within a short space of time; of course this depends on one's individual speed of working, but clearly there is a natural division here between the type of device under discussion and the major project which has been put to one side.

3. Every device is really useful in the workshop and pure ephemera have been eschewed.

The list as compiled is, roughly speaking, in ascending order of difficulty, added to which there is a certain order of things, so that for instance it is of less benefit to be able to drill holes from the lathe cross slide until one has the wherewithal to index the mandrel accurately.

I was originally worried lest it should have been dominated by the writings of just two or three authors, but my fears were unfounded: good ideas come from all over the place and from all the decades considered.

As topics have been recycled over the years, sometimes they have been improved upon, but in other cases nothing has been improved. In choosing the version for publication I have looked for simplicity, excellence of design, clear exposition of text and articles which fit into the style of the book for length without too much editing. There have been some examples where I have had to apply the blue pencil without mercy and at least one good contributor has been sidelined through verbosity, a good design having been presented in six times as many words as that chosen. Drastic editing would have completely altered the style of writing and that is not the objective of the current volume.

So it has been an interesting experience going back over the years and producing what I hope others will agree is a digest of the best of workshop practice during the past 50 years.

D.A.G.Brown.

D-Bits.

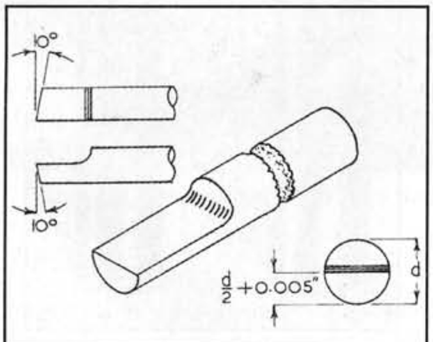
These small components are really so easy to make. Interestingly, there have been several variations published over the years, but the one chosen is the simplest to make and is very effective for finishing flat bottomed holes to size. If you have a tool and cutter grinder, making a D-Bit really does become a piece of cake. Bradley describes the whole process clearly.

The 'D' Bit

IAN BRADLEY shows the novice how to make this useful tool for drilling deep holes.

The drilling of deep holes that run true axially is a problem that has often to be faced, and it is sometimes not appreciated that the twist drill alone cannot provide the degree of accuracy needed. The greater the length of the drill the less it can be relied on to run true, although an extension device, comprising a standard drill grafted on to a length of steel rod equal in diameter to the drill shank itself, may do something to help.

The best method, however, is to make use of the D-bit. This is a tool taking its name from the cross-section of its cutting end, which the builder can make for himself and which will pursue a straight course because of its inherent rigidity and the built-in guidance it possesses. The basic shape of the tool is shown in Fig. 1 (below).

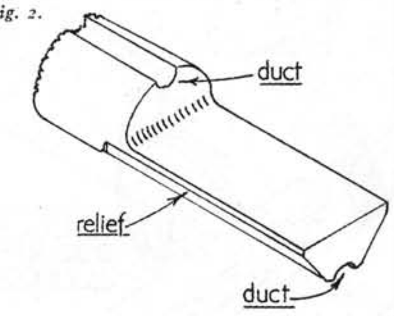


The D-bit has a flat land machined or filed on it extending backwards from the tip for a distance equal to three or four times the shank diameter d, the land being formed some 0.005 in. above the centre line. This dimension is important in order to maintain guidance.

Commercially produced D-bits were usually provided with a duct to convey lubricant to the cutting edge. This took the form of a small gutter on the upper part of the shank; in addition, the rounded portion of the guidance behind the cutting edge was sometimes relieved, though the benefits from this practise seem somewhat obscure. These points are brought out in Fig. 2.

These refinements are not of particular importance to the amateur worker, though he may find the lubricant duct of value in deep drilling.

Fig. 2.



Whilst professionally made D-bits are commonly made from high-speed steel, the amateur worker will use silver steel for the purpose. This material is readily obtainable in the form of bright round bars some 13 in. long, ground to close limits of accuracy. Silver steel is easily worked both by hand or machine methods. It can be hardened and tempered with simple equipment such as is usually found in the small workshop.

All that is needed is some means of bringing the point of the tool to a red heat, and subsequently to temper it after the hardening process has been carried out.

Hardening the material is brought about by heating it until, in the case of the D-bit, the cutting edge, and an area some $\frac{3}{4}$ in. behind it, becomes red hot. The tool is then plunged into clean, cold water and stirred about until all heat goes from it. At this stage the tool's edge is too brittle for practical purposes so must be tempered to provide adequate strength for the steel. To do so the tool must be first cleaned and polished with emery cloth to a bright finish before the shank is heated gently in the manner illustrated by Fig. 3. The flame must be applied, as shown, well below the cutting edge of the tool, then as the shank is raised in temperature, a play of colours will be seen to creep along it ranging from light straw to dark blue and finally black. The colours denoting the extent of tempering needed for satisfactory working lie in the straw-coloured range. Light straw provides an edge somewhat too brittle for heavy machining, so it is advisable to arrest the tempering as soon as a medium-to-dark straw colour appears around the tool's edge. This arrestment, finalising the hardening and tempering process, is performed simply by again plunging the tool into cold water.

The process of hardening and tempering carbon or silver steel applies equally to lathe or shaping machine tools made from this material.

Sharpening the D-bit

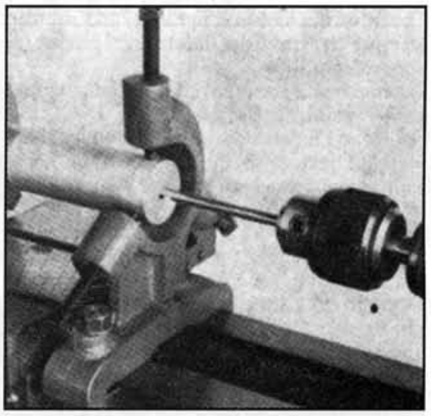
Once the tool has been hardened and tempered it will need to be sharpened. the somewhat ragged edges left by the file, or perhaps a machining operation used to shape the D-bit, are not good enough for practical purposes, so the tool needs first to be ground and then stoned so that a fine cutting edge is produced.

Grinding is best carried out on the side of the wheel using an angular rest which will be described later when dealing with tools for use in the lathe or shaping machine. Since the D-bit is made from round material it is best to catch it in small V-block. Otherwise it may not be possible to maintain the clearance angles required because of failure to keep the tool in constant position relative to the grinding wheel itself. Fig. 4 depicts the method advisable.

Using the D-bit

If success in employing the tool is to be achieved, it is of the utmost importance that it starts work correctly. For the most part the components to be machined will be too long to be held by the chuck alone; they will, therefore, need to be supported by the fixed steady as seen in the illustration, where a D-bit is being used to drill the pendulum of an electric clock.

The sequence of operations that then needs to be adopted is as follows: First, the work must be centre-drilled to provide an accurate start for a pilot drill some $\frac{1}{16}$ - $\frac{5}{32}$ in. smaller than the size of the D-bit itself. This drill should be fed in deeply. If an extension drill is used, and it is known always to follow a true course, it will be in order to completely penetrate the work since this will ease the work of the D-bit. However, complete penetration is not essential and should not be employed if there is any likelihood of the pilot drill running out.



Using a steady to support the work.

After the work has been drilled, the resulting hole must be opened out with a boring tool until the D-bit will enter without shake. The depth of this machining should be made equal to at least twice the diameter of the bit to be used, and the test for the entry of the tool made with the D-bit set in the tailstock chuck.

Needless to say the tailstock used must be accurate or the whole exercise will be brought to nought. Commercially made D-bits usually have tapered shanks so that their correct alignment in the tailstock is automatically assured. In this connection it was, of course, important that the surfaces of the mating tapers remained undamaged.

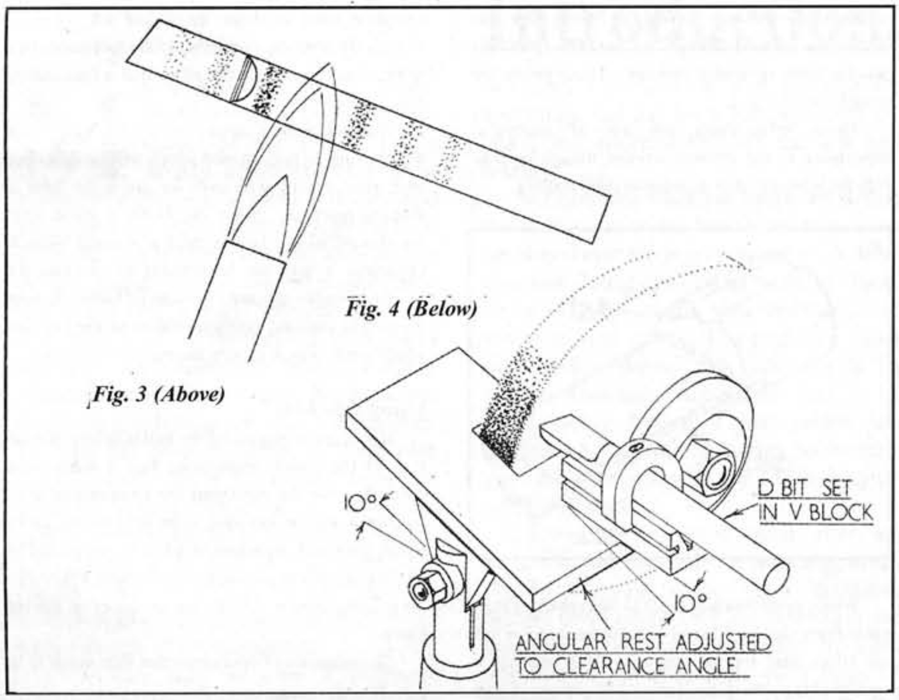


Fig. 4 (Below)

Fig. 3 (Above)

Where the bit is being used, it must be withdrawn from the work frequently in order to remove swarf, for unlike the twist drill which has partial self-clearing properties, the D-bit has none. It, therefore, needs to be withdrawn regularly to avoid the swarf packing on the cutting edge. At the same time the shanks of the tools need to be lubricated in order to preserve the smooth finish on the work. ●

Model Engineer 136 171 (1970)

Counterbores or Spot Face Cutters

Like D-Bits, these small tools are very easy to make. Looking back through the archives. I have been struck by the complicated rigmaroles designed to produce what is really a very simple item. The loose pilot enables the cutting edges to be formed so easily and a modern tool and cutter grinder makes the performance quicker and more accurate.I have no hesitatation in recommending the 1965 production of the method, followed by an up to date method for larger sizes of spot facing cutters which is economic in materials.

Spotfacing Cutters

From Novices Workshop by Duplex

Counterbores for BA cheese-head screws.

BA No.	Dia. of the Body in.	Dia. of the Pilot in.
0	0.415	0.234
2	0.321	0.183
4	0.254	0.140
6	0.196	0.108
8	0.160	0.085

Counterbores for BSW and BSF screws

in.		
1/8	0.189	0.123
3/16	0.283	0.183
1/4	0.377	0.248
5/16	0.471	0.310
3/8	0.564	0.373

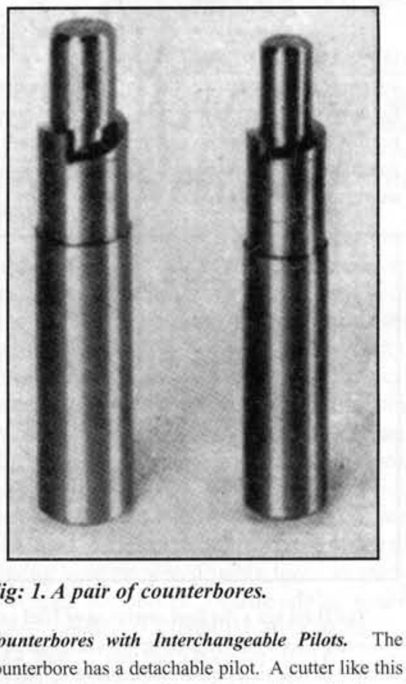
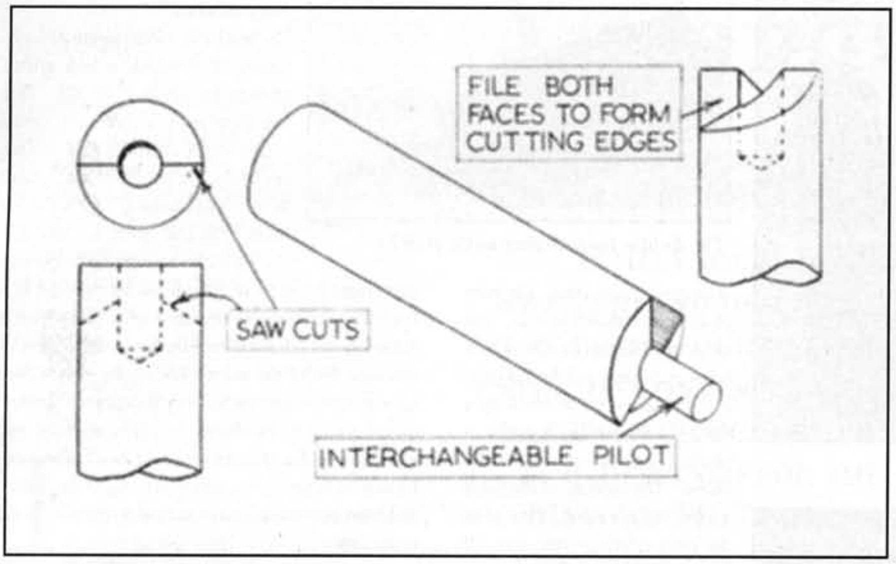


Fig: 1. A pair of counterbores.

Counterbores with Interchangeable Pilots. The counterbore has a detachable pilot. A cutter like this has many advantages, since the size of the pilot is not tied to the diameter of the cutter itself. In this way one may accomodate non-standard screws. Such counterbores are readily made from silver steel rod. The body of the tool is first turned to the required size, then the seating for the pilot is produced by drilling and, where possible, by reaming. The



Counterbore with interchangeable pilot.

smallest practicable pilot is one for a 6BA screw, which is 0.110 in. dia. and can be held in place with either a 6 or 8 BA grubscrew.

When the turning has been completed, a line is scribed across the face of the cutter body as a guide to the saw-cuts, that must be made in accordance with the illustration. The two cutting edges are then relieved by filing, in the manner shown, and the tool is finally hardened and tempered.

Using ***Counterbores and Countersinks.*** When working on metal, except in the case of brass, counterbores and

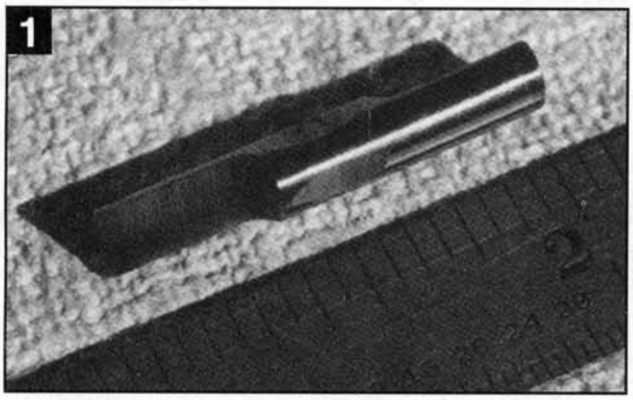
countersinks should be lubricated. For the most part, a good, thin, straight cutting oil is to be preferred, as this will serve for steel and aluminium alloys. Those who do not have supplies of this oil will find that a soap-and-water mixture will give good results on mild steel, and that aluminium alloys can be treated with 50-50 mixture of engine oil and paraffin. Keep the speed of the tools down, remembering that more bad countersinks arise from too high a speed than from running slowly.

Where a number of screw holes have to be counterbored to a specific depth, it saves time and ensures uniformity if the depthing stop is accurately set and firmly clamped in position. During counterboring or countersinking operations, raise the cutter from time to time to clear chips and prevent clogging of the teeth.

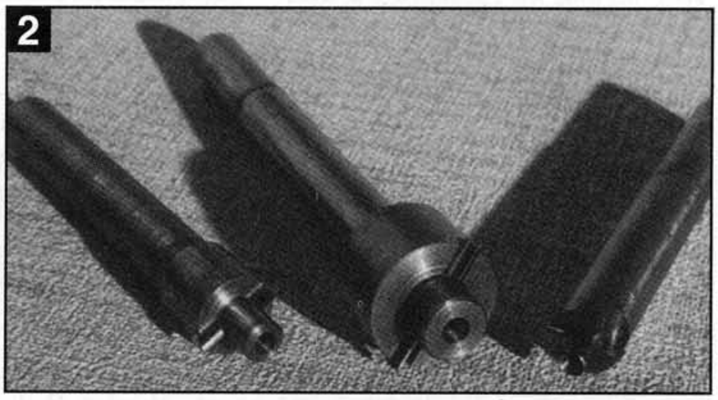
Model Engineer 131 638 (1965)

INEXPENSIVE CUTTERS FOR LARGER DIAMETER SPOTFACES

And now for the economical extension of sizes-Denis Wall



Tool bit, ground from $\frac{3}{16}$ in. dia. HSS to make a counterbore of $1\frac{1}{16}$ in. diameter.



Spot facing cutters made by the methods described in this article. The two larger versions use $\frac{3}{16}$ in. dia. HSS cutters. The smallest has a $\frac{1}{8}$ in. dia. HSS toolbit

Some years ago when I was building my Mk. 1 Dore-Westbury milling machine I was concerned as to how to produce spotfacings for the heads of the several $\frac{1}{2}$ in. dia. bolts used in its construction.

Ideally the diameter of spotface for these bolt heads should be about $1\frac{1}{16}$ in., although 1 in. would serve at a pinch. However, I was reluctant to purchase a length of $1\frac{1}{16}$ in. dia. silver steel for making a cutter from the solid and so cast around for a method of making one from cheaper materials which were already to hand, i.e. mild steel and a $\frac{3}{16}$ in. dia. HSS tool bit.

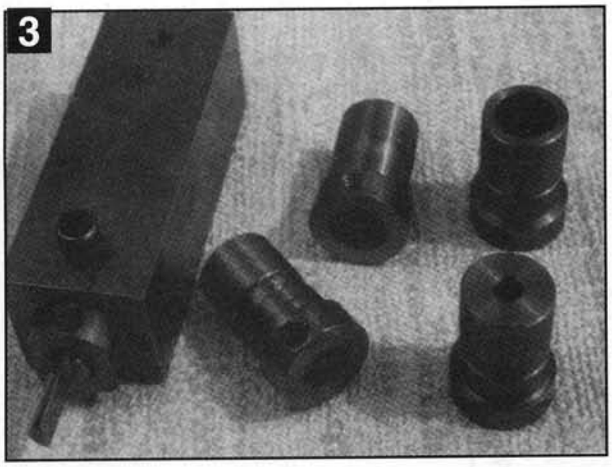
Photograph 1 illustrates the ground tool bit, **photo 2** the cutter for $1\frac{1}{16}$ in. diameter, along with two others for $\frac{11}{16}$ in. and $\frac{9}{16}$ in. dia. which proved equally effective.

The method of construction is shown on the drawings. Dimensions can be varied to suit the job in hand and material available.

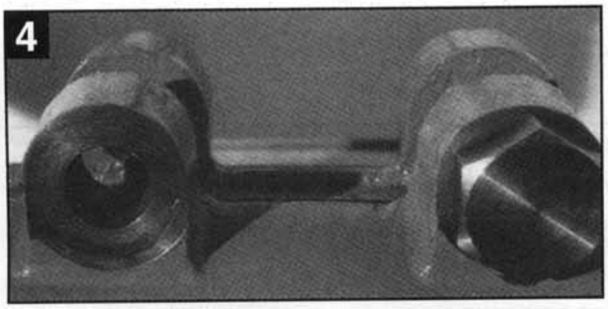
Tool grinding

Some advice on grinding the tool bit may be helpful as there is not much to get hold of! This can be overcome by the use of a simple grinding aid attributable to the late George H. Thomas and described by him in M.E. 21 January 1977.

"For the majority of readers who have no "Quorn"



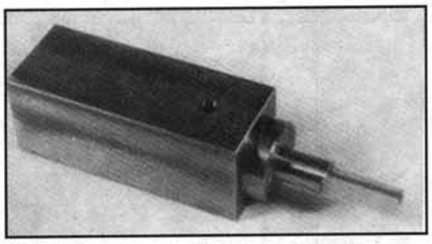
Toolbit grinding aid



Spotface produced by the 1 1/16 in. dia. cutter

or other elaborate tool-grinding aids, I have made up and photographed a simple holder which requires only a flat table set 3/8 in. below the centre of the grinding wheel. This holder is in 2 in. length of 3/4 in. square b.m.s. bored through the centre 7/16 in. dia. and a sleeve to fit in this hole turned from 5/8 in. b.m.s. leaving a head about 7/32 in. long. The bore of the sleeve shown is 1/4 in. The cutter bit is held in the sleeve by a 6 BA grub screw and the sleeve is, in turn, locked in the block by a 4BA screw which contacts a shallow groove turned in the sleeve. The method of operation will be fairly obvious. First grind the main reference face, then all the other angles can be obtained by rolling the block over and adjusting the position of the sleeve in the block. This can be determined exactly by checking with a bevel gauge against the reference face. With a sleeve to hold 3/8 in. bits this device would be equally useful for grinding the dovetail tools."

Photograph 3 shows my version which I have found very useful for grinding a variety of tool bits such as those for screwcutting and boring bars. One needs to have a flat table attached to the grinding machine and if working on the periphery of a disc wheel it should be set 3/8 in. below the centre of the wheel.



The holder for grinding tools. (GHT)

The toolholder

The holder is a 2 in. length of 3/4 in. square BMS which is best drilled through the centre 3/8 in. dia. This can then serve to hold any cutter with a shank of that diameter. One end is opened out 7/16 in. dia. x 3/4 in. deep. The sleeves, which can be from 5/8 in. dia. BMS, are turned to fit the 7/16 in. hole in the holder and if the head is left 3/16 in. long it can be tapped 4 or 6 BA for a grub screw to grip the tool bit. The bore is drilled to suit whatever tool bit you wish to hold, in this case 3/16 in. diameter. The holder should also have a 4BA screw positioned to engage a shallow groove turned in the sleeve. It will be seen that one of my sleeves has flats milled on the head. These can be helpful in setting the sleeve relating to the holder, and must be parallel and/or normal to the axis of the grub screw.

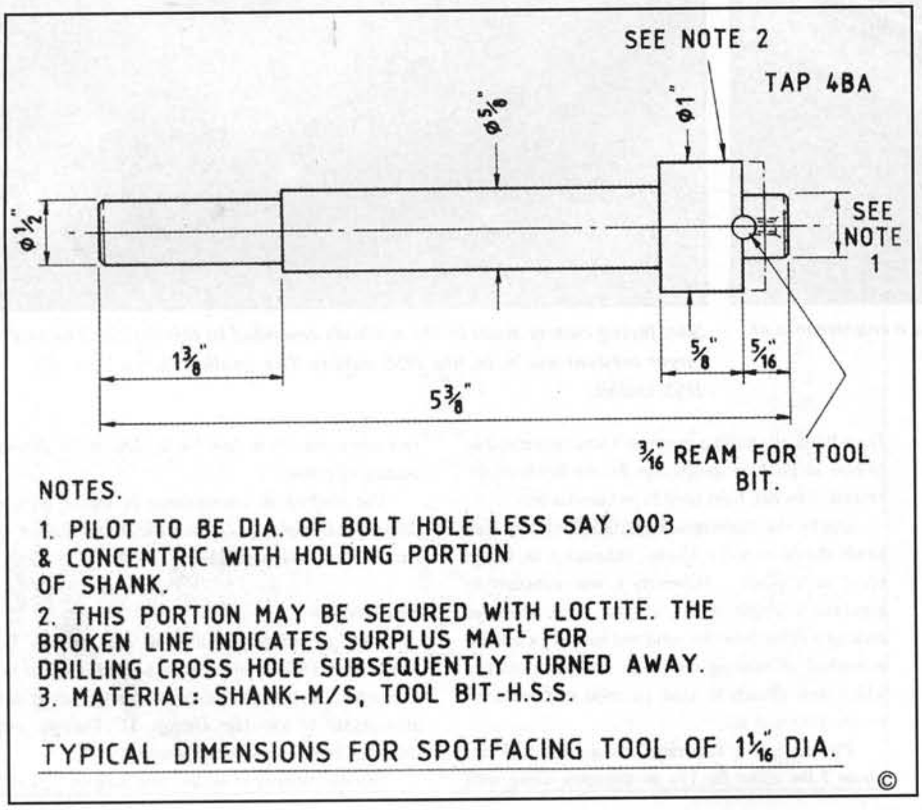
The first step in grinding the tool bit is to snap off a piece from a length of 3/16 in. dia. HSS, a little more than 1 1/16 in. long. In this respect I find that the tiny abrasive cutting wheels measuring 7/8 in. dia x 0.025 in. thick available for use with high speed miniature hand-held power tools are excellent for "nicking" around HSS tool bits so that they can be snapped off with the minimum waste. Next, a small flat should be ground half way along its length. This will be engaged by the grub screw in the sleeve and forms the datum from which the cutting edges will be ground and will also be engaged by retaining grub screw in the pilot of the spot facing tool.

The first tooth can now be ground and it should be 0.005 - 0.010 in. less in thickness than half the diameter of the tool bit and of a length such that the cutting edge will be fully housed within the pilot. The outer end of the tooth should be ground back to form a clearance angle relative to the circumference of the spotface to be formed and the inner end finished with a radius to reduce the chance of fatigue cracks occuring. Take care to grind the tooth relative to the datum flat such that a right hand cutting action will result.

The tool bit is now reversed in the sleeve and the second tooth ground. If all has been carefully set the two resulting teeth will be in parallel planes and will have zero cutting angles. With a little ingenuity in setting the sleeve relative to the holder positive cutting angles might well be achieved.

Although I have not tried it, I am inclined to think that a single toothed tool bit might be just as effective; it would, after all, be a form of fly-cutter.

In use, a low speed is required, and as the lowest speed of my Fobco drilling machine is 475 rpm. and therefore a good deal too fast for a 1 1/16 in. dia. cutter on cast iron, I simply rotated the spindle by hand using the chuck key as lever. Notwithstanding that when working on a casting one almost invariably starts with an interrupted cut, first class spotfaces were achieved, as is eveident from photo 4. ●

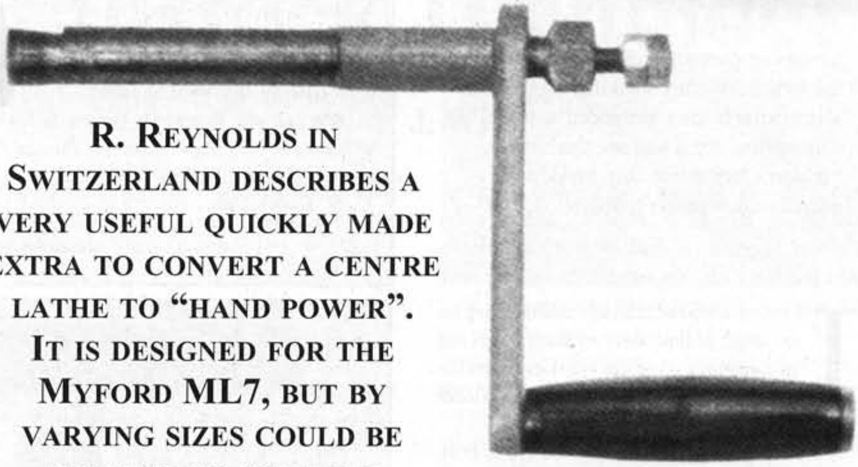


Model Engineer 174 737 (1995)

Mandrel Handle.

Although it is possible to buy a commercial mandrel handle, such accessories are inordinately expensive and the home version offered has been chosen for its simplicity as a "Saturday Afternoon Job". One minor criticism I have is that the overhang of the centre screw and draw assembly could give rise to sore knuckles, so on assembly this projection should be kept to a minimum.

A mandrel handle



R. REYNOLDS IN SWITZERLAND DESCRIBES A VERY USEFUL QUICKLY MADE EXTRA TO CONVERT A CENTRE LATHE TO "HAND POWER". IT IS DESIGNED FOR THE MYFORD ML7, BUT BY VARYING SIZES COULD BE ADAPTED TO FIT MANY OTHERS.

There are from time to time remarks in various articles published in Model Engineer that the lowest speed of such and such a lathe is too high for screw cutting. Personally, I find even the lowest speed of the ML7 (25 r.p.m.) to be rather high for some work and have long given up using it. Instead I turn the mandrel and thus the leadscrew by hand. Perhaps some of our readers may be interested in making such an article.

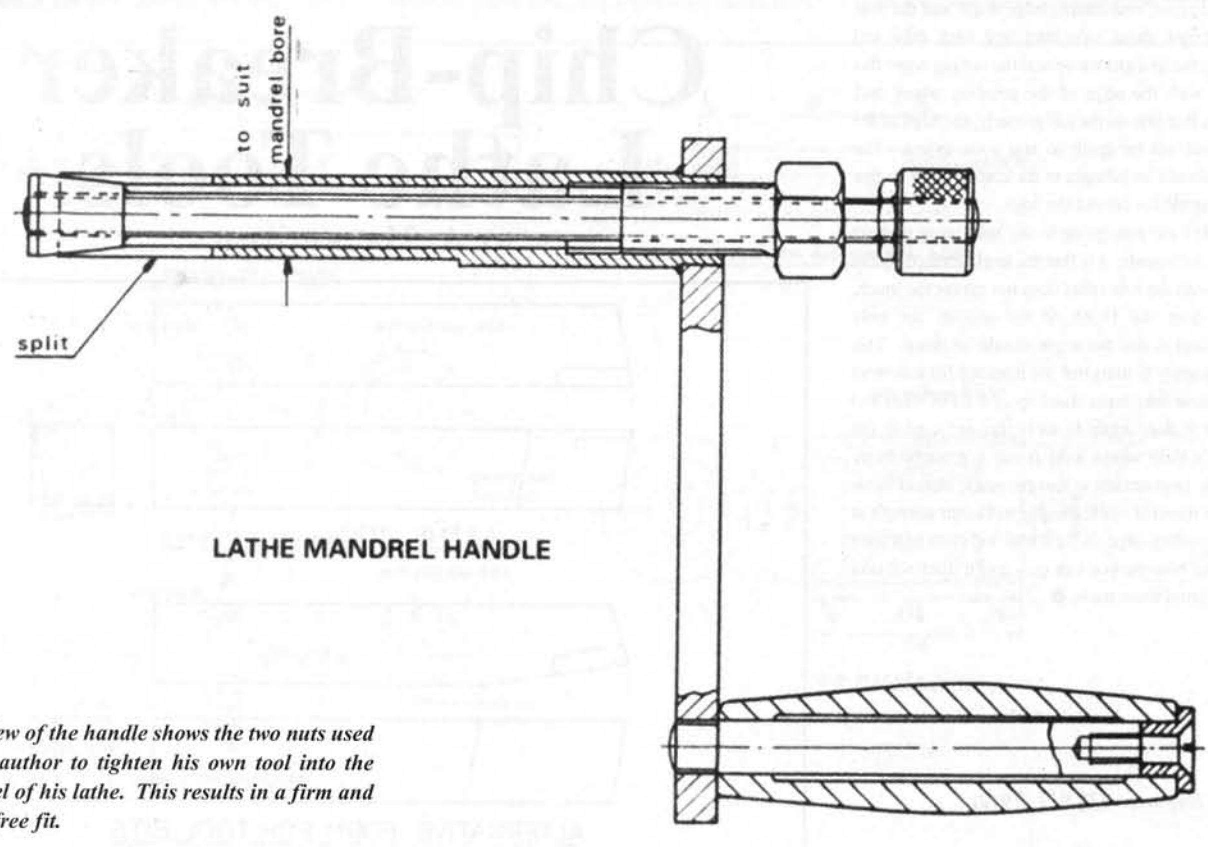
The drawing and the photo make the construction fairly clear, I think. Unlike most articles employing a cone to splay the tube which grips the mandrel bore, my device uses screws of different pitches to draw up the cone, which means that the latter does not rotate. I think now that I built a bit of luxury into my device.

The inner screw is a normal M8 which has a pitch of 1.25 mm and the outer screw, which is the one which is rotated, has a fine pitch of 1 mm. The cone is thus drawn up 0.25 mm for every turn of the outer screw.

The dimensions are not at all important except for the tube fitting in the mandrel bore. Mine seems to suit me and give adequate torque for thread cutting. All the pieces came out of the scrap box.

The lever and the tube are silver-soldered together as are the cone and the M8 rod. The end of this rod was supposed to receive a knurled knob but as the reader will see this has now been in use for several years with just two nuts. ●

Model Engineer <u>167</u> 515 (1991)



LATHE MANDREL HANDLE

This view of the handle shows the two nuts used by the author to tighten his own tool into the mandrel of his lathe. This results in a firm and shake-free fit.

Chip Breaker.

I hate to be knee deep in swarf in the workshop, especially if it wraps itself around the chuck. Little seems to have been published over the years on the subject of chip breaking, so the two short extracts are reproduced with an exhortation: try it and see the benefit, but don't forget that chip breaking actually takes power to drive.

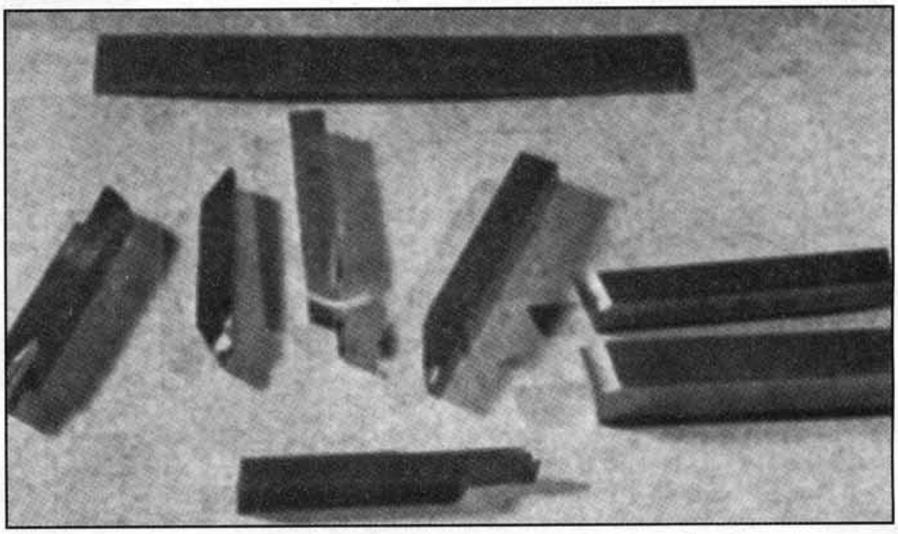
Chipbreaker Tools - a letter from D. H. Robinson of Ware, Herts.

Sir, I have often seen articles about lathe tools of all shapes and sizes in the magazine, but I have never seen mentioned the form of lathe tool which is now widely used in precision engineering shops. It seems to derive both from the side tool and a chipbreaker and consists of normal and front side angles on a H.S.S. tool, but instead of a top angle, there is a groove up to the leading edge and parallel to it, the groove being approximately 1/16 in to 3/32 in. radius.

The tool may be used for turning, facing and the same principle applied to a boring tool. It has the advantage of curling the swarf and avoiding the long awkward streamers associated with a side tool. It seems best used with a fairly fine feed.

D. H. Robinson — ***Ware, Herts.***

Model Engineer 138 921 (1972)



A selection of chip-breakier tools, including facing, threading and cut-off tools.

Chip-Breaker Lathe Tools

BY A. MACKINTOSH

If you have worked in a large machine shop for any length of time, there are many things that are taken for granted and one does not realize that other people may not have the knowledge that you have gained.

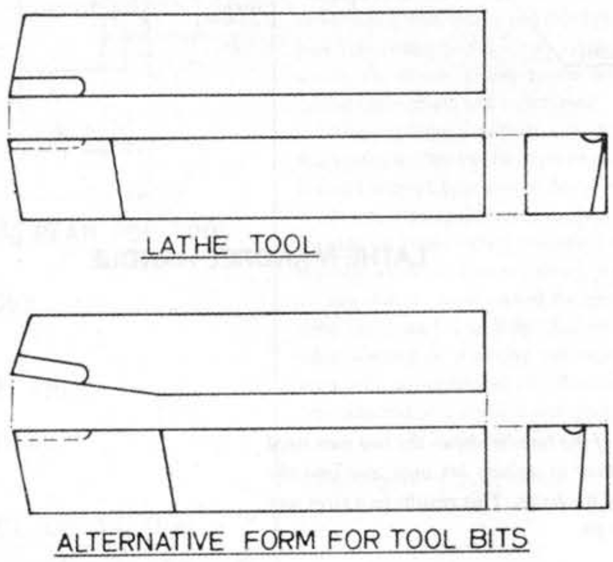
One thing was brought to my notice by Mr. D. H. Robinson's letter on page 253 of "M.E." March 3, on chip-breaking tools. As almost all my tools for steel and aluminium turning are ground in this way and as I don't remeber anything in "M.E." for the last 12 years or so, possibly a short article might be in order.

When turning steel or aluminium, it is well known that the turning tool should have a sharp side rake and a fairly sharp back rake if it is to work properly. If you are going to make a conventional tool, you will have a lot of grinding to do and this is a slow business at best of times quite apart from the fact that every bit of steel that is ground off the tool lowers its rigidity.

When making a chip breaking tool, first grind in your end relief, end cutting edge angle and the side relief; forget about side rake and back rake and simply grind in a groove behind the cutting edge; this is done with the edge of the grinding wheel and, provided that you do the job properly, the edge of the wheel will not be spoilt to any great extent. The groove should be brought to the cutting edge so that no land is visible behind the edge.

What I am now going to say may bring protests from perfectionists: it is that the angle formed by the groove with the side relief does not matter too much, neither does the finish of the groove, the only requirement is that the angle should be sharp. This does not apply to tools that are intended for industrial use because they must stand up to a lot of wear and tear, but it *does* apply to tools that are used in the amateur's shop where wear is not a great problem. The only requirement is that the angle should be as sharp as possible while leaving sufficient strength in the tool cutting edge. A little trial and error will soon show you how far you can go - and it does not take long to grind these tools. ●

Model Engineer 138 921 (1972)



Tailstock Dieharder.

This accessory is well worth making at home and the combination of the two popular die sizes on the tool makes sense. My original L.H. Sparey design still does good service, but this variation is worth the extra hassle to keep the dies at their working diameters without taking trial cuts.

An Improved Tailstock Dieholder

by A. J. Wise

A TAILSTOCK DIE-HOLDER is I think a must for any model engineer with a lathe and so it was one of the first tools made when I started a couple of years ago. Then I met George Joines and saw the improvement he had made to the basic design, and promptly made another one to his pattern. The time saved even in my short modelling life is far in excess of the time spent making it, to say nothing of the convenience. Just think, no more time spent changing and setting up dies - no more work spoilt because the thread is too tight or too loose. All your dies are set up accurately in their own holders and you pick them up, slot them in, and use them, just like that.

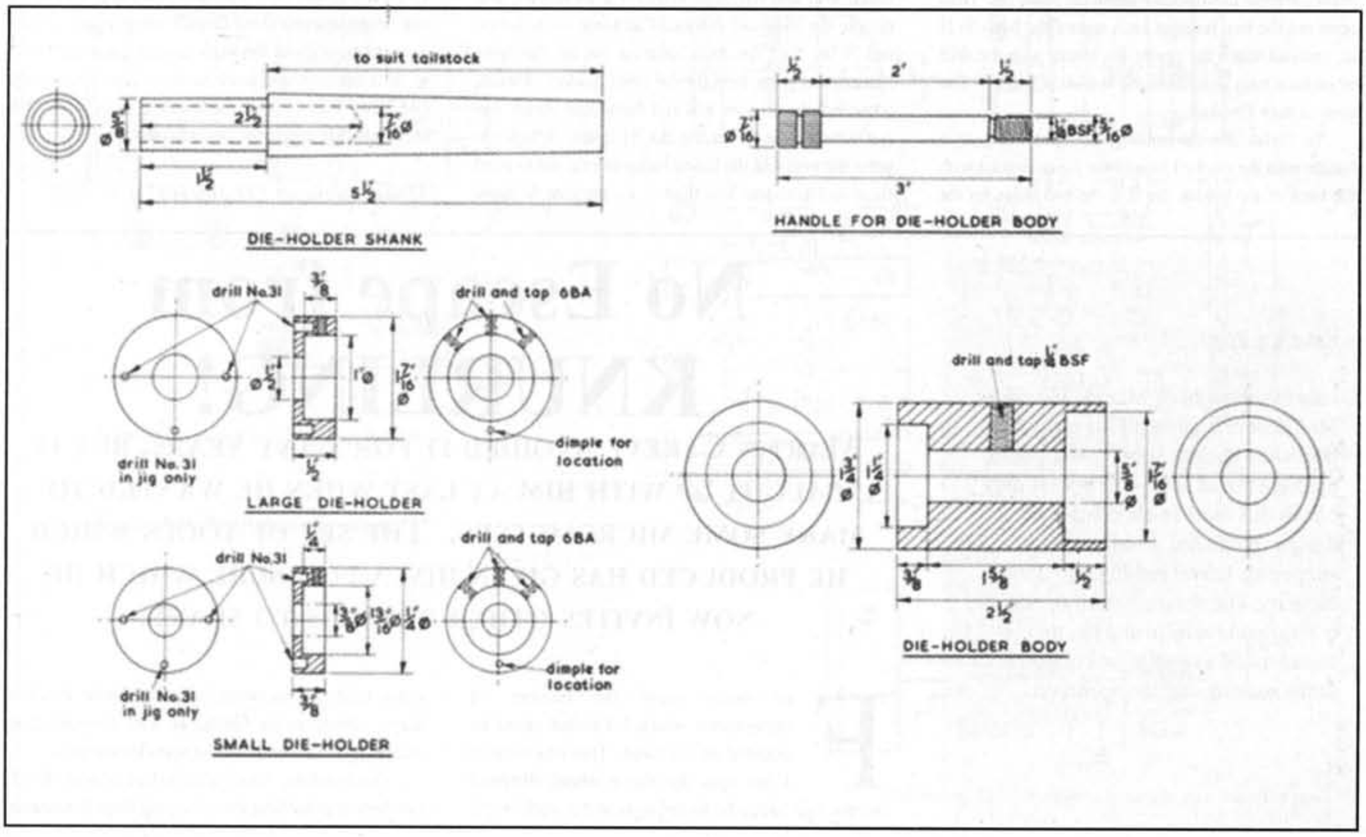
The body of the die-holder was made from b.m.s. 2 in. dia. and turned to size. It was knurled to provide a grip as an alternative to the handle when working on small threads. The body was then drilled through and bored out ⅝ in. One end was then counterbored 1 7/16 in. dia. x ½ in. deep and the other end 1¼ in. x ⅜ in. deep. (The body could be counterbored one end only for the large size and use the large holders for both size dies - but I preferred the two sizes.) The side is marked for centre, drilled and tapped ¼ in. BSF for the handle, a seating being provided by an end mill or counterbore. This finishes the body for the time being.

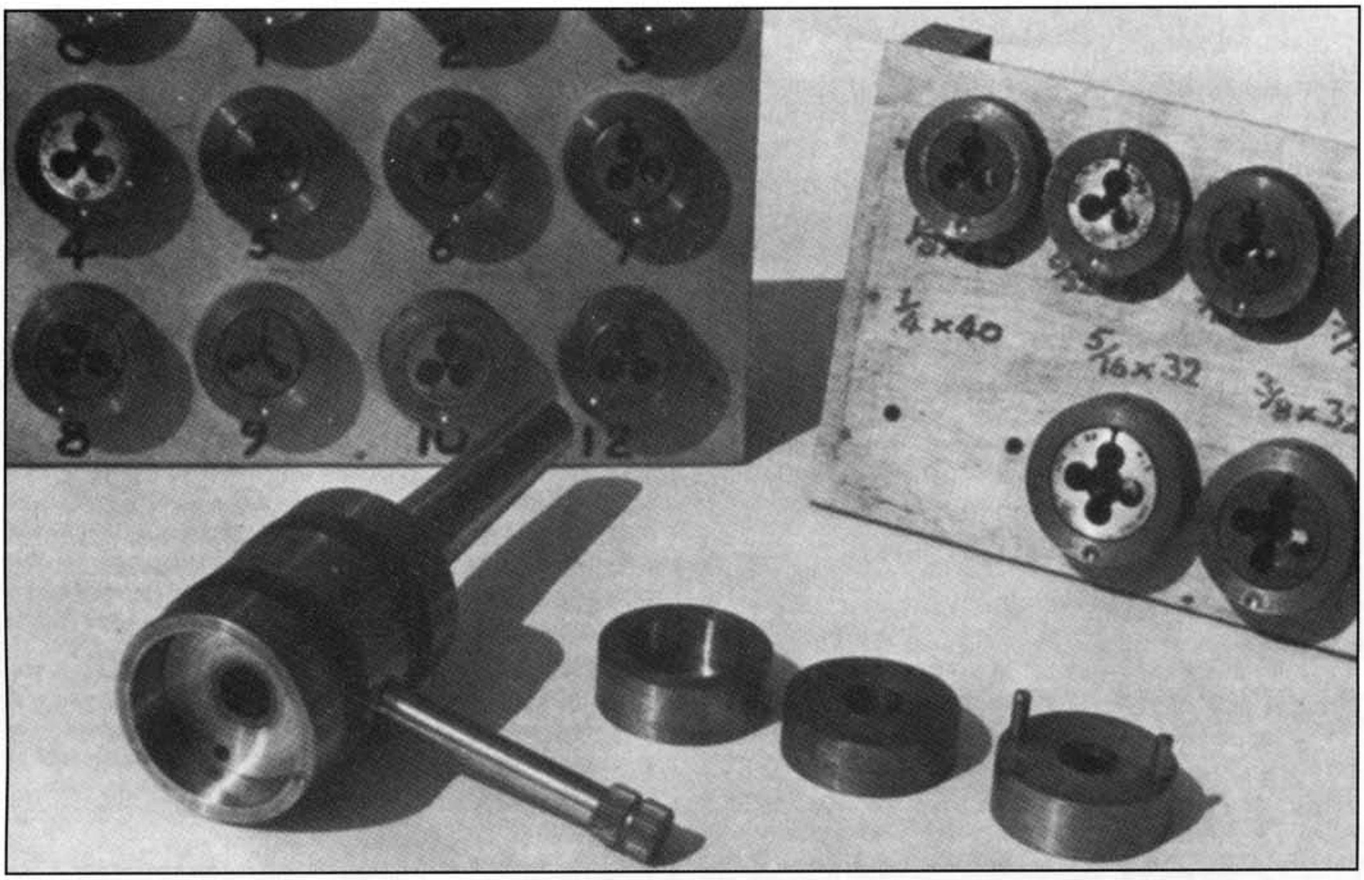
The shank is b.m.s. 5½ in. long and taper turned to fit the tailstock. Mine has a No. 2 Morse taper and this is easily obtained by setting over the top-slide. Hold a mill or drill with a No. 2 M.T. shank in the chuck so that the M.T. is projecting, then with a D.T.I. in the toolholder (set at centre height) traverse the top-slide along the Morse taper gradually correcting the set-over until the D.T.I. reads zero over the full length. Replace the drill with the mild steel and set the tool in the holder at exactly centre height, then using the top-slide to traverse the tool, turn the taper. When complete fit the taper into the head-stock mandrel and turn the shank to fit the die-holder body ⅝ in. dia. x 1½ in. long. Drill the shank 7/16 in. for a depth of 2½ in. and if desired right through with a smaller drill to enable longer threads to be handled. This finishes the shank.

The handle is b.m.s. ½ in. dia. x 3 in. long turned to shape and size as per drawing and threaded ¼ in. BSF.

Then comes the tedious part - making the individual die holders. The large ones are made from 1½ in. b.m.s. turned down to 1 7/16 in. dia. and parted off ½ in. thick. If the bar is accurate, use the full diameter and bore the body accordingly. You will want one for each die plus one for a jig; it is as well to do some spares for future dies while you have the set up. The small holders are from 1¼ in. b.m.s. parted off ⅜ in. thick, again one for each die, plus jig, plus spares. Either the holders should be turned to fit the body or if the full size of the bar is used, the body should be bored to fit. The holders should be a close fit, so that they will shake out but not shake about. Each holder then has to be drilled and bored. The large ones drilled ½ in. through and bored 1 in. x ⅜ in. deep for dies to fit. The small ones are drilled ⅜ in. and bored 13/16 in. x ¼ in. deep for dies to fit. If the drilling is done before the parting off, it will make that operation easier. The counterboring can be done as a separate job afterwards. Leave one of the holders in each size solid as a jig.

Taking the large jig first, mark out and drill 3 x No. 31 holes ⅛ in. from the edge as shown on the drawing, then on the side scribe a line across the position of the holes for the adjusting screws, taking the spacing from a die. Mark one face of the jig as a reference. Take the jig and drop it into the appropiate





end of the die-holder body and clamp in position, marked face outwards. Drill the two holes one at each side ½ in. deep and centre dot the edge of the die-holder body adjacent to the third hole. This indicates which way round the die-holder goes when in use. Repeat this operation with the small jig. Then open out the two holes at each end of the body to ⅛ in. and just touch the centre dot marks with the drill to make a neat dimple at the indicator marks. The body is then finished.

To finish the die-holders, clamp the jig to a holder with the marked face of the jig in contact with the back of the holder, the drill the two holes for the pins No. 31 x ¼ in. deep on the large holders and 3/16 in. deep on the small holders. Turn over and centre dot the edge of the face of the holder, on the side adjacent to the third hole, as an indicator mark. Turn on side and transfer the marks for the adjusting screw holes, drill and tap these 6BA for grub screws, and dimple the indicator marks. Cut some ⅛ in. b.m.s. rod ⅜ in. long for each locating pin on the large holders and 5/16 in. long for the small holders. I tested some lengths of ⅛ in. rod and found one which was just a nice press fit for the No. 31 holes. When cut, press the pins into the holes, being careful not to bend them and also that less than ½ in. projects to avoid fouling the bottom of the locating holes. Fit three 6BA grub screws - socket head type to each holder, place the die in the holder and adjust to accurate size and the job is done.

I can assure you that every time you use this tool you will wonder how you ever managed without it, and having correct sized threads is a joy that is there every time, without the work usually associated with it. It is certainly too good an idea to keep to myself and a few friends have made them, so join the club and make life easier for yourself. ●

Model Engineer 141 386 (1975)

Knurling Tool.

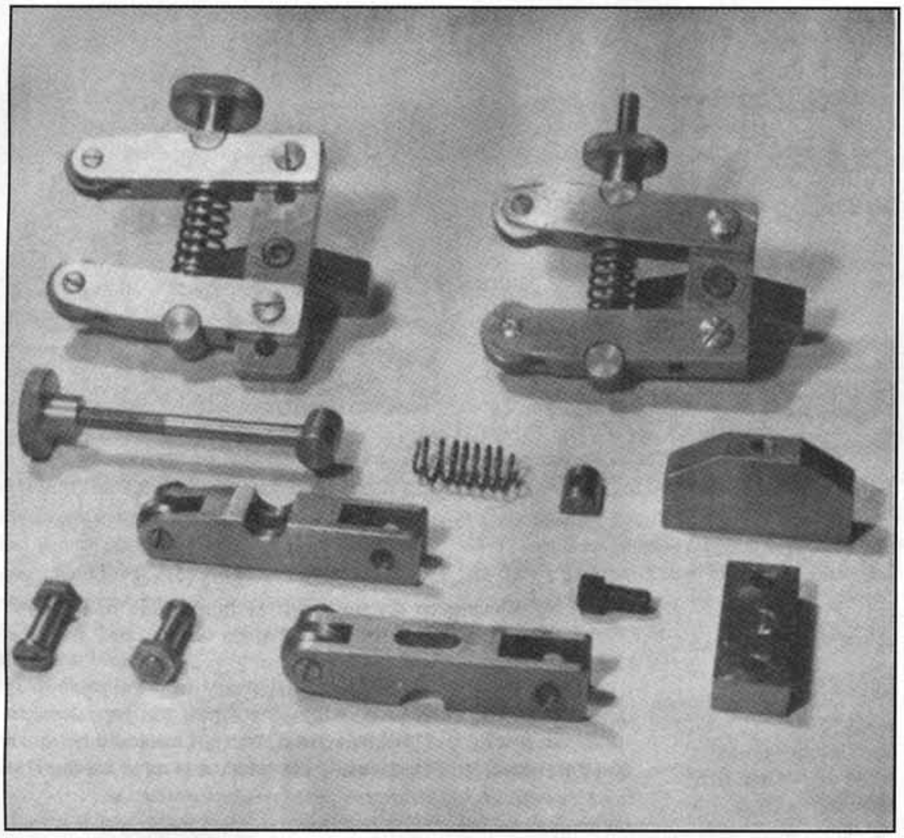
I always thought of Martin Cleeve as Mr Capscrew, since all his many published designs were held together by socket head screws. There is only one in this tool! In choosing among designs published, I looked for simplicity, lateral rigidity and 2 in. capacity. The description of operation is clear and realistic and the tool is commended as one to be enjoyed both in the making and the operation.

No Escape from KNURLING!

MARTIN CLEEVE AVOIDED IT FOR MANY YEARS, BUT IT CAUGHT UP WITH HIM AT LAST WHEN HE WANTED TO MAKE SOME MICROMETERS. THE SET OF TOOLS WHICH HE PRODUCED HAS GIVEN HIM A PLEASURE WHICH HE NOW INVITES OTHER READERS TO SHARE.

For many years the number of components which I knurled could be counted on one hand. This was because I had only the single wheel, diamond pattern, that had to be forced against the work by the cross feed; an operation which strained the feed screw almost to its limits, as well as placing an undesirable load on the lathe spindle bearings.

The resulting knurl always had a poor finish, nowhere approaching the satisfying deep penetration



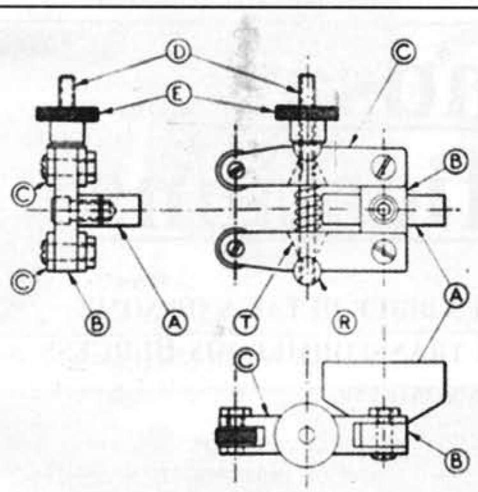
Two assembled and one in pieces.

of a professionally knurled part. It was impossible to knurl a slender component such as a scriber stem. But when I decided to make a set of micrometers, knurling could no longer be ignored. As I did not wish to devote undue time to what regarded as rather a side-issue, I designed the simplest possible holder that I could think of; and as I could foresee that every time I wanted to do some knurling the wrong knurls would be in place, I made three holders, for coarse, medium and fine wheels. I was pleased with the results, and I made many tests. When a friend asked if I had a length of ⅝ in. dia. mild steel to spare, I had to ask if he minded its being knurled!

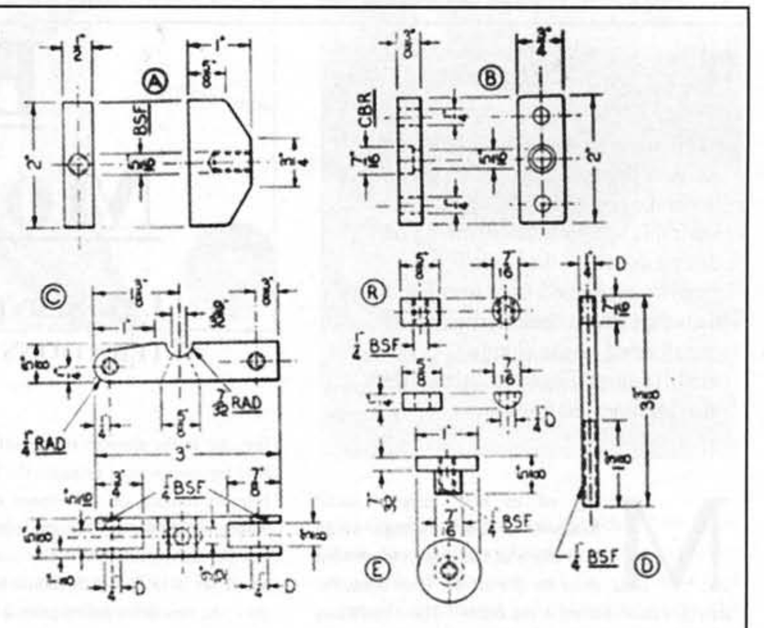
You will see in the picture two assembled holders in the background and one in pieces in the foreground. These tools, which each carry two separate knurling wheels of opposite hand, are sometimes known as the pinch knurlers, wherein pressure is applied with a screw and nut which draw together the two knurl-holding arms or levers. As a maximum knurling pressure occurs only when the knurls and component centres are exactly in line, all the forces are resolved into a mere crushing pressure on the work, and the cross side is relieved of all but purely nominal stress.

The tool at the left has a slightly longer vertical knurl-arm carrying bar. I made this for the coarse knurls only. The idea is that the arm pivot points can be moved apart for the knurling of larger diameters, up to about 2 in. - diameters which are unlikely to require the finer knurls.

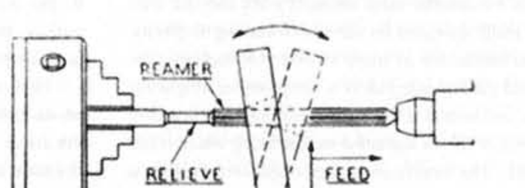
In the detailed drawing, A is a shaped piece for holding the lathe toolpost at approximate centre height.



General arrangement of the holder



Right: Details of the components



Forming the clearence hole for the tension rod.

The upright B is fixed to A with one 5/16 in. BSF hexagon socket-head cap screw. It carries the two arms C which are drawn together by the special bolt D and the knurled finger nut E. The only special points about the assembly lie in the bolt D, and the means by which the knurling wheels accomodate themselves to slight differences in centre height, for the arms to oscillate in following the movement of a component that may not be revolving concentrically, and for the bolt holes in the arms to be of such a shape that the bolt D, can hold a symmetrical pressure regardless of the angle of opening or closing for work of various diameters.

These requirements are met by making the bolt head in the form of a roller R, which can operate in a corresponding seating arm. The upper arm has a similar radial seating which takes a plain semi-cylindrical washer, drilled a nominal 1/4 in. to clear the draw bolt. Oscillation clearance is given to the draw bolt by our making the holes of a triangular shape, indicated by the broken lines T.

The components are all easily made. We can shape the fixing piece A with a slitting saw, or we can fly-cut or hand-fashion it. The material is 1 in. x 1/2 in. section bright steel. Component B, which should be made next, and polished for use as a gauge when you mill the receiving fork-ends in the arms C is of 3/4 in. x 3/8 in. section mild steel.

You can make the knurl holding arms C from nominal 3 in. lengths of 5/8 in. square section bright steel, and you can form the fork openings by mounting each on the cross slide at symmetrical lathe centre height and feeding directly on to a milling cutter, or slitting saw, if you have one of not less than 1/8 in. in thickness. I used a 3 in. x 1/8 in. thick slitting saw and repeated the cuts until the slots were of the required width. This method lessened the strain on the lathe and allowed me to adjust the widths to a nicety. The knurling wheels should pass into their slots with a minimum of side play and the slots at that end of the arms which pivot about the upright support B are best made with a modest push-fit.

Note that the forks for the knurling wheels are made slightly to one side. This brings the wheels as near as possible to the chuck side of a component and allows rather more metal for the wheel pivot pin threads. You will find that making the fork ends first will save you from being confused about the side on which you should carry out the remaining operations.

You can form the semi-cylindrical seatings with their 7/32 in. radii by clamping the arms together, and then drilling and reaming, or merely by drilling and polishing as well as you are able, if you have no reamer.

Forming the triangular shaped clearing holes for the draw bolt promised to be rather a n uisance until I thought of an idea that made the work interesting and pleasurable. I used a reamer as a sort of internal milling cutter. The work is first passed over the reamer to the reduced portion, which can be ground away by hand. Then the arm, which is mounted on the cross, or on the top-slide at symmetrical centre-height, can be given an angular bias, and be transversed over the reamer in a longitudinal direction, after the cross slide has been adjusted to give a cut of a few thousandths of an inch. By constantly increasing the angle of the component, and frequently brushing the chips from the reamer flutes, I speedily completed all six arms. I used a 1/4 in. reamer, but after I had finished the hand-blending and deburring the holes approached the 9/32 in. x 3/8 in. dimensions indicated on the drawing.

You can make the roller R, from mild steel, but hardened silver steel or EN8 carbon steel would give you a superior result. I made the semi-cylindrical washer by drilling and facing away with the component held in two jaws of a four-jaw independent chuck. The knurling wheels are held by pivot pins, hardened, threaded and lock-nutted and the arm pivot screws were especially made with thin heads and a rather difficult fit throughout, to reduce side play.

As I wanted the tools quickly and was not looking for an exercise in special skills, I bought the knurling wheels. I was in some doubt what to buy until my dealer settled the matter. He kept only coarse. medium and fine, and there was no choice as far as he knew of the degree of coarseness or fineness. I used the set with satisfaction. My wheels are 5/16 in. thick.

I have found that one way of using the knurls is to clamp them lightly over the maximum diameter of a component, to retract and give the tension nut from half to three-quarters of a turn, and then, with the component revolving, to advance again to the maximum diameter position. If the component requires a knurl greater than the knurling wheel widths, I traverse along with the saddle hand-feed. For important work I usually try the knurls on an odd piece of stock of the same diameter as the main work. In this way I can get the best tension setting and reduce the risk of the double knurling which sometimes occurs with incorrect pressure.

For knurling steel you should use a little oil. All knurling should be carried out at rather slow speeds. ●

Model Engineer <u>130</u> 734 (1964)

Bandsaw Modifications.

There must be tens of thousands of Burgess bandsaws in workshops up and down the country and they all suffer from this appalling shortcoming of design, in which the blade is not properly restrained from twisting. In my own experience, the machine is transformed by the simple modifications described. Blade life is also improved as a result.

Bandsaw Modifications

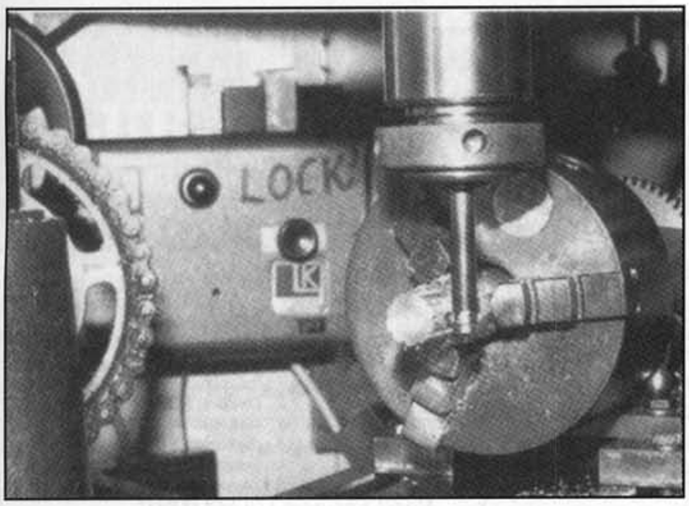
J.M. Service gives brief details of some alterations which transformed his Burgess bandshaw.

Many of us now have a small bandsaws in our workshops which take much of the chore out of what must be one of the least attractive activities encountered in our hobby. These machines offer exceptional value for money, but they are after all really designed for the wood working fraternity, who outnumber us many to one. Of necessity, the metal cutting potential is a compromise; alright for the occasional DIY metal cutting, but scarcely adequate for the sustained steel working which is our wont. The modifications described were made to a Burgess BK.3, but are probably adaptable to other makes.

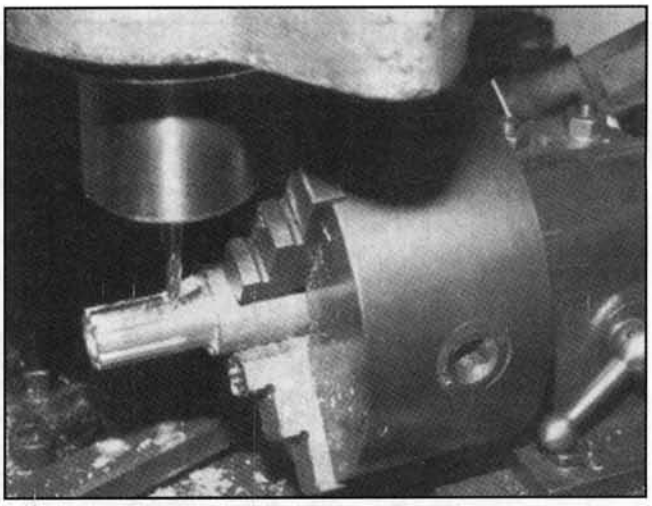
I felt that the blade speed on my machine was too fast, but in the absence of any information, I had to find my own way. I estimate the blade speed on the Burgess running on slow speed is 336 ft. per min. which is good enough for non ferrous, but on the fast side for mild steel. My 'bible' says that the cutting speed for 1/4 to 1 in. MS should be 250 - 200 ft per min.; the new drive pulley gives a blade speed of 240 ft. per min., a reduction of about 28%. Cutting quality and blade life are improved, when the machine is used on mild steel or cast iron.

First of all, a form tool is prepared as shown in **photo 1**; this is comparatively simple to make using the driven pulley as a template, I found that on my machine. the teeth on this pulley were better defined than those on the driver. My cutter was made from 1/8 in. square HSS, but round HSS or even silver steel should do. A piece of light alloy was held in the 3 jaw and turned to 5/8 in. length, drilled and reamed 3/8 in.; then transferred to the dividing head for cutting teeth. The photograph shows a Geo. Thomas dividing head, but as there are only 10 divisions, any simple dividing device will suffice.

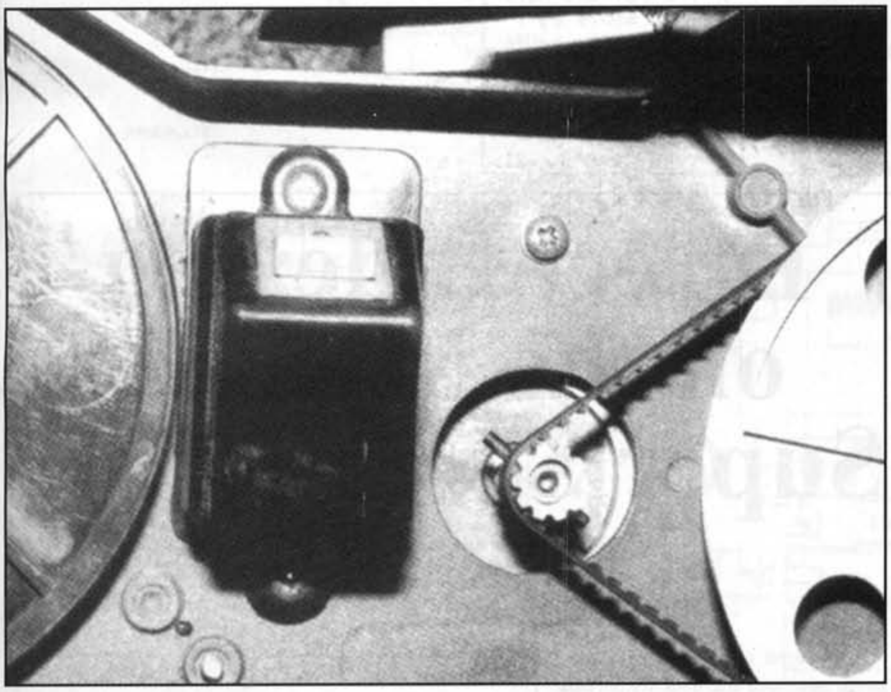
The teeth we were cut in three passes, the tool being re-sharpened before the final cut. The drive belt was used to check that depth of cut was correct, in my case 0.056 inch. A 5/32 in. hole was drilled through the centre of the pulley 7/8 in. from the end; the whole was then turned through approximately 20 degrees, realigned and the slot cut with an end mill as shown in the photograph. The pulley was turned through 180 deg. for cutting the opposite slot. The work was then returned to the lathe and parted off at 1 1/8 in. length. All the sharp edges were rounded off with a small file, and the pulley was ready for use. I



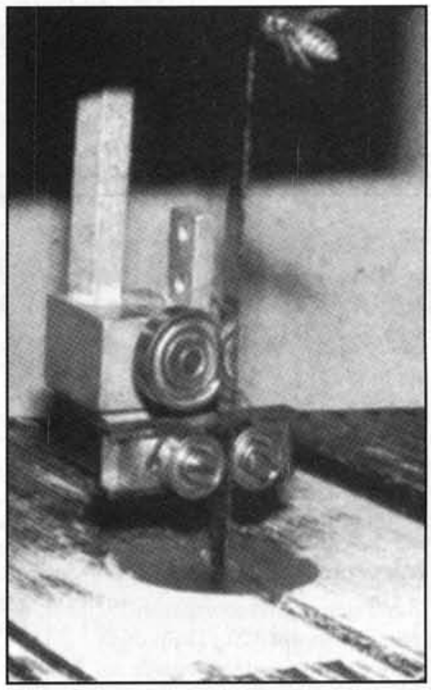
1:Cutting teeth on the toothed belt pulley using the form tool.



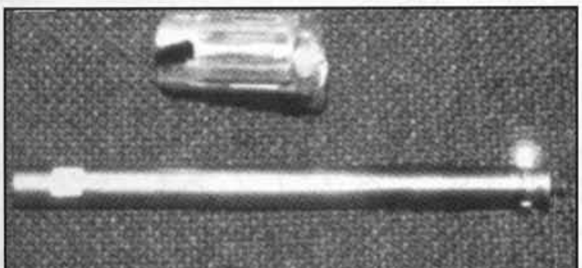
2: Cutting the slots in the pulley using a 5/32 in. end mill with the holding head set at approximately 20 degrees.



3: The completed pulley fitted on the machine.



5: The blade guide in position on the machine - the wasp serves no useful purpose.

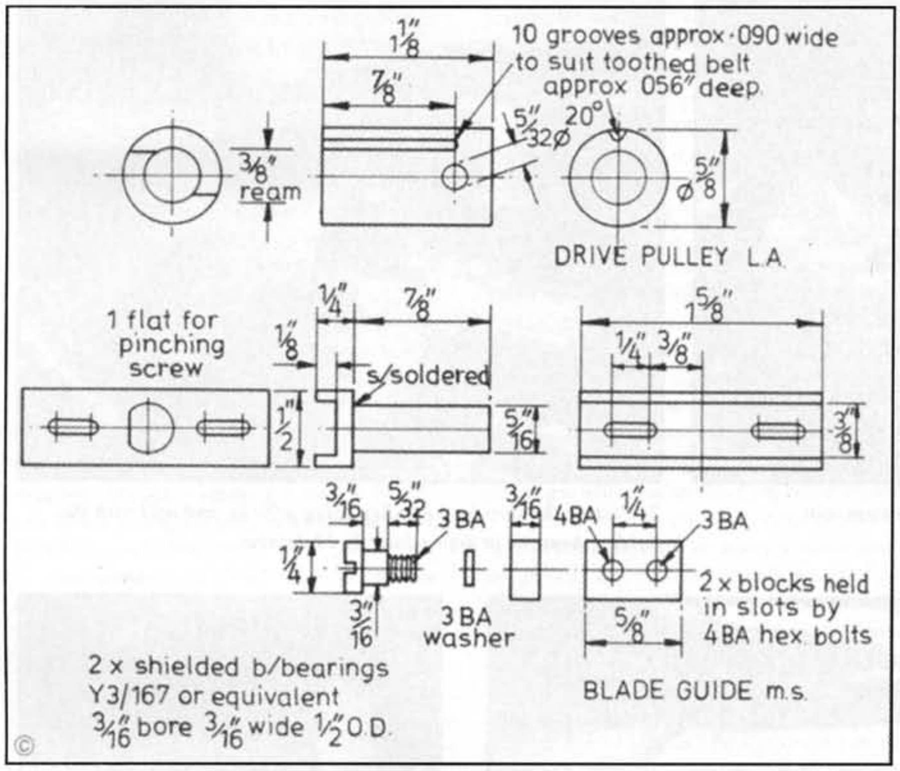


4: This shows the new pulley, form cutter and component parts of the blade guide.

suppose tufnol or plastic as on the original could be used, rather than light allloy, but this is up to the individual constructor.

Blade guides

Soon after acquiring the machine, I had to cut some 2 in. dia. discs in 1/4 in. mild steel, and this it did reasonable well, but it then developed a distinct preference for curves rather than straight lines. The trouble was the blade guides which were very basic consisting of two steel dowels rubbing against the sides of the blade. These were at first replaced by steel blocks which gave some improvement, but the same symptoms eventually re-appeared, and ball bearing guides were then devised. You will find that this makes a marked improvement to the accuracy of cutting; you can cut circles to your heart's content and the machine will docilely go back to the straight and narrow as and when required. The drawing and photographs are almost self-explanatory, a 3/8 in. x 1/8 in. groove is milled in a 1/2 in. x 1/4 in. x 1 5/8 in. MS flat with two 1/8 in. x 3/8 in. slots as shown. The 5/16 in. x 7/8 in. shaft which is silver soldered at the centre of the bar, fits into the existing guide carrying bracket. Two 3/16 x 3/8



x ⅝ in. blocks carry the *shielded* ball bearings and are held in the slot by two 4 BA hex bolts. To use, the two 4 BA bolts are slackened off, the blade inserted in the machine and adjusted to normal tension, the ball bearings are set to hold the blade just behind the teeth, then pulled together by thumb and forefinger onto the blade and locked in position with the 4BA screws.

A final thought

Readers will note in the photograph that the plastic disc which fits into the table at the blade position has been replaced by a mild steel plate slotted just over blade thickness. This is a minor modification but is recommended especially when cutting small items. ●

Model Engineer 170 548 (1993)

Direct Dividing Attachment.

Many of the "Great" contributors over the years have described dividing attachments working off the lathe mandrel; we have seen detents various, changewheels fixed to the tail of the mandrel and division plates applied to worm gears. But let's face it, most of the divisions required for model engineering purposes, apart from clock construction, are encompassed by the prime factors of 120. The present device has the inate advantage not generally shared by other submissions that it can be left in place in the lathe headstock, ready for immediate use.

Direct Indexing on the Myford Super Seven Lathe

By C. W. Rose

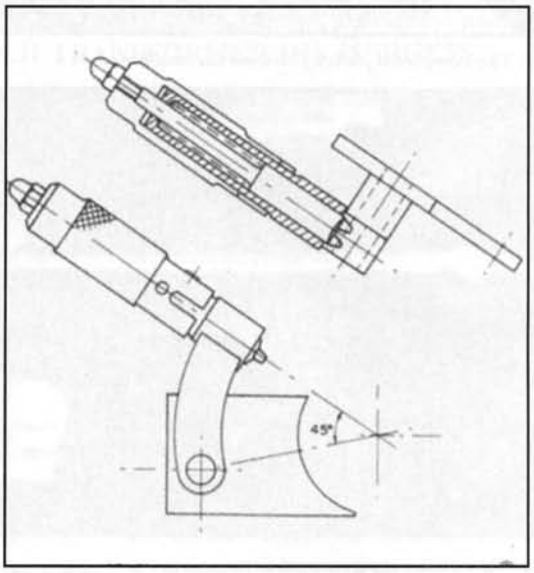
Part I

Since George Thomes published his book on dividing and graduating, many readers may feel that there is no need for tyet another article on a headstock dividing attachment. As it happened, I had designed and made my fitting along time before George Thomas' book appeared and when Prof. Chaddock saw it in place on my lathe he persuaded me to write it up for *Model Engineer*. The drawings and text were completed, then I saw the review of *Dividing and Graduating* which mentioned "three headstock attachments". Naturally I wondered if perhaps one of these might be similar to my idea, but this proved not to be the case.

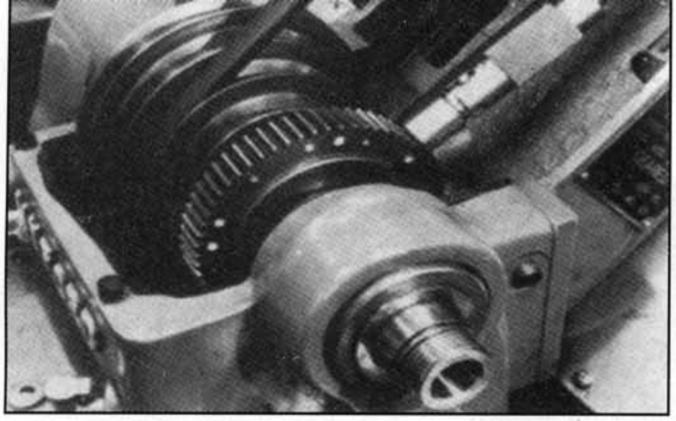
In his recent series of articles George Thomas mentioned that, if his Myford taper turning slide were not a permanent fixture on his lathe, it would never be used. One of the features of my design i sthat it is not really an attachment but becomes part of the lathe, being fixed inside the headstock out of sight but instantly available when required. It can, of course, be easily removed to allow use of the more versatile Radford dividing head, for work such as graduating index collars, but routine division is simpler and quicker by direct indexing.

With the refinement of half spacing on the 60 tooth bull wheel, the following divisions are available: 2.3.4.5.6.8.10.12.15.20.24.30.40.60.120

Another point in its favour is that, unlike some designs, no holes have to be drilled in the headstock – fixing is by a single ⅜ in. BSF cap screw using the



General arrangement fig. 1



Permanently in position inside the headstock – always ready for use. (Photograph by Mr. S. E. Smith).

existing hole thoughtfully provided by Myford for the industrial collet attachment. The single screw is quite adequate since the baseplate is wedged against the bronze spindle bearing and the countershaft casting.

Determination of the space available when the guard was closed was a problem, solved after a little headscratching by shaping another block of wood to fit over the bull wheel and up to the back of the headstock. The sloping front was cut back until the guard would close. Preferably the slope of the plunger housing would have been parallel with the guard, but the plunger must be radial to the gear, so it had to lean back to allow clearance.

To avoid counting individual teeth, with risk of errors, each fifth tooth is marked with a dab of paint in a drilled dimple in the side of the gear. For simplicity of operation these are colour coded, red for four divisions and yellow for six (or three). Obviously two opposite dimples are common to both, so these become orange. The half-tooth refinement was added when I had need of eight spaces, hence the intermediate dimples at 7½ teeth, coded white. To index for these, the sleeve is turned 90 deg. or 180 deg. according to the design of detent – the slots on

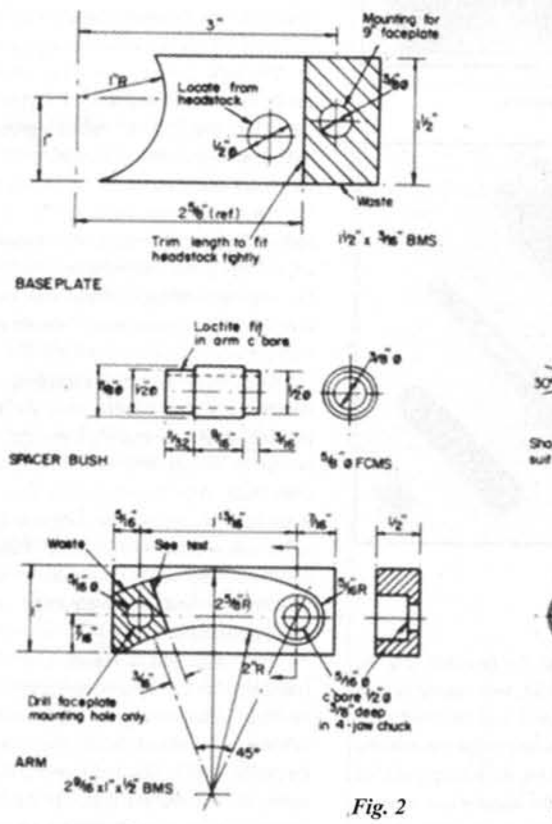


Fig. 2

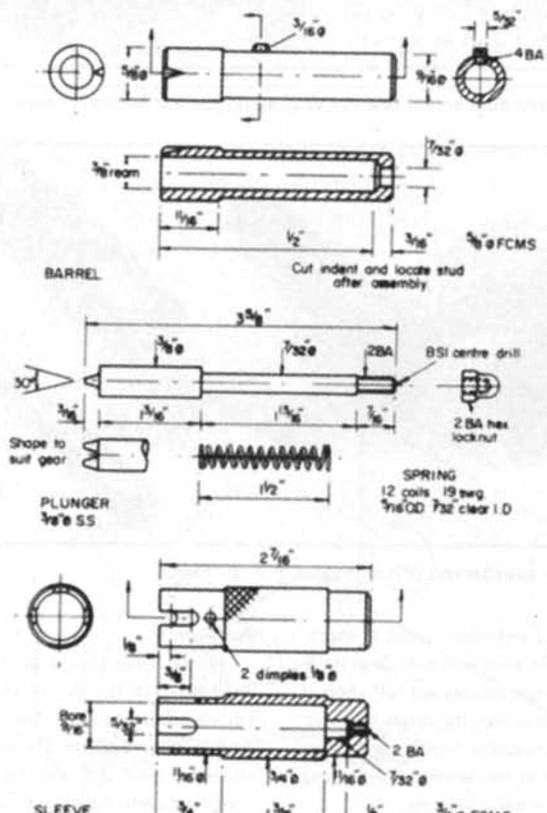


Fig. 3

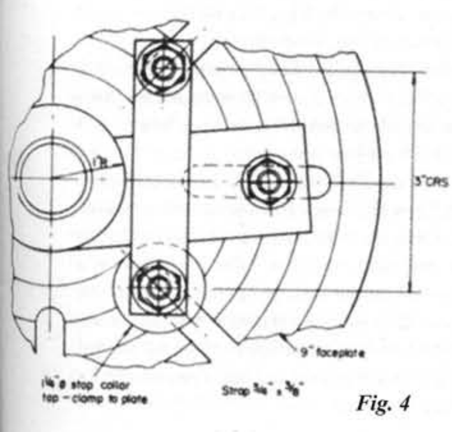


Fig. 4

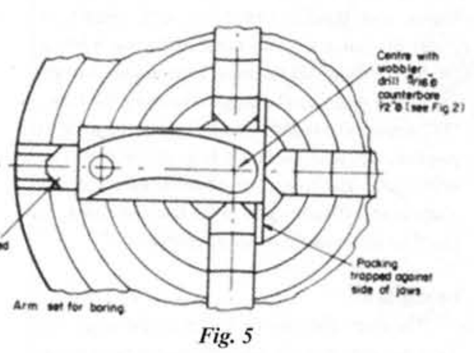
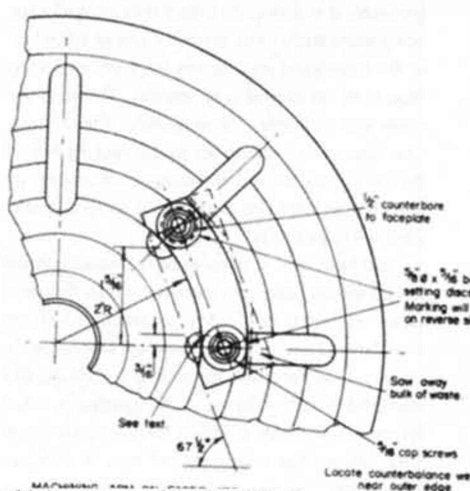
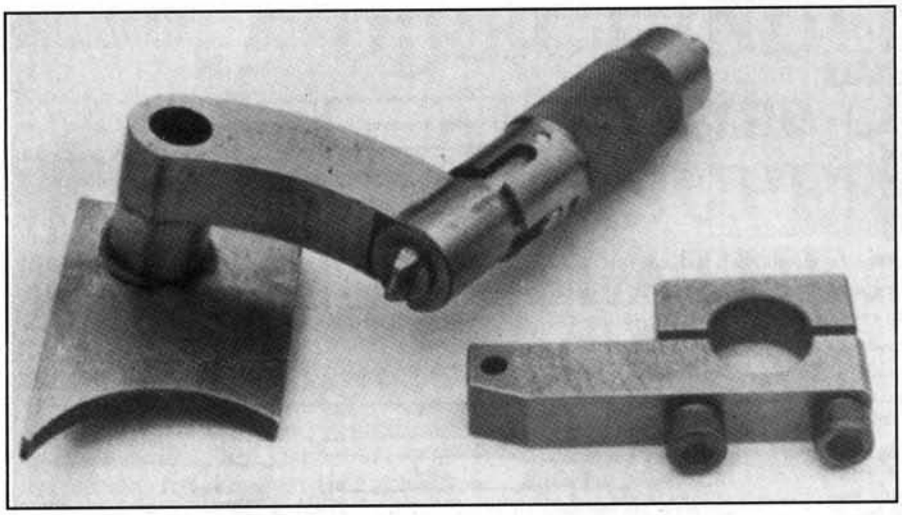


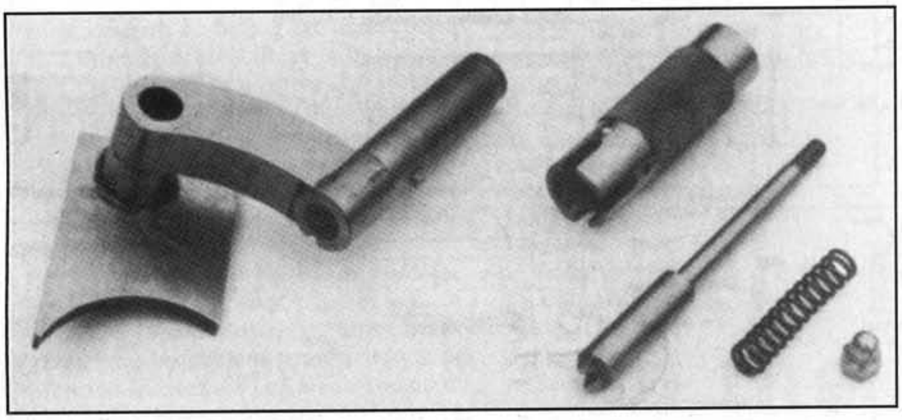
Fig. 5



Machining arm on faceplate Fig. 6



Above: The completed attachment and the drilling jig for the bullwheel dimples.



Components of the attachment. (Photographs by S. E. Smith.

the sleeve are dimpled and colour coded to match. This is well worth while since with only about 1/16 in. clearance between plunger housing and bull wheel, it is not easy to see which way the detent is facing. However, the small projection, together with close fitting of the plunger in the housing and a strong spring, make for very positive indexing.

The project is interesting as it involves a variety of techniques, including setting up two components on the faceplate. The 9 in. dia. Myford plate is preferable if available, the longer slots are useful but, being much thicker and heavier, it acts as a flywheel on the intermittent cuts. Setting rings are helpful, my large plate has rings at ½ in. spacing. The small one came with the Super 7 more recently, with no rings. One final point – remember to use packing behind the job to avoid the sort of damage I saw recently on a small plate belonging to an ML7 in an auction sale. That had rings alright!

Old hands will need no working instructions and indeed will probably vary the design to suit their own ideas. However, to give less experienced brethren confidence, I have included drawings showing parts set up on the faceplate, in the four-jaw chuck, and ready for silver soldering. This process is often referred to as 'brazing' but to me that means brass wire, brazing flux and bright red heat, resulting in bad scaling.

Baseplate

Before setting this up on the faceplate (Fig. 4) make the 1¼ in. dia. stop collar, with tapped hole to suit your clamping screw which will be fitted from the back of the faceplate. The stop collar can hold the packing in place. For checking the setting a scriber clamped at centre height in the toolpost can be set at the required radius from the 2 in. ring on the faceplate. After machining, the curve should be checked with a gauge – cob end of 2 in. dia. bar or a turned disc. Trim the square end of the baseplate until it will wedge tightly into place behind the bearing in the headstock. Coat with marking blue, clamp, spot through Letter "O" drill (8mm), or preferably with a specially made centre punch fitting the hole. Mark with the usual crossed lines by eye. Drilling in stages can be checked by using the Letter "O" again and passing it through with the plate in position, repeating the test at ⅜ in. dia. with a ⅜ in. BSF screw. The hole would be better bored, but the shape is so difficult to grip in the four-jaw chuck. It could be set up on the small faceplate.

Spacer Bush

The short spigot fits the baseplate, the longer one must not bottom in the counterbore, yet to be made, in the arm. Allowance for Loctite can be made in the counterbore.

Arm

Only the 5/16 in. clamping hole should be drilled after marking out, and the rectangular shape is retained for setting by wobbler in the other centre in the four-jaw, as shown in Fig. 5. To ensure that the job is parallel to the face of the chuck and not likely to move under drilling pressure, it is worth making up a stepped packing piece from ⅛ in. strip as indicated in Fig. 11. The tenon goes into the bore of the chuck, avoiding risk of being thrown out when running. My original Pratt four-jaw, like Tubal Cain's, has four steps but, as he remarked, the later Burnerd has only three. Although the hole will be ⅜ in. on the final assembley, drill only 5/16 in. at this stage to suit the cap screws used for mounting on the faceplate. This is important since the screws locate the job under the setting collars. Remember to allow about 4 thou total clearance for Loctite on the bush spigot diameter.

The bulk can be sawn away, leaving the ends square to provide a witness for angular setting sfter the 2 in. and 2⅞ in. radius curves have been machined. ⅝ in. collars or washers, 5/16 in. bore, will be needed under the cap screw heads for setting on the faceplate, lining up a scriber in the toolpost against the 4 in. dia. ring on the faceplate. The inner edge of the collars should line up with this radius – the original marking out will now be towards the faceplate. The counterbalance weight will need to be well out near the edge to clear the tool.

After machining the curved shape, turn the mandrel in low backgear until the job is in the position shown in Fig. 6, checking with a bevel protractor, or one from a combination set, on the cross slide. Alternatively, a simple tinplate template in the form of an isosceles triangle with 45 deg. apex angle will provide 67½ degrees. Carefully remove the lower screw and setting collar to enable the line marking the finished length to be scribed, 3/16 in. above centre height.

The 5/16 in. radius curved end is best left for finishing after Loctiting to the spacer bush if it is to be filed. After sawing the angled end slightly full, this can be machined to form the hollow seating for the barrel with boring head, boring bar in four-jaw chuck, or ⅝ in. dia. end mill. For this the arm can be clamped flat at centre height on the topslide, which will be more rigid than a vice on vertical slide set-up.

Barrel

This is best bored after drilling, leaving a few thou for reaming after silver soldering to the arm. To reduce scaling the bore can be plugged. Leave the hole for the indexing stud and the indent until later, their position is important. A suggested set-up for silver soldering is shown in Fig. 8 This will allow the barrel and its seating to be horizontal. Sandwich flux and silver solder foil in the joint and get your wife to press down on the vital spot whilst you apply the heat. It will be as well to provide her with a length of rod to use rather than her finger. Clean up, fit the index stud after spotfacing the seating and make the indent. This is provided as a 'window' to see the tooth being indexed. With the alternative offset detent it will need to be slightly wider. Check the bore with the selected rod for the plunger, use a hand reamer to clean and true if necessary, but a close fit is vital here.

Assembly of Frame

After opening up the 5/16 in. hole in the arm to 3/8 in. dia., it chould be possible to have a mock-up of the frame in position with a 2 in. long 3/8 in. BSF cap screw. (By shortening this screw to 1 7/8 in. the outer half of the long tapped hole in the headstock can be left available for the other attachments.) It was necessary to clean out the hole in the headstock with a plug tap passing right through before the screw could be started from inside. If all is well the parts can be stripped down for silver soldering the spacer bush to the baseplate.

After cleaning up, the arm can be Loctited in position on the lathe and clamped with the cap screw, setting the clearance between arm and bullwheel even all round. Obviously care is needed here to avoid fixing the cap screw permanently!

Plunger

The spade detent is the critical part, it will be as well to allow a little surplus length. It can be milled or filed, depending on workshop facilities. For milling you need a 16 DP No. 1 gear cutter, as the tooth to be cut is of rack profile. I have a 16 DP No. 2 which would have served but the mill was not running, so my forked detent was filed. However, if making another I would make the offset detent.

Tubal Cain gives Circular Pitch of 16 DP as 0.1963 in. in his ***Model Engineer's Handbook.*** The offset will be a quarter of this, 0.0491 in. to give half tooth spacing when turned 180 degrees. The location slots in the sleeve will be 180° deg. apart to corresponed with the short parking slot midway. However the detent is cut, like a "V" belt it must not "bottom".

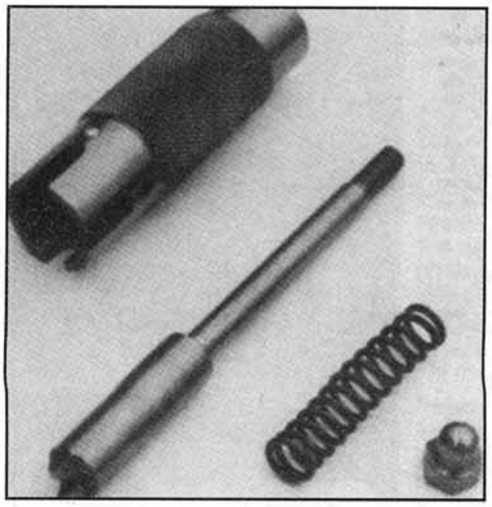
In the forked pattern which I made, both "normal" spade detent and the cross slot are central. With the 3/8 in. rod set true in 4-jaw chuck, using a dial test indicator, face the end leaving a 50 thou "pip" in the centre as a guide. (Fig. 9) This will help in keeping the spade end central and the right thickness. It will have to be filed away eventually. The shape can be checked against a 16 DP gear – preferably a spare one about the same size. I had to do mine referring to the gear on the lathe. Filing the central slot and outer sides is a matter for a good eye – if it is not central you will find out in due course and adjust accordingly or try again.

I have not made the offset detent, but I think it is preferable. I suggest marking out the end of the blued rod, after facing (no pip), with the scribing tool in a vice on the rigid vertical slide as before (see Fig. 10). This will be set to a true centre in the headstock after temporarily removing the chuck complete with job. Make sure that the movement of the slide is upwards to take up backlash. When dead on centre, change back to chuck, move the slide up a further 25 thou, scribe a line by moving cross slide, repeat 50 thou higher. According to my reckoning that should leave the detent tip 50 thou thick, offset 50 thou. File the profile up to these marks and try it!

Before you can do that, though, the shank of the plunger must be reduced for about 2 in. length to 7/32 in. to enable it to enter the barrel from below. The frame can now be screwed back into its place on the lathe and the accuracy of the detent checked. Put your favourite 9 in. dia. faceplate back on the spindle – if you only have the small one turn a large disc and rig the scriber in the toolpost again.

Mark temporary pencil lines on the side of the bullwheel (where the dimples will be) for the quarter divisions, opposite a space in each case. Use the detent with finger pressure (from wife) at each of these in turn, making a fine squared pencil line on the edge of the faceplate dead opposite the scriber.

Repeat with the intermediate divisions, using the detent turned to the other position, mark again on the edge of faceplate. With dividers check to see if the intermediate mark is midway, and the best of luck. If this passed by Inspector Meticulous, you



The components of the plunger. (Photograph by S. E. Smith.

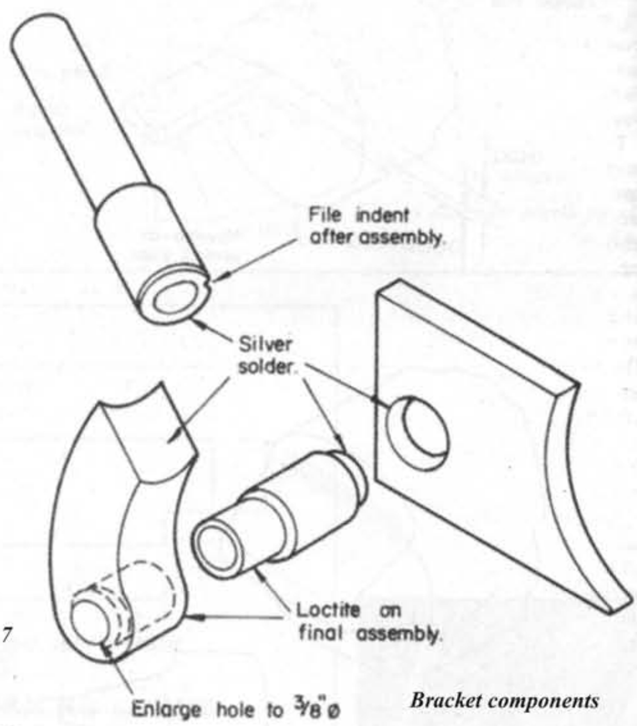
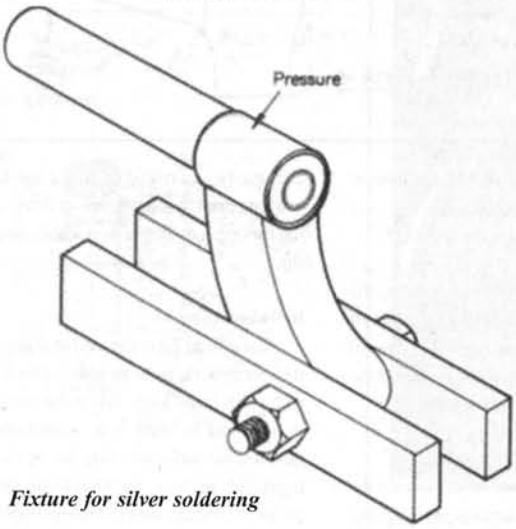


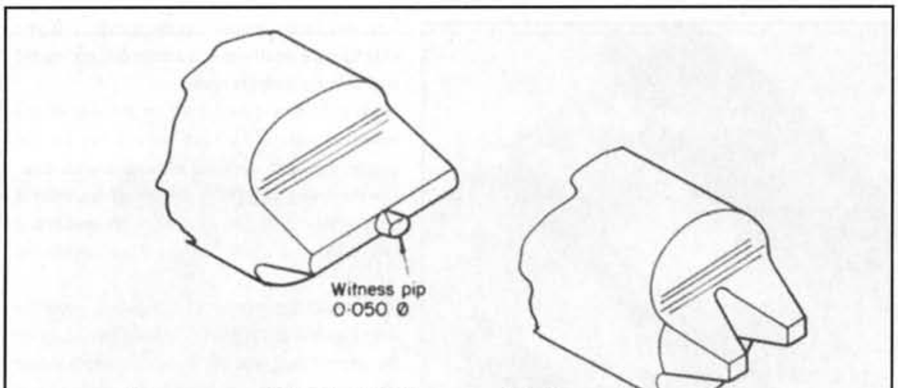
fig. 7

Bracket components

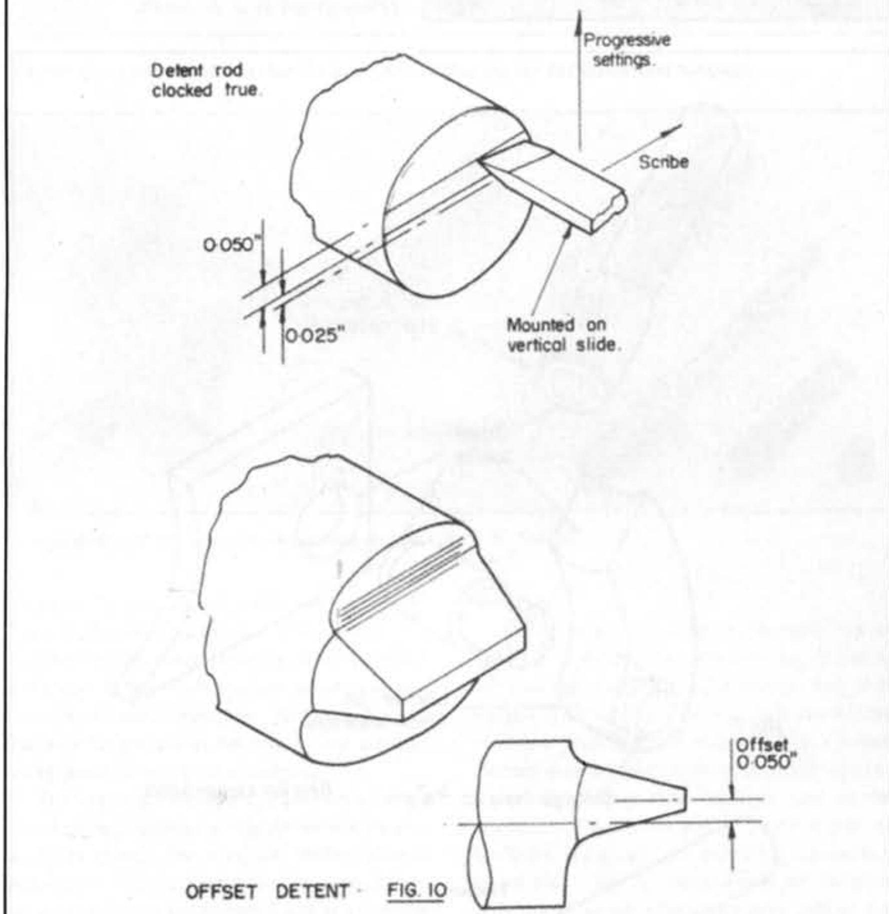


Fixture for silver soldering

fig. 8



FORKED DETENT FIG. 9



OFFSET DETENT - FIG. 10

will know that spacing 8, 24, 40 or 120 divisions at smaller pitch diameters will be spot on.

Detent Spring

Perhaps the first thing to "find" before starting the project – I happened to have one in stock. As tested on the kitchen scales it needs a pressure of 5 lbs. to compress it ¼ in., about the travel of the plunger in the finished job. It must slide easily in the barrel.

Plunger Location Sleeve

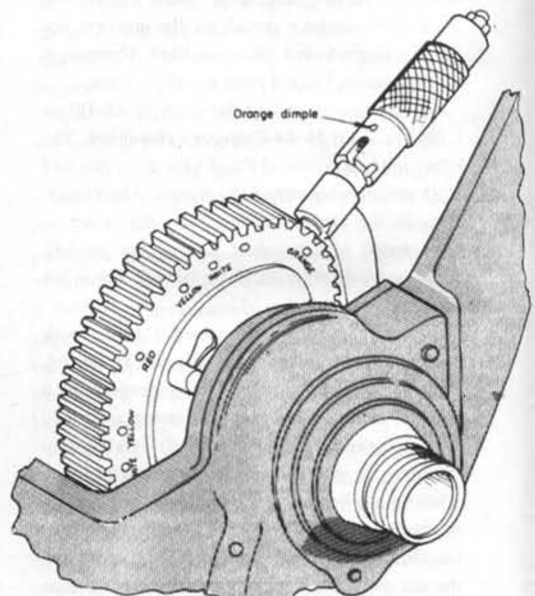
This bears a close resemblance to the one on the Myford dividing head. A clean knurl is essential and the hole is best bored at the same setting. The indexing slots can be slot-milled or drilled and filed. There are two long ones to suit the type of detent and a short one for parking. A dimple is needed opposite each long slot.

Bullwheel Dimples

The drilling jig is intended to clamp on the shank of the spacer bush, so to provide a grip it must be bored with paper in the joint. When clamped in position a ⅜₂ in. drill can be used in a wheelbrace to make the dimples, but make sure they are in the right place! I happened to have patternmaking red and yellow available. Mixing dabs of these provided the orange for common marks, and the sleeve dimple for the "normal" setting. Yellow for the remaining four marks for six spaces and white for the four split tooth intermediate marks, and the other dimple on the sleeve. Four dimples are left unpainted, they will provide twelve spaces when required, and using the split tooth division 24 spaces come form 2½ teeth, 40 from 1½.

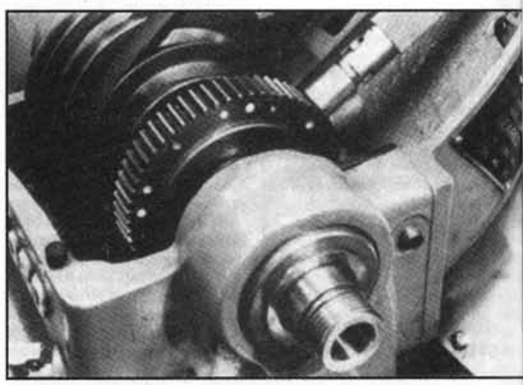
This indexing device has proved to be well worth making. As it stands it can be used for accurate marking out but a drilling spindle for the cross slide becomes an urgent necessity. ●

Model Engineer 153 518 (1984)



DIRECT INDEXING FIXTURE FOR MYFORD SUPER 7 LATHE

The direct indexing fixture in place.



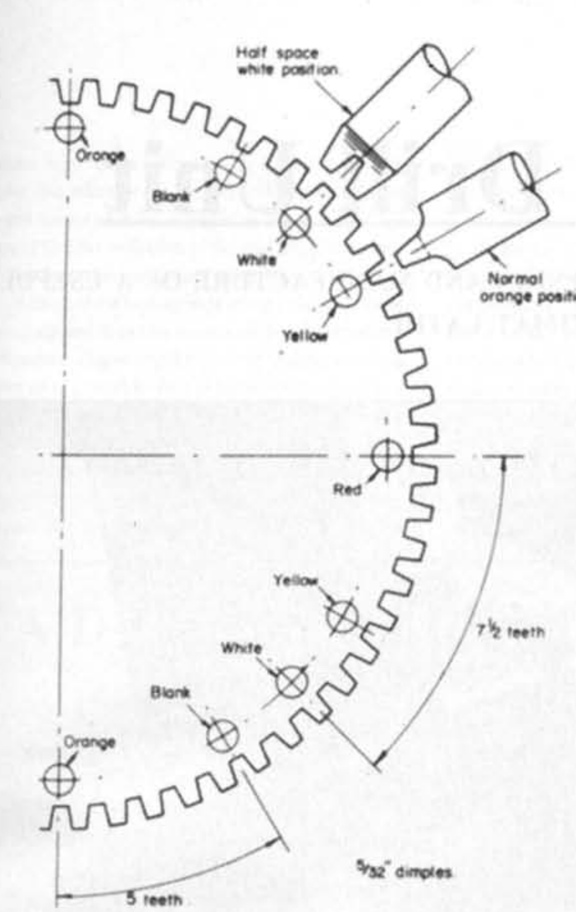


Fig. 12 Bull gear marks for forked detent.

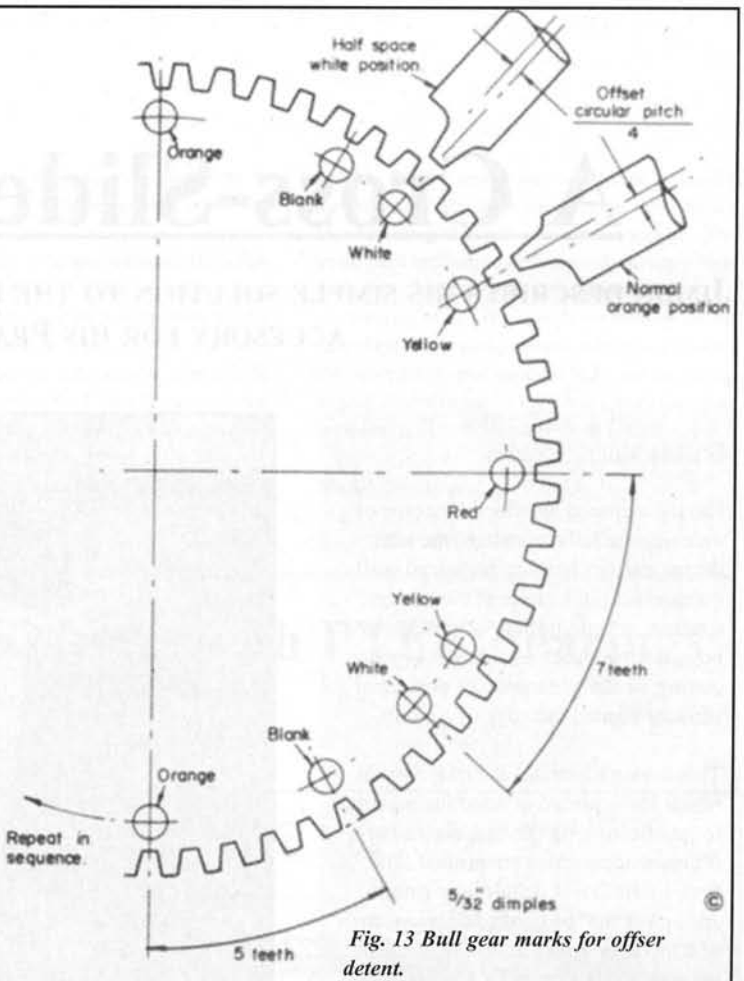


Fig. 13 Bull gear marks for offser detent.

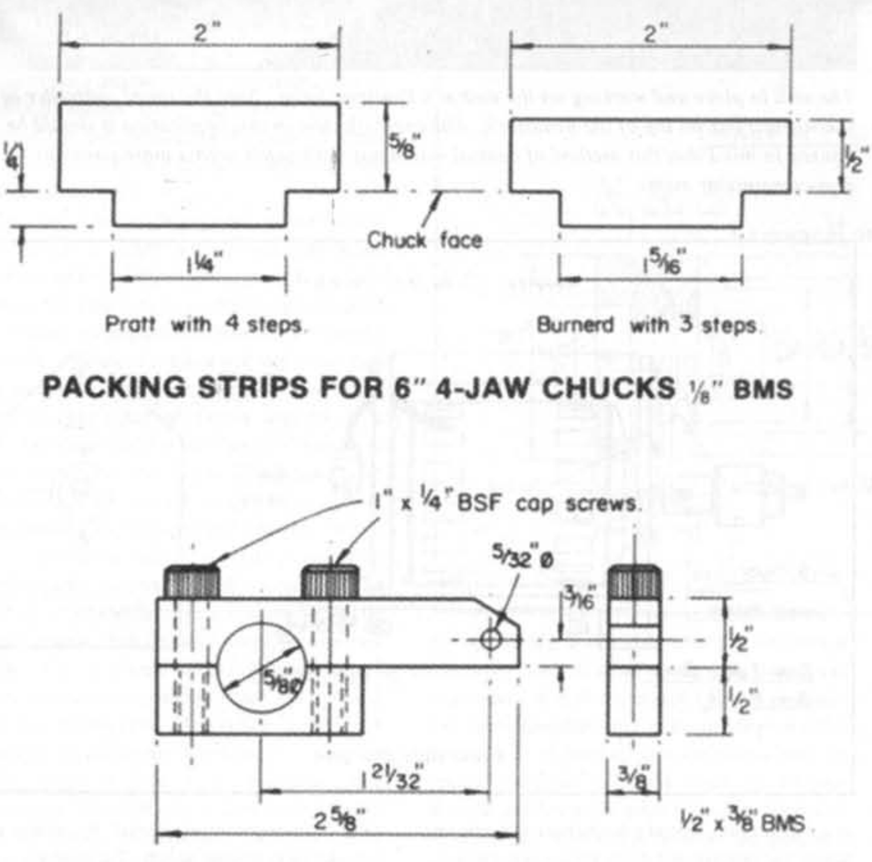
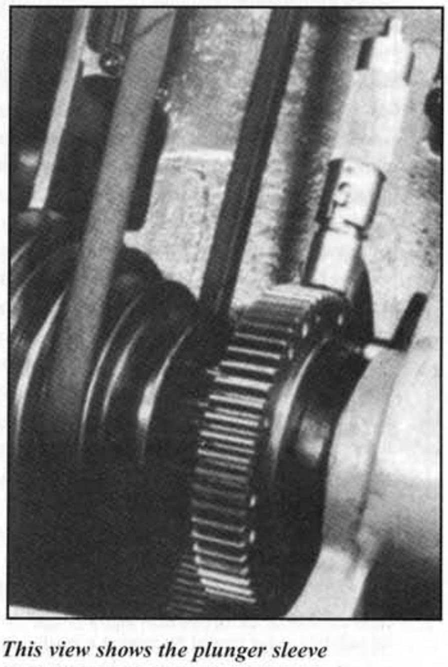


Fig. 11 Drilling jig for bull wheel dimples.



This view shows the plunger sleeve located over the indexing pin

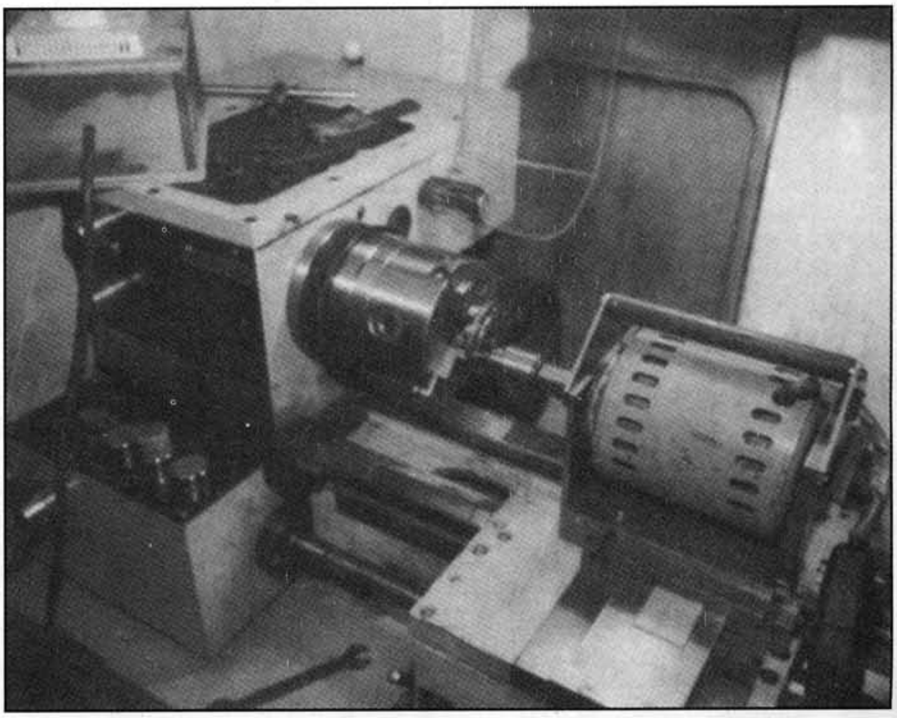
A Cross-Slide Drill Unit

JIMBO DESCRIBES HIS SIMPLE SOLUTION TO THE DESIGN AND MANUFACTURE OF A USEFUL ACCESORY FOR HIS PRAZIMAT LATHE.

Drilling/Milling Spindle.

Having acquired an effective means of indexing the lathe mandrel. the next device enables holes to be placed easily on an exact pitch circle at the correct spacing, or light milling operations to be performed, such as external keyway cutting, or the generation of polygonal surfaces around the edge of a circle.

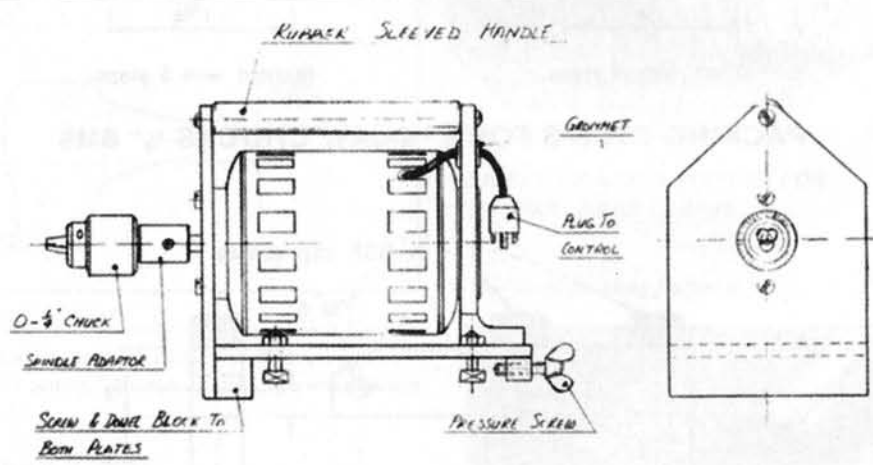
This device illustrates the quandary in which I was placed in selecting material for publication; in the end, two rather different accessories are printed: the first, by Jimbo, is delightfully simple and speed can be controlled by means of a thyristor speed controller, such as the type of kit offered by Maplin Electronics nationally; but it is limited to drilling operations. On the other hand, Beck's device is much more sophisticated but since it originally ran to some 33 pages, it has had to be edited, with only the drawings and a few of the photographs reproduced. The serious constructor is referred to Model Engineer for February to October 1983 for nine monthly instalments!



The unit in place and working on the author's Prazimat lathe. Note the speed controller in the wooden box on top of the headstock. Although effective in this application it should be bourne in mind that this method of conrtol would not work safely with a more powerful or non-commutator motor.

My plan for a cross-slide drill started life as a complex design to be mounted in place of the toolpost on the compound slide of my lathe to provide the facility of drilling at angles other than parallel to the lathe axis. A general lack of centre height with this idea seemed to require the use of a non-rotating shaft with the drill chuck fixed to a rotating body which also carried a pulley driven from a separate motor. Before starting to cut metal I checked to determine how many jobs had, in the past, actually needed this angle drilling facility - and found that there had been none. So my original idea was scrapped and a simpler design evolved which, mounted on the cross-slide, proved to be much simpler. My calculations showed that a motor in the region of 80 - 100 W would provide sufficient power for the small centre drills and twist drills up to 3/16 in. dia. for which I intended to use the attachment.

Subsequent enquiries produced a motor from a fellow club member (note well, you lone hands) and its suitability was proved by turning a small adaptor to hold a 3/16 in. drill onto the motor shaft. Careful use as a portable drill showed a happy marriage between theory and practice and detail design was taken in hand.



Cross slide drill unit

The successful candidate is a Gestetner 1/10 HP (80W) 2850 RPM, capacitor start and run motor for which I arranged speed control by means of a domestic lamp dimmer switch. The mechanical unit has a short flexible cable ending in a three pin plug. The capacitor and speed control device are fitted into a wooden box with a 3 ft. lead and socket for the drill.

Mains input to this control box is via a 6 ft. flexible cable and mains plug. An ON/OFF switch and the speed control knob are mounted on the outside of the box. I find the separation of the drill and control unit makes for easier storage and mounting.

I checked the leading edge of my cross slide from the chuck and found its squareness beyond reproach. I therefore aligned my drill unit by pulling the base plate up to a shoulder on this leading edge which is a practice I follow with all my slide mounted accesories. A thumbscrew on the trailing edge provides ample clamping pressure. Since my tee bolt heads are oblong and not square and the bolt diameters are greater than the slot width (necessitating flats), I facilitate their alignement by means of a saw cut across the tee bolt end in line with the tee slot.

Since my motor is spigot mounted, to ensure alignment the holes in the end plates were bored from the headstock. A handle at the top improves rigidity and a rubber grommet is fitted into the rear plate through which passes the flexible cable. The spindle carries an adaptor with a No. 1 Jacobs taper to mount the ¼ in. drill chuck. Anyone using a foot mounted motor will require packing to raise the spindle axis to centre height. The spindle-to-lathe axis concentricity is checked by clocking with a DTI held in the lathe chuck and rotating the lathe spindle, *not* the motor spindle. Parallelism can then be checked by leaving the indicator in the chuck and clocking along the top and then along the front of the motor spindle. The motor must be clamped endways and sideways; bolts in clearance holes are just not good enough.

Indexing of the lathe spindle for dividing can be carried out by any of the methods which have been so ably described in past issues of M.E. and the setting of pitch circles by use of my Cross Centre Gauge as published in M.E. 5 March 1993. ●

Model Engineer 170 727 (1993)

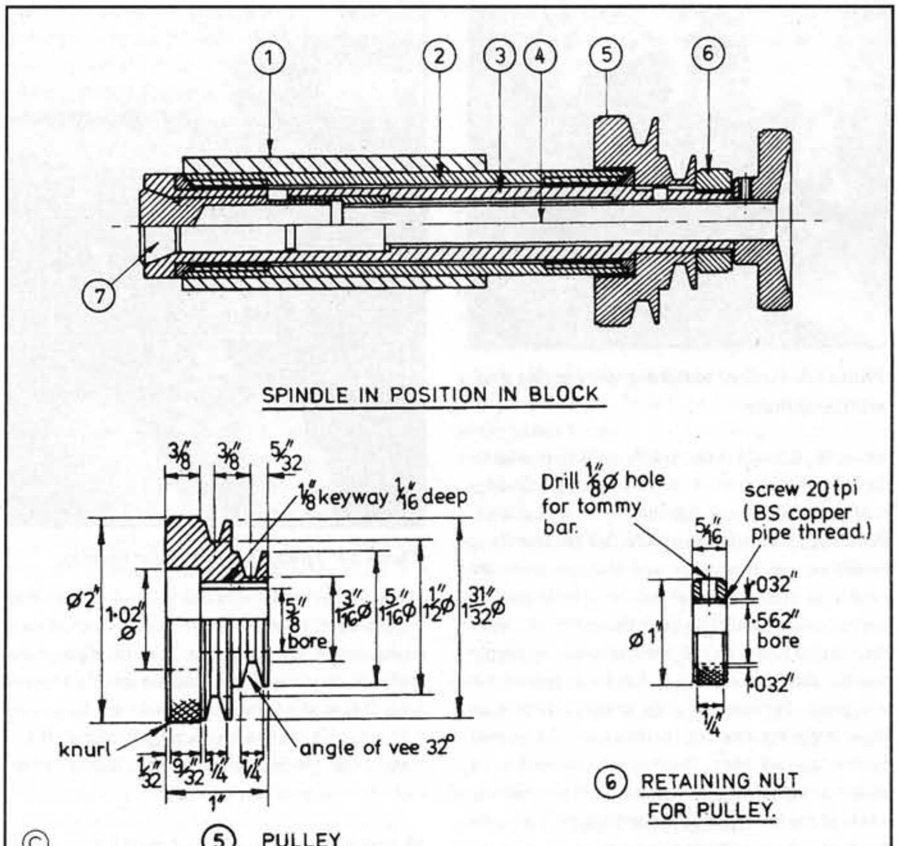
A Drilling and Milling Spindle with PTFE Bearings

BY D. BECK

The Drive

From articles that appear in this journal I get the impression that many an amateur's machine tools are overpowered. Such excess is not confined to amateurs. I remember one works in which, when I joined it, screw conveyors were driven at 3 r.p.m. by five horse-power motors. Work out the torque that that implies! When a conveyor jammed the spiral ribbon was wrapped round the shaft. So ⅛ in. shearing pins were fitted in the couplings of the final drive. These would transmit a torque equivalent to about a tenth of a horse-power at most; but no-one thought of using smaller motors. New conveyors still got 5 h.p. motors and 5 h.p. worm reducers. Eventually I got permission for one of these combinations, which to everyone's surprise, did the job perfectly for years.

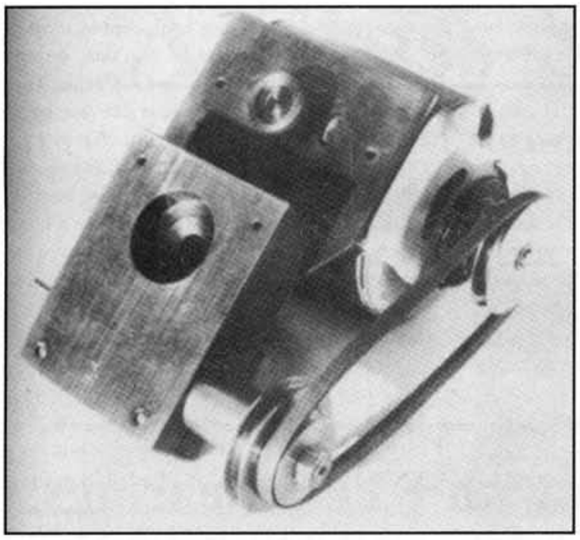
The motor in the photographs of the milling attachment is a 1/20th horse-power, split-phase, induction motor running at 1,440 r.p.m. It is a little too small for some jobs at the higher spindle speed (2,800 r.p.m.) but perfectly adequate on the lower one (720 r.p.m.). It's merit is that it will stall rather than break an endmill. It will not, of course, drive a large circular milling cutter or slitting saw nor is it intended to do so, but it is quite powerful enough to drive 1¾ in. or 2 in. dia. cutters. There is no point whatsoever in using a motor of more than a tenth of a horse-power – larger motors get in the way. If you need extra power for some unusual job you can rig up an electric drill. An overhead drive would have the advantage of providing more power and a greater range of speeds. But I think I would find the belt irksome. But, as a matter of fact, if you use larger pulleys to reduce the speed this motor will drive a 2 1/2 in. dia. milling cutter. The pulley can substitue for the existing pair or slip over them.



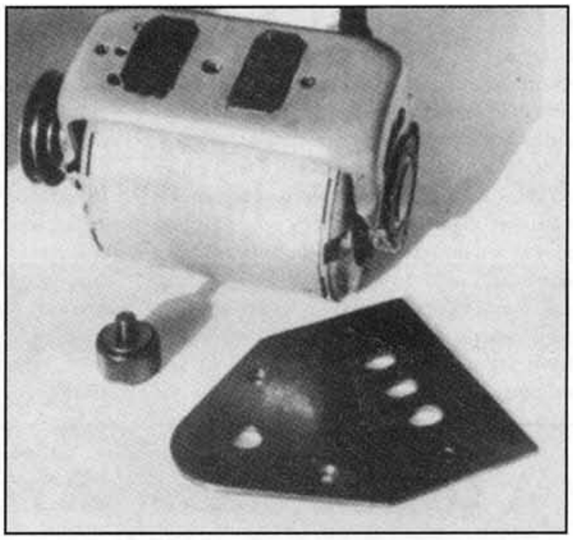
The motor is held to its mounting plate (photographs 49 and 50) by a single 5/16 in. BSF screw with a large knurled head. There is a captive nut, made form a piece of ½ in. by 3/16 in. m.s. attached to the inside of the resilient mounting of the motor. Two pads of thin Neoprene sheet, one on each side of the hole provide all the friction needed to take the pull of the belt. They also provide enough resilience to lock the screw so effectively that I found it necessary to drill tommy-bar holes in the head. The three elongated holes in the motor plate allow the motor to be lined up with the pulleys with the spindle projecting from the block by different amounts and, being elongated, they allow the belt to be tensioned. (The other holes in the plate and resilient mounting (photograph 49) are mistakes. I thought register pins would be needed to prevent the motor rotating about the central screw.) Because of this very simple fixing the motor can be put on, taken off or turned end-for-end in matter of seconds – which is convenient in that, when setting up to drill or mill a job at some awkard angle, the block can be positioned before the motor is mounted. The belt is the smallest standard V-section: a round rubber belt would do equally well and might allow the pulleys to be reduced in diameter.

The Device in use

The block, which is free to rotate around the bolt on the topslide, can be clamped in any position and the spindle cn be put in either way round. When



Left: Photo 49 Underside of block with motor mounted on it.



Right: Photo 30. Motor plate and underside of motor base with neoprene friction pads.

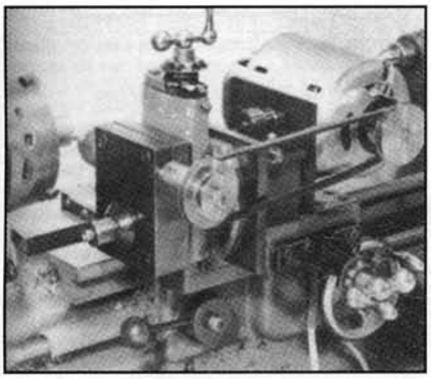


Photo 53: Vertical mounting for topside and milling spindle.

setting up, the axis of the spindle must be parallel to the axis of whatever of the three possible feeds – saddle, cross-slide or top-slide – is to be used. Because of care taken to ensure that the spindle is parallel to the front edge and that the sides are exactly at right angles to it, the spindle can be aligned either parallel to the lathe centre line or at right angles to it with sufficient accuracy by simply pushing the front or side of the block against the workpiece. For example, if the spindle is to be used transversely the front of the block can be pushed against the face plate, the front of the chuck – or against a parallel held in contact with it; alternatively a side of the block can be pressed against a piece of bar in the chuck or between centres, or against the tailstock barrel. Similarly the spindle can be aligned with the lathe centre line by pushing the front of the block against the tailstock barrel or a side against the face of the chuck. However this method is open to doubt when the feed is not one of the ortogonal feeds of the lathe itself. For instance, if the path of the cutter is determined by the vertical slide. Only if this is set truly vertical will the feed be truly at right angles to the spindle. But if the side of the block were traversed past a d.t.i. held in the chuck and the block adjusted to the same reading at each end of the travel there could be no ambiguity; the spindle would be precisely at right angles to the feed. (Sometimes

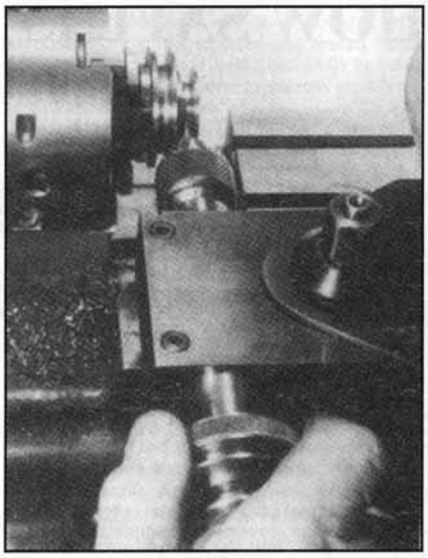


Photo 54: The spindle used for tapping.

of course it doesn't matter if it isn't). When the feed is not parallel to any of the orthogonal axes, a d.t.i. (or equivalent, e.g. fixed point and feeler gauges) is really the only way of aligning the spindle with the feed. It is always the most accurate way. To support a d.t.i. for this job you need a magnetic base. If you haven't one, the base from George Thomas's hand-tool rest is an excellent substitute.

What limits the size of work?

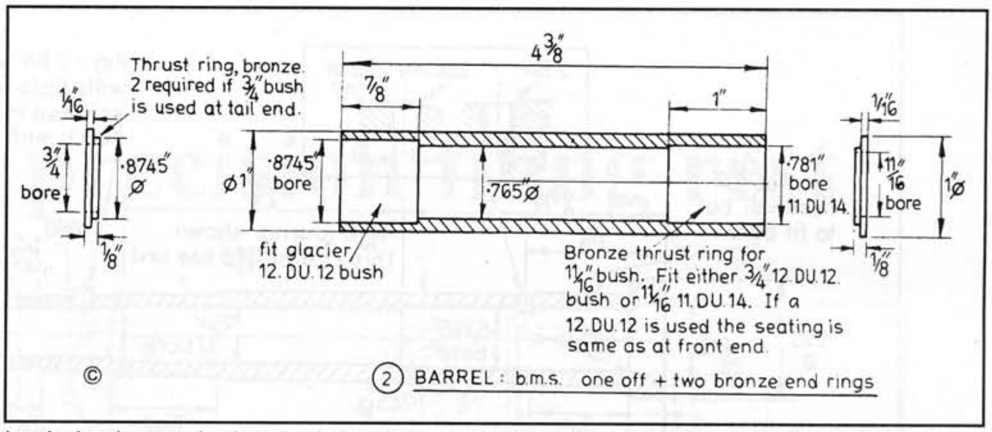
The spindle can be set so that its nose is flush with the block or projects by an inch or more – which it may have to do when drilling or miling at an acute angle (otheerwise the corner of the block prevents a centre drill reaching the work.) On the other hand, when drilling radial holes the available cross-slide travel limits the maximum diameter of the job and obviously the further the spindle is pushed back into the block the larger this diameter can be. (Incidentally the long boring table makes a tremendous difference to the ML7 in this and in many other respects. The standard one is really too short even to have a rear toolpost permanently mounted on it.)

Other arrangements

I made the original milling spindle long before I made a vertical slide from the Schort boring table, which only became available for that purpose when the difficulty of getting the spindle far enough from the axis of the lathe suggested to me the advantages of the long one. Before that, in order to be able to mill slots and spanner flats and so on, I made myself a vertical mounting for the topslide. This turns out to be better than the vertical slide in some respects. It disposes of the motor better and it can be used on the front of the boring table. A vertical slide cannot becasuse of the spacing of the T-slots and the presence of the pivot for the topslide. So it has to be mounted at the back. This does not matter when the spindle is in line with the lathe axis, but when it is being used transversely the motor bumps into the belt-tensioning lever of the Myford headstock. That can be avoided by mounting the motor on a plate attached either to the back of the vertical slide (veritcal movement being accomodated, as in the vertical mounting for the topslide, by the belt being comparatively long and a little slack) or to a stirrup fitting a T-slot and extending to the rear so that motor and slide move together. With the barrel unclamped and a chuck, if necessary, substituted for a collet, the spindle is a most useful tapping machine for holes drilled in the lathe. And since the spindle is exactly at centre height, it is the easiest way of drilling such holes anyway.

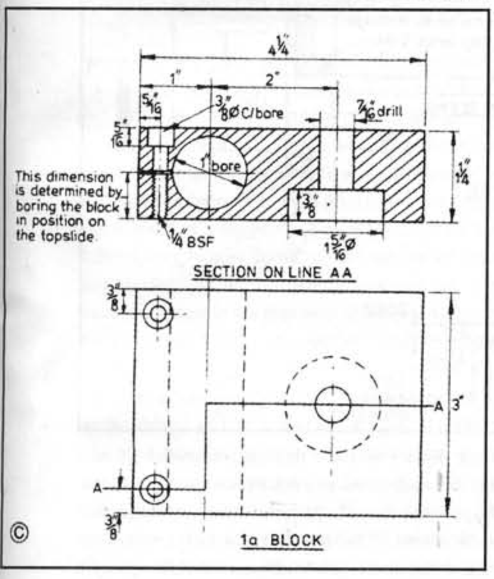
The block Figure 2:1

Face the top and bottom surfaces with the block held in the four-jaw chuck; the 7/16in. dia. hole and the recess are machined at this setting. The block can then be clamped to the boring table for flycutting the vertical faces. It is worth taking some trouble to ensure that opposite faces are parallel and adjacent ones at right angles to each other so that any face can be used for aligning the spindle. I clamped a flat to the boring table and set it parallel to the cross travel with a d.t.i. The block was located against this for fly-cutting the two longer faces (photograph 5). The flat was then set parallel with the lathe axis and the block clamped with one of its faces against it whilst one of the ends was machined. It was then turned



over so as to use the same face for registration when machining the other end. The two holes for the clamping screws are drilled, opened up to half the thickness of the block, tapped and counterbored and the block is ready for boring.

That is how I did mine. For some reason I did not think of doing this job with the block clamped in position on the topslide. This method turns out to be somewhat easier - for one thing you can use a smaller fly-cutter. Set the front edge of the block at a right angle to the lathe axis, traversing it by the cross slide past a d.t.i held in the chuck. Machine it. Swing the block through 90 deg. and set the newly machined face parallel with the lathe axis, using the saddle to traverse it past a d.t.i (as in photograph 6) and machine the end. That's two faces at right angles. Turn the block through 180 deg. and, to avoid cumulative error, set the machined front edge parallel to the lathe axis as before using the saddle to traverse it past a d.t.i. Machine the other end face and you



have both ends at right angles to the front. The rear face doesn't really matter but you might as well get it square with the ends using the same procedure. Then, if you intend to split the block clamp the barrel, drill, tap and counterbore the holes for the screws as before.

The bearing housing or barrel Figure 2.2

This is most economically made from steel tube, if you can find a piece about 1 in. outside diameter with a wall thickness of about ⅛ inch. Another alternative which saves a little time is to use ground-steel rod. It seems criminal to spend time reducing about 90% of such expensive material to worthless swarf and you have no choice about boring the block to fit but at least you start with a truly round and parallel outside diameter. I used ordinary 1 in. dia. mild steel bar. (I have recently discovered the ideal starting point – the tubular column from a Black and Decker drill stand. There is no need to machine the outside diameter.) Whether you use that or tube and intend to bore the seatings with the barrel in place in the block, the first job is to machine the outside. Start with a piece of about ½ in. over length and face both ends. Then set the other end running true in a 4-jaw chuck and support the plugged end with a fixed steady and drill a centre. If you are strting with a bar, centre one end in the same way. Remove the steady, bring up the tailstock to support the end and clean up the outside. The exact diameter does not matter if you are on route !. If you are taking route 2 the block should be bored first and the barrel made a tight push fit in it. either way it is worth taking some pains to get a really good finish; the fit will be better maintained. Tiny ridges between tool marks wear down rather quickly and a tight push fit can become a sliding one in no time.

Put back the steady, aligning it whilst the job is still supported by the tailstock centre. Then turn the job round, set it running true at the chuck, and machine off the ½ in. or so by which it was held. That's all for tube. If you are using a bar, centre the end and drill and then bore right through to just over ¾ in. diameter: 0.081 in. would be fine. The barrel is then ready to have the seatings for the block (Route 1) the next step is to bore the block. We'll come back to that after describing Route 2.

Machining the seatings; Routes 2 & 3

If however you are doubtful about setting the cutteer of your noring bar with sufficient accuracy, the simplest course is to go straight ahead using the set-up you have – that is, with the outer end of the barrel in a steady – to do one seating and then turn the job end-for-end, and do the other. This method allows the cross slide micrometer dial to be used to measure the depth of each cut. Provided that the setting of the barrel to run dead true in the chuck is done with care and the pads of the steady are properly concentric and support the outer end of the barrel without shake, it is difficult to see how either seating can fail to be concentric with the outside of the barrel. (The steady is mportant. I made my first barrel without one and the bush at one end is off centr by 0.003 in. and that at the other by 0.002 in. in the opposite direction).

If youintend to do the job this way, make the plug gauges for the seatings before you start on the barrel otherwise you will have to dismantle a perfectly good set-up to make them. They should be about 0.0005 in. smaller than the bores of the seatings they are to gauge and the finish must be really good.

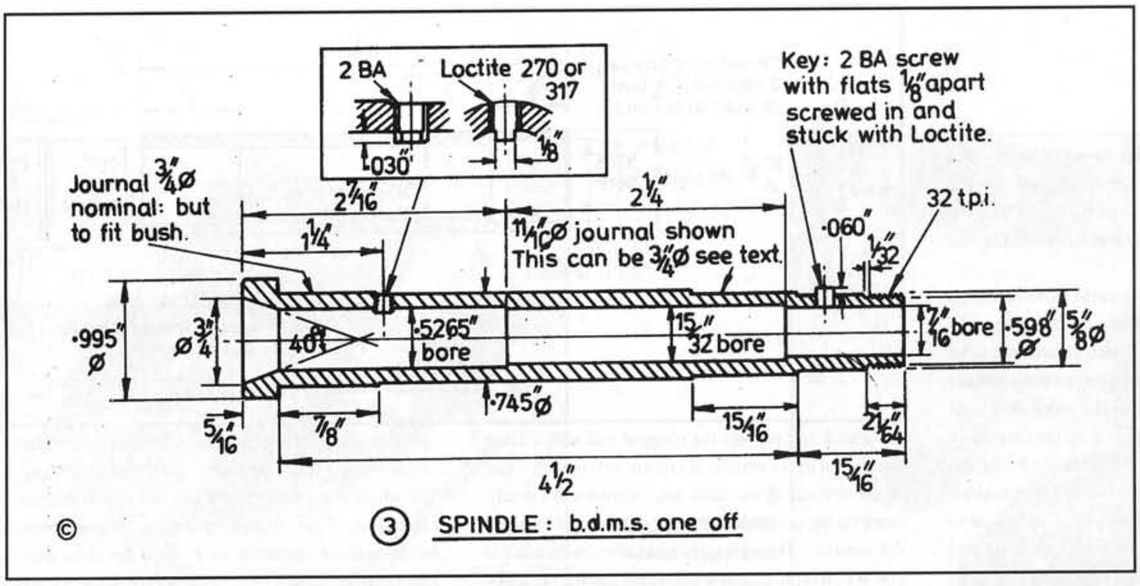
Boring the block

Clamp the block to the topslide using the bolt and conical washer that clamp the 4-tool turret. (if you haven't a turret you have to make a thick clamping washer. The Myford one is 1½ in. dia.) Set the front edge of the block parallel to the lathe axis with a d.t.i. as before. Wind in the cross slide until the point of a centre in the tailstock just drops into the vertical centre-line of thebore previously scribed on the end of the block. (No horizontal centre-line is marked. The whole point of doing the job this way is that the centre-line of the barrel is placed exactly at centre height without measurement.) Lock the cross-slide (the topslide should have been locked already) and drill and then bore the hole to take the barrel. (My largest drill is ½ in. in diameter so, having worked up to that through two smaller sizes I followed it with a ⅜ in. dia. boring bar followed by a ½ in. and finally by the ¾ in. dia. one with micrometer adjustment of the cutter). When you approach the final cuts, check that the block has not shifted by travesing a d.t.i. along the front edge/ The barrel should be a good tight push fit in the finished bore.

The spindle (Fig. 2.3)

Use something better than F.C.M.S. if you can get it – a piece of EN30 for instance – but ordinary mild steel works quite well. My spindle is made from that and, after six years, it shows no wear. The marks on the journals visible in some of the later photographs are D.U. transferred from the bushes as it is intended to be. All the outside diameters are finished and the screw thread cut at one setting with the job either between centres or with the nose in a Griptru or 4-jaw chuck and the other end supported on the tailstock centre. The journals are sized using the bushes in the barrel as gauges. However, there is a minor difficulty.

Glacier specify that the journals should be ground to a finish of 16 micro-inches CLA. An equally smooth turned finish will not do. (Incidentally, to get a really good turned finish use a low speed – the lowest you can get without backgear (150 r.p.m. seems about right.) Consequently, the last few tenths of a thou must be removed by other means. If you have access to a centre grinder, fine; otherwise you can polish the finest turned finish you can obtain with very fine emery cloth or, better still, with a lap. As I have already explained I used a split copper lap. The difficulty already referred to will now be apparent; you must finish turning with the journal still too big to go into the bush, you don't know the diameter at which to stop turning and start polishing. If, using the bush as a gauge, you try to force the journal in you will enlarge and amage the bush. A short length thus enlarged will not matter; the bushes are longer than they need be. One way to do the job is to turn the journal until it can just be forced into the end of the bush (by no more than 1/32 in.) then to go to work with an emery stick or lap until it goes the whole way with a tight push fit. It is then run in as already described. the advantage of having a smaller journal at the tail end is that, when using bushes as gauges, the front one passes over the



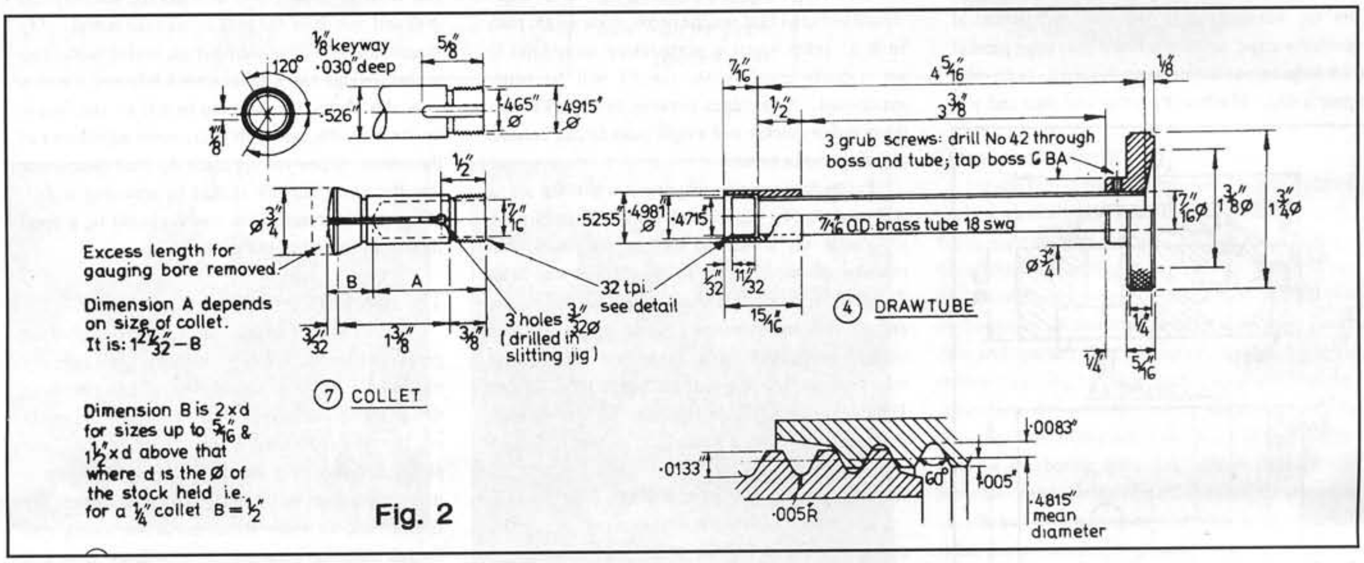


Fig. 2

rear journal without touching it. An alternative, and better, way is to make two plug gauges that are a tight push – or twist – fit in the bushes and turn the journals to diameter "milked" form these. Whenthe journals are finished, the spindle is set to run true in a 4-jaw (or Griptru) chuck with its tail end well into the headstock mandrel and drilled right through finishing with a 15/32 in. dia. drill – if you have one long enough. Otherwise the drilling of the tail end will have to wait until the spindle is set up in the barrel to finish the bore whilst running in its own bearings. Leaving the drilling till then has the advantage that the centre in the tail end can be used for the next two operations.

The draw tube (Fig. 2.4)

I have suggested that this be made from brass tubing simply because it is easier to get hold of than small diameter steel tube. But steel would be stronger. Indeed it would not be a very troublesome job to make the whole thing from 9/16 in.or 5/8 in. dia. mild steel rod. In that case the hole should be drilled 3/8 in. dia. and then bored – just in case the drill should have run out by a few thou. (It is almost certain to do so.) If brass tube is used, the screwed end must be steel and is brazed on before being finished. then the tube is put in the four-jaw (or a Griptru if you have one) and set to run true and the outside diameter of the screwed end finished to slip fit in thebore of the length gauge. The cutting of the female thread is better left until the collets are ready to have their threads cut.

The knurled knob needs no comment except to note that the three holes for grub screws will be so much easier to drill after you have finished the spindle that it may be worth while making a temporary knob at this stage – preferably a smaller one which you are going to need when you bore the collets. the three holes for the grub screws are, in any case, most easily positioned with the draw tube attached to a collet – another reason for using a temporary knob at this stage. It can have a single grub screw which does not penetrate the draw tube, which is temporarily fitted with a short plug at this end to prevent it being distorted by the screw. When you come to them, the tapping holes are drilled through the boss and draw tube but only the holes in the boss are tapped. This allows the point of the grub screws to enter the tube and so transfer the axial load. To position them, screw the draw tube up to about 1/8 in. from the shoulder of a colet, and push it into the spindle until the collet seats against the cone in the nose and push on the knurled knob, hard up against the tail end of the spindle and run a No. 42 drill through the holes already rilled in theboss and through the tube. The holes in the boss can then be tapped.

A word about knurled knobs. Take no notice of people who tell you that you must get your knurling sharp. Knurling is intended to provide grip, not to lacerate your fingers. A slightly blunt knurl provides a stronger grip than a sharp one because it is more comfortable to hold. So make sure your knurling is blunt. Have a look at it through a magnifier. If each tiny diamond comes to a point run a smooth file over the job until each can be seen to have little bright flat at its summit. That may lose you marks with some jugdes; but should you brush your knuckles against a beautifully sharp and phtogenic knurl rotating at 3,00 r.p.m. iti is likely to machine off a quantity of skin, whereas you will receive no more than a brusque reminder of its presence from a blunt one.

Making the collets

I bored my collets 7/16 in. dia. partly to make the segments as flexible as possible and thus easier for the jaws to seat on the cone even if the diameter being gripped is a little undersize, (with a thick shank the segments tend to hinge from the tail end and so only the tips of the jaws can grip) and partly with the idea of being able to hold 7/16 in. dia. endmills. But this bore is really too large; the threaded ends are so flimsy that they are deformed if the collet is dropped. It is far better to reduce the bore to 27/64 in. or 13/32 inch. This gives you another fifteen or thirty thou to play with. You can give it all to the collet keeping the thread dimensions the same as those for the 7/16 in. bore; or you can transfer some of it to the base of the female thread in the draw tube by using the alternative dimensions in Figure 2. Though the female thread in the draw tube looks flimsy it has proved (so far) quite strong enough to do its job. ●

Model Engineer 150 208 (1983)