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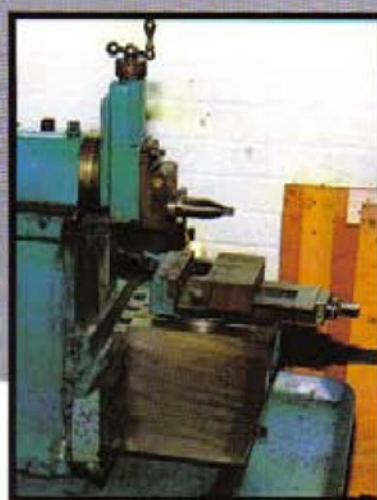
MODEL ENGINEERS'

WORKSHOP

THE PRACTICAL HOBBY MAGAZINE



**INTRODUCING
BENCH
PRESSES**

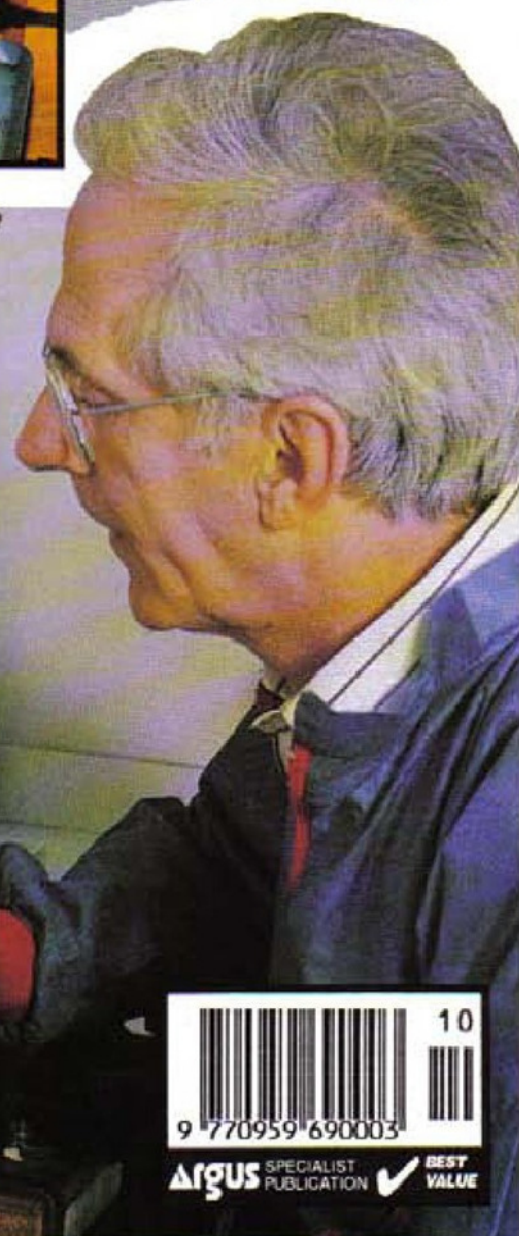


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SECOND-HAND?**
Bargains abound

**SPECIAL-PURPOSE
MICROMETERS**

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SURFACE
FINISH**

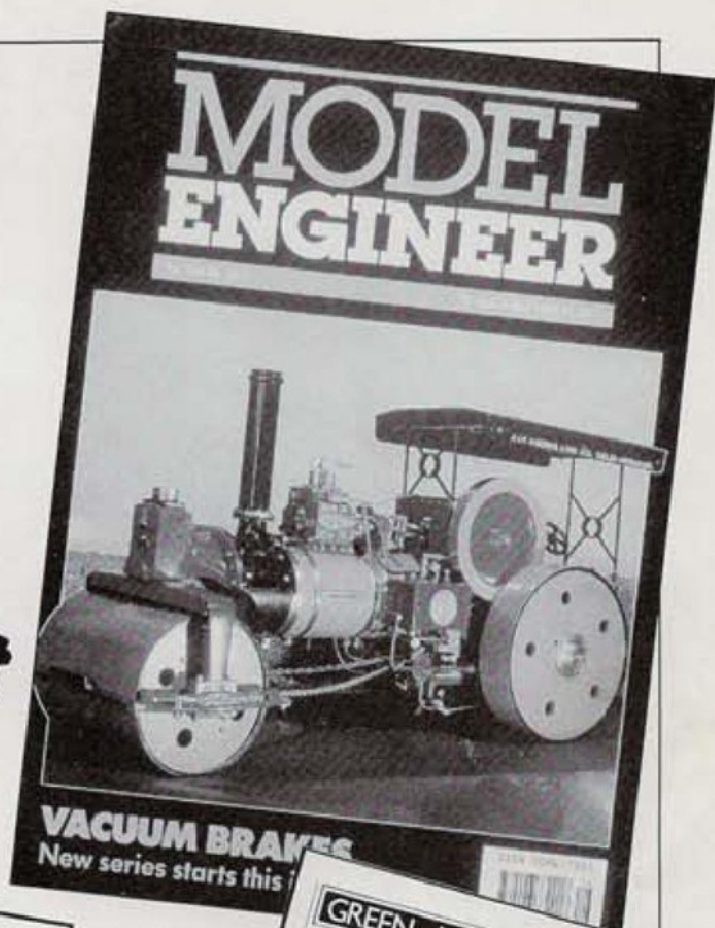
**By adding
a flywheel!**



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There's something to anticipate twice every month in fascinating Model Engineer magazine! Whether your interests lie in live steam locomotive models, traction engines, internal combustion motors or stationary engines, world famous M.E. will inspire, instruct, advise and encourage. Model Engineer is published on the first and third Fridays each month and costs just £1.40 from all good newsagents; alternatively, you may care to ensure your regular copies through an annual subscription - a mere £33.60 for UK readers (overseas rates and airmail details on request).

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Argus House,
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CONTENTS

19

Editor: Harold Hall

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7 ON THE EDITOR'S BENCH

Harold Hall's commentary

8 SCRIBE A LINE

Readers' views and ideas

14 MICROMETER ADJUSTABLE BORING BAR ADAPTER

An inexpensive additional use for the three jaw chuck

18 BENDING STRIP METAL

Simply prepared tooling makes intricate shapes possible

20 A DOUBLE DESIGN DRILL

A light precision drill described in two versions

28 ADDING A FLYWHEEL

A simple addition which can revolutionise machining results

31 BACKLASH

Great minds think alike - readers experiences of adding flywheels to machine tools

32 MICROMETERS - SOME INTERESTING VARIANTS

A look at what is available in the specialist field

35 We visit - HOME & WORKSHOP MACHINERY

A look at a progressive company who deal in tooling suited to the amateur and engineer

38 PLANERS, SHAPERS AND SLOTTERS

Historically this group of machine tools have great significance for the engineer, we look at their origins

41 TRADE COUNTER

A first look at some products and services - perhaps new to you

42 MAKE A FILING REST

The building instructions to accompany our pull out plan

45 DIVIDING

This computer programme will remove many of the time consuming calculations which can put one off this form of workshop activity

46 USING A BENCH PRESS

Presswork holds a mystique for many workers, in this article we try to dispel some myths and show how a press and simple tooling can be used to advantage

Modeller on the cover...

Your editor, Harold Hall in his immaculate home workshop; many of the projects featured in M.E.W. were designed and proven here.

50 AN IMPORTANT ANNOUNCEMENT

Our production dates are changing - just to keep you informed

51 THE MODEL ENGINEER EXHIBITION

Others would like to see your work - your chance to exhibit - and some advance information about some highlights of the show

54 HOLDING C'SK SCREWS

They can be the very devil - here is a simple remedy

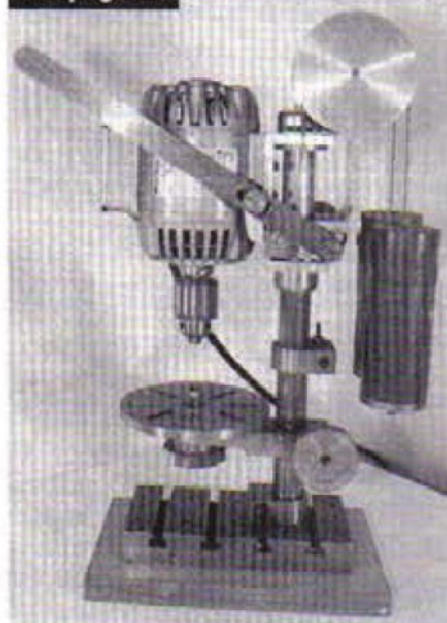
58 AN OFFHAND GRINDER FOR THE UNIMAT LATHE

Space was a problem, so this special tool was made to fit on the outboard end of the Unimat - it also adds to the flywheel effect!

64 A TOOLPOST GRINDER

Building instructions for the machine which was discussed in our last issue

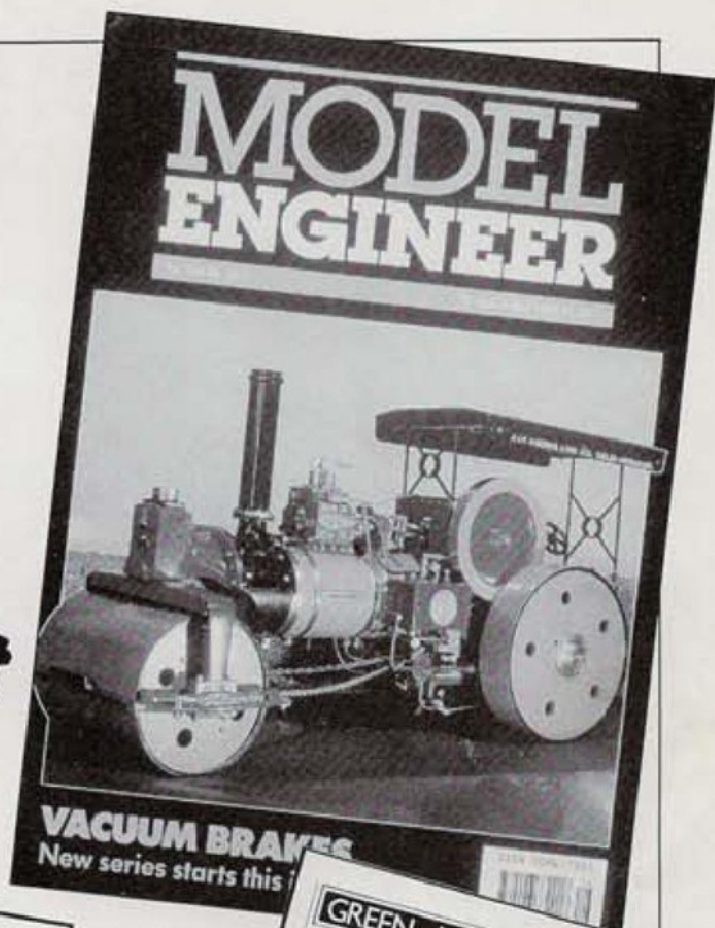
See page 20



Advertiser	Page	ADVERTISERS' INDEX			
A.S.P.	13, 56, 57, 76	Castell Eng.	76	I	
A.S.E.	16, 17, 75	Emco Maier	73	Inter City Mach.	13
Argus Books	52			M	
Blackgates Eng.	13	F		Macc M.E.	76
Camden Min. Steam	4	Fyne Fort Fitting	55	Maidstone Eng.	44
C.Z. Scientific	52	G & M Tools	80	Mihill Supplies	55
Chronos	34	G.L.R. Supplies	74	Myford Ltd.	6
Cowells Mach. Tool	6	Graham Central	44	Model Eng. Serv.	78
College Eng. Supp.	76	Graham Eng.	44	R	
Compass Hse. Tool	56	H		Reeves A.J.	4
Chester (U.K.) Ltd	74	Hegner U.K.	74	Rollward Ltd	56
		Home & Workshop	79	S	
				Stanton Thompson	76
				T	
				Tabwell Tools	74
				TEE Publishing	5
				Tiranti, A. & Co.	44
				Tractive Power	76
				V	
				Viola Plastics	55
				W	
				Warren Mach. Tools	53
				Weldmet Welding	30
				Wise Owl Publ.	55
				X	
				XYZ Systems	2

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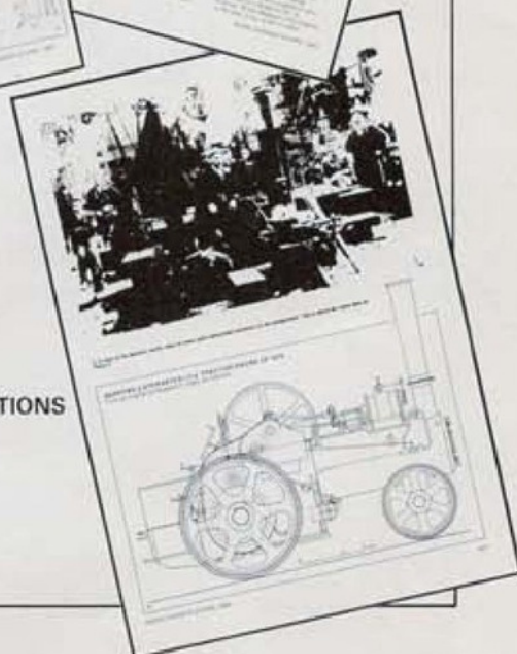
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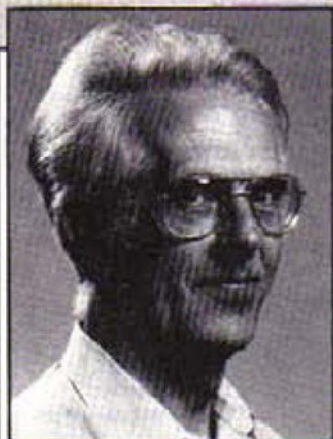


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Harold Hall

ON THE EDITOR'S BENCH

Change of publication date

You will find elsewhere in this issue, notification of a change of publication date for *Model Engineers' Workshop* starting with the next issue. Do take note of this, in particular if you collect your copy from the local newsagent, as it is an earlier date and you may miss your copy. The reason is to assist with production scheduling within Argus Specialist Publications.

DC speed controllers

I am sorry that the article on the construction of speed controllers for small DC motors has had to be postponed. A number of contributory factors have made this not practical for this issue, and I consider that for such a technical article it is not acceptable to cut corners. I hope it can be available within the next few issues.

M.E.W. Authors

It is with much regret that I have to report the death of two contributors to *M.E.W.* Both Dave Lammas and Al Longworth have given us a number of interesting articles since the magazine commenced, and these have helped considerably in getting the magazine off the ground; there is an article from Al in this issue.

I would like to offer personally, and also on behalf of you, the readers, our condolences to the two families at this difficult time.

Safety specs

I had not intended to return to this important subject, mentioned in my last editorial, so quickly, but at least one reader has misunderstood my meaning, perhaps I expressed it badly. The reader, on his reader survey, referred to my cavalier attitude to safety in my comments on the subject. However, if one reads this again, it will be seen that I stated that I was not attempting to discredit BS2092-2 spectacles, but to indicate that something better is possible, and as such should be sought after, with prescription spectacles to correct eyesight.

If on the other hand, spectacles are not part of your daily attire, then DO WEAR BS safety specs when carrying out dangerous operations in the workshop. It is however worth taking note of the fact that instances of contamination to the eye are not always caused by flying objects. In very many cases it is carried to the eye on the hand, when one instinctively rubs the eye when some irritation is present. Even with spectacles, safety or otherwise, the

instinctive action will be to remove these to wipe the eye. **You Have Been Warned.**

I do hope that these brief comments will eliminate any misunderstanding. Perhaps the sender of the survey may like to make contact with me, I can then send some photographs to illustrate my point. Better still visit you, but by the postmark on the envelope this may have to coincide with other visits to the area due to the distance. Being a works manager in engineering you may be of help to me in this matter.

Early home workshop machines

During my time as editor of *Model Engineers' Workshop* I have received many requests for help from readers regarding machines that they own, but which are no longer in production. The majority of these queries are asking for copies of the machine manuals or details of where suitable spares may be obtained.

So as to avoid similar requests appearing in the magazine but from different readers, I have commenced to collect relevant information myself, so that simple requests can be answered without delay. This may appear to be adding to my workload, but the present system of placing requests in *Scribe a Line* with the long delays inherent in this method, together with multiple replies in many such cases, is also time consuming.

I would request therefore that readers with older machines help me in this endeavour. I am looking for copies of the machines' manuals, also any sales type literature, especially if this contains the machine specification. It is appreciated that readers having such information will want to retain this, so it is photocopies that I am looking for. Realising that this may involve expense, these costs will be reimbursed. Photographs of your machine would also be nice, these would not be required for publication so quality is not critical, so if you have a few shots left on the end of a film why not use them in this way.

There are of course, a few machines that were sold in large numbers and are still very much in evidence. Because of this, and so as to avoid receiving many copies of the same manual etc., please write to me first, sending me details of the make and model of your machine and what you can offer, manual, leaflet, photograph etc. If you know the serial number and/or date of manufacture and any history of your machine this would be useful.

If you have a machine of unknown make and are prepared to provide a photograph, I would be very happy to receive this, just possibly I may be able to identify it for you

from other information received. Finally if you know a source of spares for your machine, or have had a part made for the machine on a one off basis, details regarding this would be very useful. I should make it clear that I am interested, not only in those machines made many years ago, but also in those that have only ceased being manufactured in the last few years.

Please ensure your name and address is added to the rear of any photocopies you send, with regard to photographs of machines please add your name and address and also brief details of the machine. This may, or may not, generate an increase in correspondence so please realise a reply may be slow in coming, but I will eventually acknowledge receipt of your letter.

The flywheel effect

In the Oct./Nov. '92 issue of *M.E.W.* I commented regarding a letter received from a reader who had added a flywheel to his Mill/Drill, finding this to have distinct benefits whilst carrying out machining operations. Readers views were requested as to why this was so, and a number of replies received. In this issue, the original correspondent, Philip Amos of Australia, explains how the addition of the flywheel was achieved. Also included are some of your comments as to why you consider this proves beneficial, these are published under the heading of *Backlash*.

Apparently this approach has been incorporated in well known commercially available machines, and not only milling machines, sometimes lathes. In this issue we have also an article on adding an off hand grinder to the outer end of a Unimat 3 lathe. The author, Mr R.J. Loader, suggests that it can, if convenient, be left in place whilst turning operations are carried out. I wonder if any benefits would result if this were done.

The addition of a flywheel, temporarily, to the end of any lathe mandrel whilst intermittent cuts are being taken should not be difficult. Being directly coupled, as opposed to the splines present on the mill/drill, may make it even more successful, is any reader prepared to give it a try?

Articles

It had been my intention to request in this issue an article on the construction of a de-humidifier, this as a result of a reader request. But having just received in the post my copy of the latest *Model Engineer* magazine, (Vol. 171 no. 3949 16 July) a quick skim through shows me that the construction of such a device is being covered. It would therefore be inopportune to duplicate this subject in *M.E.W.* in the foreseeable future, so if you are interested in this I would suggest you acquire copies of the *Model Engineer*. Their article is being run as a series.

MORE TEETH!

Small tools that have infinite uses and can be obtained cheaply on the surplus market are the picks used by dentists; they can be obtained in many shapes and are very strong. **Jason Langan**

SCRIBE A LINE

Your views, your pages! Your opportunity to make your point, ask the question or simply pass on a snippet of interesting advice to others. Your letters for publication in *Model Engineers' Workshop* are always welcome

A word of caution

Mr Gerrard of Exeter offers a word of warning.

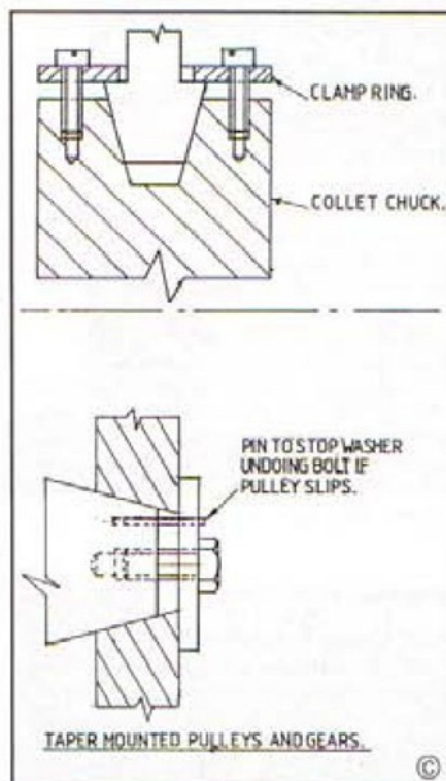
I am not too happy about the article regarding a wood planer in Issue 17, as no allowance has been made for balancing the block; at 8000-9000 rpm any out of balance can be disastrous.

I once had a cutter from a commercial good quality spindle moulder fly out; fortunately after destroying the fence the drive belt came off. I know this is not quite the same case but we are here dealing with home produced blades which rely on 2 x 1/4in. BSW screws for their safety - 1/4in. BSF would have been better - whereas commercial machines have a wedge form of fastening.

Reluctant tapers

Continuing our correspondence on the subject of tapers that are reluctant to hold, Kym Heier of Newnham, Tasmania offers some further ideas.

Some notes regarding tapers that are reluctant to do their job. This occurred while I was a maintenance fitter at a Textile Mill. One morning I found the drill chuck and taper in two pieces and immediately embarked on the recommended series of manoeuvres. I was less than impressed by the stub taper's reluctance to stay in its hole. However some light machine oil was applied to the male taper and holding the chuck in one hand and the taper in the other, I slammed them together. Two years later when I left the company they were still together.



As no surface is dead smooth nor two tapers necessarily identical, the imperfections must have caused sufficient friction to prevent the tapers going completely home.

In this instance the lubrication of the mating surfaces would allow the taper to enter the hole further giving a stronger grip.

A couple of other solutions I have seen to this problem are added to a collet chuck - a clamp ring as per sketch.

One untried but interesting thought that occurred while thinking of this subject was - that if one was able to get some unsupervised time in the kitchen - warming the chuck in the oven and putting the taper in the freezer for a while before uniting them, then the chances of the taper holding would be greatly improved.

Warco 220 lathes

Have you purchased a Warco 220 lathe? If so, Richard Gomme would like to hear from you so as to compare notes, sounds like a good idea.

Recently I took my first steps into model engineering and purchased a decent sized lathe - the Warco 220 as reviewed in M.E.W. last November. I'm making quite good progress with it, the current challenge is its screw cutting facility. I feel there could well be mutual interest and benefit from contact with other Warco 220 lathe owners. I'd be very pleased to hear from any with a similar viewpoint.

No more lost parts

Joe Ginn of Crimbleham offers his idea for avoiding those lost parts. Discipline, and a baking tin are his salvation.

There seems to have been recent complaints from people losing parts and tools, in particular Fettler. My wife solved the problem for me for all time. She gave me a large oven baking tin, nicely lined with pink Drayton, as she said, "To protect my more delicate parts". Now whenever I put anything down, I put it in the tin. Once you have got into this discipline your troubles, at least in this direction, are over forever.

Imported machine tools - good value?

P. Stallard of Romford considers that some 3rd World machines are not worth the money they cost, and that secondhand items are a better buy. This may be so in the case of lathes, but the supply of small secondhand vertical mills is very limited and would soon dry up if all purchasers went in this direction. What do other readers feel on the subject? In your opinion do 3rd world machines represent good value for money?

I would like to see more publication of trials of equipment, new and old, such as mill/drills, lathes, drilling machines etc. I

would also like to know whether in M.E.W.'s opinion they are worth the purchase price. This is a lucrative market and some machines from other countries are, in my opinion, inferior and too expensive. I realise that it is difficult for any magazine to print such articles because of their advertising revenue, but you are asking what your readers would like to see. Both Model Engineer and Model Engineers' Workshop, at present carry articles with headings such as "Improving" a mill/drill, where perhaps they should be saying that the basic machine it is not worth the purchase price. For many years, I and many others have purchased secondhand equipment that is known to last. I am very sceptical on committing myself to 3rd world machinery because of its price and inferiority.

From my experience of attendance at the M.E. Exhibition over the last 8 years more people are purchasing secondhand equipment (e.g. hand tools) than ever because of its reliability for the future.

Insulation - heat and electricity

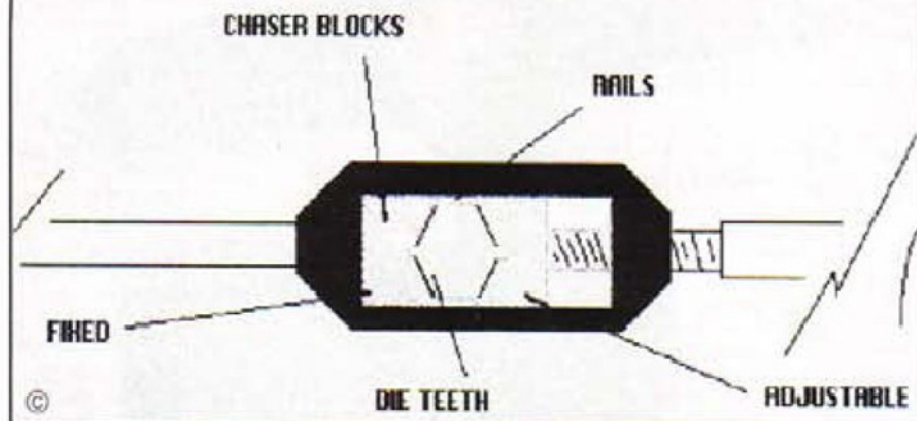
From Les Rix of Melton Mowbray:

Regarding the insulation of wooden buildings for use as workshops, I have enjoyed success using 25mm expanded polystyrene sheet sandwiched between the log-lap walls and the internal plasterboard cladding. This gives a moisture-proof liner. However with the recent comments on electrical safety may I enjoin other readers not to bury PVC-clad cabling in proximity to polystyrene. Professional involvement with expanded polystyrene and styrene resins indicates that embrittlement and cracking of PVC may occur in the short-term with consequent risk. It is probably better to surface-clip cabling then cover or use surface conduits.

Observing the recent "entertainments" with variable-speed operation of electric motors may I urge any reader with such a requirement to search high and low for the 3-speed Sachs motor used in the Zanussi Z900 series washing machines. Regrettably these are now obsolete and an example will be 12 years old or more. These units are truly excellent, running at 930, 1480 and 2900 rpm with the low-speed winding being abuse-proof and also serving as the starter winding. They may be identified by a conical tinplate end-cover over a reduction gearbox and have a sprag clutch for overrun and also a centrifugal brake-shoe arrangement which engages at 2900 rpm to render a 290 rpm drive. This extraneous ironmongery is discarded. I have contrived a control-box for it (This will be the subject of a future article - Ed) and my Myford now has 18 speeds forward and reverse!

Finally a query. I have an elderly implement that can only be described as an adjustable die and stock. I presume it is something that was common years ago. Basically the cutters are matching chaser blocks with slotted sides abutting rails in the die-stock window; one against an end-stop and the other adjustable by rotating one of the handles. Threads at 16TPI from 1/4 to 1/16in. would have been possible with my example. The uncanny resemblance to a large tap-wrench was aided by its use for this purpose until I rescued it. I intend to remake the chaser blocks from cubes of gauge-plate and would welcome reader advice on what this unit is and the limiting geometry of the cutters.

(See Insulation - opposite page)



Bandsaw modification

P. Wilton of Langford has carried out a modification to a band saw, as suggested in *Model Engineer*. He proposes that we may like to re-publish this article in *M.E.W.* However it is policy not to duplicate articles, although some similarities are bound to occur, from time to time. Readers who are interested in the bandsaw modifications discussed in *Model Engineer* (7 May issue) could obtain a back copy of the magazine from Back Issues Dept., Argus House, Boundary Way, Hemel Hempstead, HP2 7ST.

May I draw your attention to the article in *M.E.* No. 3944, by J.M. Service, which deals with improving the performance of the Burgess Bandsaw (and similar makes).

I have successfully completed the modifications and can confirm the advantages gained of straight cutting and a better speed for metal-work.

Since it is possible that not all of your readers are regulars to *M.E.*, may I suggest the article be reprinted in *M.E.W.*

Thanks for a good magazine, keep the ideas rolling. I shall shortly be retiring and intend to have a second career as a model maker.

Would this help?

Henry Kratt of Atlanta, U.S.A. proposes an idea which unfortunately, due to lack of available Editorial time, at least at the present, is not feasible. However, I feel that it would be useful to get some feedback from other readers as to their opinion of this idea.

First off, I don't know how the average hobbyist buys his/her machine tools - new or used - so none of this may be appropriate. With the exception of a drill press I bought thirty years ago all of my equipment was bought used (euphemistically - previously owned). In some issue or other you declined a request for the magazine to do "comparative product testing". I was thinking though that the readership of the magazine has already done extensive testing on their own but without the subjective comparative aspect - "C" has great igoggon rods, but "D" has a poor wobbly shaft, etc.

An appropriate questionnaire could be devised for each major shop item and included over a series of issues. Solicited would be the essential data of make, model, year, price - new or used, capacity, availability of spares, recommendations and reasons therefore, precision/accuracy, would you buy it again and at what price, that sort of material. These would be returned to you for filing. Then if a chap

were to be considering a "Belchfire 150" welding machine he could, for a fee, request photocopies of appropriate replies on this machine. If the respondents were willing to discuss additional details they could include their names, address and telephone numbers with their replies.

Bandsaw blade breakages

We have a few letters which continue the subject of blade breakage on three wheel bandsaws. The first is from L.E. Billinge of Langdon Hills :-

In reply to several interesting points raised in your issue No 16 I would like to make the following comments:

1). Bandsaw blade breakage

Re Mr Sterland's comments on bandsaw blade breakage, he is quite correct in his assumption of a relationship between blade thickness and wheel diameter. I fell into the old trap, that of trying to save costs by buying in bulk. The problem is that most suppliers sell bulk lengths for industrial machines, as that is where their demand lies. Most band saws in home use are the small three wheel bench type models for which bands are specifically manufactured and they are both thin and narrow (c. 3/16 in.). I solved my problem by buying an old industrial machine (much cheaper) which can happily accommodate any band material.

2). DC Motors

Please, please continue to provide information on electric motors and drives. We modellers are, in my experience, far too conservative in our ways. True the 1500RPM induction motor has served us well for best part of 80 years but we should be aware of the uses and advantages which can be achieved with thyristors and other electronic devices. These can be of immense value to us in particular as we expect our small machines to do everything under the sun, whether they were designed for such purposes or not.

Terry Gould of Shrewsbury offers a tip for builders of bandsaws - (see Autumn 90 and Feb/March 92 *M.E.W.*).

I have recently finished building the 3 wheel bandsaw. The method given for the traction tyre works well and is a simple way of doing it, that is if you have the correct size Vee pulley.

While I did my drive Pulley/wheel this way, it wasn't long before I had to remove the drive pulley from the bandsaw to complete another job. To replace this drive wheel on the bandsaw an alloy wheel was made just like the other two. For the traction tyre I used a length of 1/2 in. wide poly belt. The grooves or Vees on a Poly

Vee belt are nearly the same form as 1/4 in. BSW, at 11 TPI. A 1/4 in. BSW Chaser was used to cut the grooves. The belt was then Superglued and pinned at the ends.

I did try the chair webbing (*M.E.W.* Feb/March '92) which works well with fine cut teeth. With a 14 TPI Raker blade, the teeth soon rip the webbing. Did the author find the same or is there some way to seal the webbing to stop it fraying?

And from Ernie Hodgson of Newport, I.O.W., who initiated this series of correspondence in issue 14.

Many thanks for forwarding the letters to me on the subject of breaking band-saw blades on the Naerok machine. I have written to the two gentlemen concerned, thanking them for their interest.

The first suggested that I should silver solder the blades. I did try this, but the blades still broke.

The final solution (I hope) involved filling a step on each end of the blade and then silver soldering. This idea was given to me by a friend, some weeks ago. I immediately tried it and so far the blade has lasted well.

Correspondent number two was also on the mark when he suggested that the blade, was too thick. I borrowed a book on the bandsaw (an American publication), this stated that 3 wheel bandsaws, because of their small diameters, should use 0.015 in. thick blades. These turn out to be more expensive than the standard 0.025 in. ones, so I perished that thought. Anyway, I have a roll of 0.025 in. band-saw blade and I obviously want to use this if possible. The step trick seems to have solved my problem. It was fairly easy filling each end of the blade to half thickness, using a micrometer to check thickness. I didn't get any bumping either when I tried the blade on my machine.

A reader's viewpoint

John Richardson has completed the Reader Survey and makes some comments regarding this. He also seeks information about a band saw welder in his possession, and finally a source of supply for knurling wheels:

Please find enclosed your questionnaire completed as well as I could.

It may sound like heresy to a publishing house which does so much good for hobbies and modelling in general, but I know quite a few people who are put off by the words model engineering because they have such a close connection with steam locomotives and traction engines (however admirable they may be), while clocks seem to have got away! Yes, there are people who seem interested only in making workshop equipment and I was surprised to see your questions recognise this. I suspect many of your readers will turn out to be just amateur engineers who have had no proper training or previous experience, but who like to do something quite different from their daily activities of a more cerebral kind. As for me, I need no models to fill nonexistent empty hours but I do need to maintain or make more durable my relatively contemporary car (Question 6) and dream of certain camera accessories.

Regarding Question 14, your spectrum is really two spectra. "Very useful" is not the antithesis of "Not interesting". Your historical articles are very interesting and I like them very much, but not useful, while many articles are very likely to become very useful in due time.

Regarding Question 10, I particularly like M.E.W. because it is 100% amateur engineering. Even if I do not have an immediate use for the content of any particular article, it is there for reference if and when the need arises, hence reference indexing becomes very important. (I was thinking of indexing Quick Tips.)

Band saw blade repairs

I have a Coronet band saw which, being a 3 wheeled type, uses 0.014/0.015in. thick band saw blades which are not at all easy to get and which, from time to time, break; but they would, wouldn't they! It is not even worth trying anything thicker than 0.015in.; it breaks immediately. Can any reader name a source of the thinner blades, please, whether Coronet size or in coils to make up? A long time ago, I was advised to braze or silver solder the broken ends of blades using a Scarf joint and made a little Jig to hold the two ends, photo enclosed. I did not enjoy any real success, not knowing how long to make the scarf (the longer it is, the more rigid the joint), my propane torch not being hot enough to braze and the scarfed dead ends of band saw blade being even more wilful than in life. I wonder if any of your readers may care to comment.

I was then given a machine called Selecta, photo enclosed, but without any instructions. I have no idea who made it. It is plated for 230/250 volts, single phase, 50 cycles with a capacity of 1 inch. The red bits perform the same function as my simple jig, holding the broken ends of the blade. The blue handle clamps the two ends of the blade together, but whether scarfed or butt jointed I don't know. The switch on the left is "On" or "Off". The switch on the right has modern plastic labels, up is "Braze" and down is "Anneal". Please can someone give me detailed instructions on how to use this potentially very valuable device. I understand that Johnson Matthey in Sheffield produce, or used to produce, thin strips of silver solder and wonder if these are appropriate and still available?

Knurling Wheels

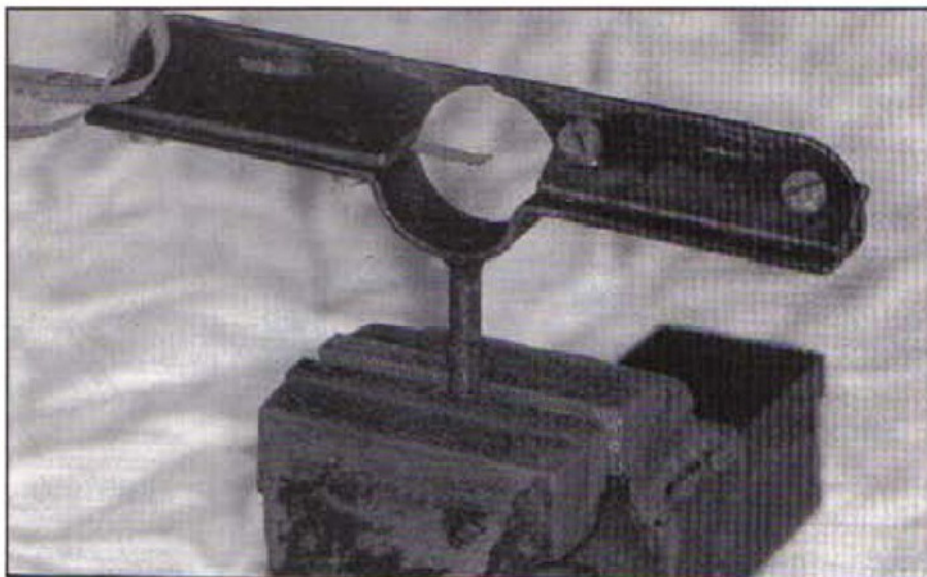
I have need of a straight cut knurling wheel with an outside diameter of $\frac{3}{4}$ in., a width and central hole of $\frac{1}{4}$ in. and a Pitch, if that is the proper term, of 28 TPI or 0.9mm (11 gaps per cm). Can any reader suggest a source, please.

Computers in home workshop mode

Ron Dauben of Taunton shares his experiences in looking for economy software packages

As a subscriber to M.E.W. I have noticed your requests for information on/by CAD (Computer aided design) users. As someone using my computer for the benefit of other model engineers, I thought the following might be of slight interest.

I have spent a lifetime "in" electronics of various flavours and so the "innards" of a computer are little different in component type and general theory of operation from many other things that we exist side by side with. The reason for starting in this way is to enable me to explain that as Editor of Taunton Model Engineers club magazine, I have attempted to help the magazine along



A bandsaw blade joining jig, a boom as it allows freedom of both hands during this fiddly job. One end of the blade is shown clamped in position on the left, the clamp screws are inserted from below. The clamp and screws are shown detached on the right hand side. A large key ring will perform a similar service especially if the blade has to be broken, slipped through a pre-drilled hole and re-joined.



The commercial joining tool described in the letter, can any reader give precise instructions for its use?

a little by using the computer I am experimenting with various DTP (Desk top publishing) and Graphics packages to try to get the mix required for this - and on the way I have dabbled with CAD.

The computer I now use is a relatively old (1987) IBM compatible (Black & White) which was given to me in "office failed" condition - "for spares if it is of any use". Accepting the above about the "innards" I delved inside and found, to my surprise, that with a little common sense I was able to put the thing in going order. A dry joint from new here and a wee bit of mechanical trouble on a disc drive lock there and it was going.

Point number one - don't be afraid of the beasts, they were built by people like us, ordinary human beings.

This gave me a computer that I could update to from my old Amstrad and opened the way to a much wider range of

programmes.

Point number two - programmes are not written by people like us.

Amongst the first thing I found was that the price of Programmes (I refuse to bow to the American accepted way of spelling) was more than frightening and for things like DTP and CAD packages was really out of this world unless there was some commercial justification in having one. I was then introduced to the idea of what is called 'Shareware' programmes. I would imagine that these were initially written by folk who did not make the big time, and who were looking for an outlet for their work. Simply, the principle is to pay a small amount (between £1 and £3 generally) to allow you to try a programme. If you like it you can then register for a much smaller amount than would be asked by a full blown programme maker. The programmes

I have so far sampled are totally adequate for my needs, anyway you pay to try which is better than investing in something that you find later is not up to scratch.

The main problem I have found is one of unlearning. I expect you use a PC of some sort to produce M.E.W. and have had to learn the madness of some programme writers mind before you could start. What tends to happen when trying shareware is that this is multiplied by a factor of however many programmes you want to sample because in programme writing there is very little standardisation so each one has its own learning curve and there is a complementary unlearning curve for the last one you were trying. Given that, the principle is very useful to enable the selection of the very programme you need.

The reason for labouring this is to paint the scene a bit. At present for our Club Magazine I am trying an excellent DTP that costs around £50 when I can afford to register for it, and a Graphics package that complements it, and on the same basis will cost me around £40. I have tried one or two CAD and Printed Circuit Design programmes which would cost roughly the same after registration, but have not lunched into them with the same enthusiasm that I have with DTP/Graphics. You asked if anyone had used a DTP for drawing - well, although I have not produced anything that I would wish to keep, I have managed to produce simple drawings on the DTP package although I suspect that given time and practice the Graphics programme could turn out acceptable results. The CAD proper programme I have so far found that is most likely to be of use goes under the name of "Draft Choice". (This program will be our choice of economy package in our future CAD article - Ed.). It is relatively user friendly and - importantly - it will print out to a dot-matrix type of printer so it is not necessary to invest another small fortune in buying a swish pen plotter device.

In the little experience I have had so far of CAD I think that I could have produced a conventional ink/pencil drawing in about an eighth to a quarter of the time it would take using the CAD package! Practice would obviously improve on this. (This is probably true for a simple drawing where the requirements are known prior to starting. However for a complex drawing, or where the design is being established as the drawing progresses, CAD will win hands down - Ed.).

If you have not already come across them, try The Public Domain and Shareware Library. Winscombe House, Beacon Road, Crowborough, Sussex. TN6 1UL. Phone 0892 662398 for supplies of Shareware Programmes.

A timely tip

This useful little idea comes from M.L. Turner of Bridlington:-

This may be of some interest, or it may be old hat, but I cannot recall having seen this item in any books. If you consider it to be of any use please pass it on. I made and used one of these when serving my apprenticeship; it can be made for one size or several sizes. It is used for drawfiling thin flat sections and is particularly useful for curved profiles. Please accept my compliments on the contents of this excellent magazine.

Black holes!

We have had a number of replies regarding "Fettler's" problem of lost items in the workshop. We publish a couple of them this time, the correspondence is now closed. The first letter is from N. St. John Hennessy of Dublin, he states that he has the mathematical answer to the problem, but is keeping this to himself for the time being!

Your correspondent "Fettler" has my deepest sympathy over his recent sad loss. I am however surprised that one of your readers should subscribe to the ridiculous superstition that these small parts grow legs and walk off. This was widely believed by Turners in the middle ages but is now discredited.

Recent work (see Hawkinge et Al) has conclusively proved that in every workshop is a small Black Hole. By definition these are of course invisible but their existence can be proved mathematically. I would give you the Formula, but it would be too advanced for your readers. The only person who really understands it is me, as just about everything, except my lathe and the bench itself, has already vanished into it.

Southbend lathe - information sought

Can any reader help Mr. A.J. Reynolds of Stevenage by providing information about his old Southbend lathe?

Having now received seven issues of your excellent publication, which incidentally I read from cover to cover several times over, I am astounded at the expertise and inventiveness of your various contributors. So far I have attempted to build one project, a bandsaw which was published in one of your issues. I tackled this with only an electric drill, various hand

tools and an arc welder, but came to a dead stop, due to a lack of the means to turn the spindles etc. I must add at this point that I have been involved in radio and electronics since I was a lad just prior to WWII, but have always kept an interest in the mechanical engineering side. I retired a few years ago but just recently decided to invest in a screwcutting lathe, so realizing a long standing ambition. Rightly or wrongly I purchased an older model, (it might possibly be older than myself) I could not afford one of the pristine expensive models on the market. I am quite proud of what I have bought, seeing it standing there in the middle of my shed, all worn but well oiled metal and flat belt flapping around, while I attempt to find which of the various screws adjust for wear.

It is through your pages that would request if any reader is able to tell me where I can obtain operating or adjusting instructions and the whereabouts of any suppliers of spares (in particular change gears) for this model.

The lathe is: A Southbend, 9in. swing x 3½ft. bed. I will gladly cover any reasonable costs.

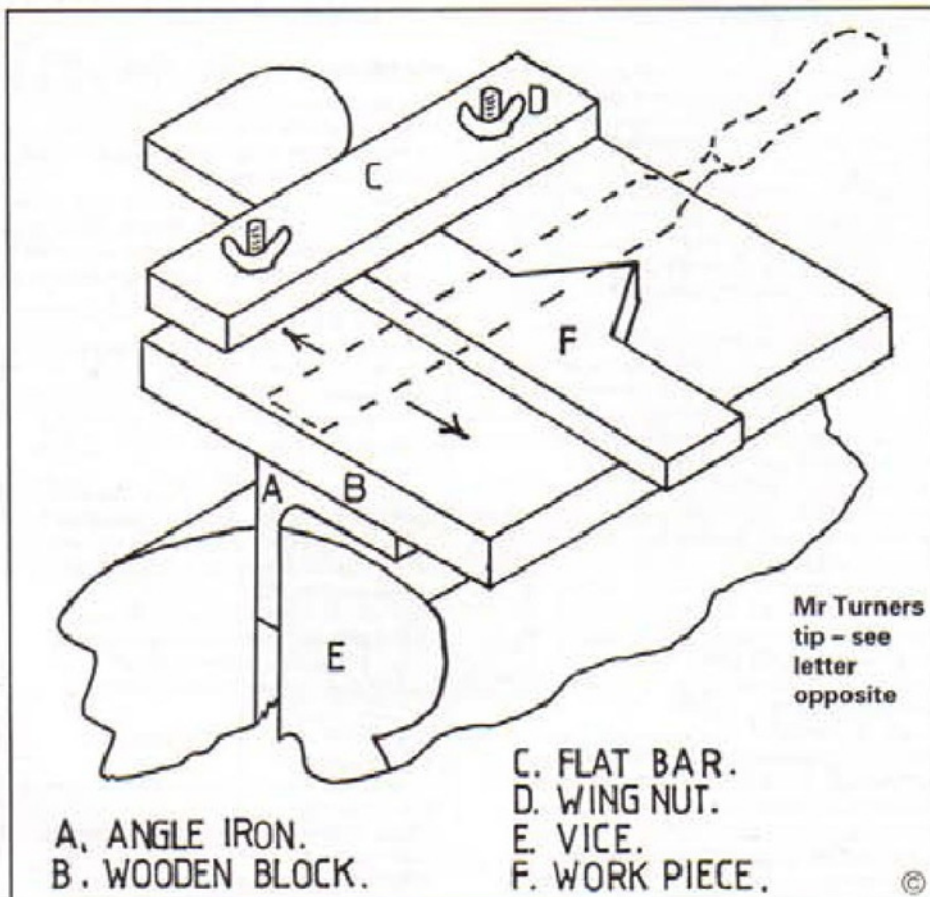
I am now carrying on with the bandsaw in the hope that I can complete it. Please keep up the good work with the magazine.

Reader identity and square holes

Ron Dyer of Boucherville, Canada writes on a number of subjects and is seeking help on some; can any reader help?

Once again congratulations on the very fine magazine M.E.W. Your continued emphasis on SAFETY is particularly to be applauded.

1) While it is a little unusual, and quite nice, to have an Editorial preamble to Readers' Letters, there is a certain loss of precision with this format. For example



"Chris Ball of Canada states that....." Now Canada is a big place! It would add some interest to include the Province and even the town or city. (Thanks for the hint, this is now being done - Ed.)

2) Square holes. I remember that in the '60s, Scientific American featured a very comprehensive paper on square holes and square wheels. The bicycle with square wheels, featured in a photo, was said to ride quite smoothly! I wonder whether a reader with access to a good reference library could turn up the precise reference? Drilling square holes was a major feature.

3) Can any knowledgeable type show me design details for a single top pan balance or scales, with counterbalance to indicate the weight on two or more bars along the front. The single top pan is rectangular, with rounded corners, about 9 x 5 x 2 in., and made from polished stainless steel. These things were available retail some years ago, somewhat costly and at the time I did not have the cash to spare for one of these. Now I have the cash, but lack the source! I almost have the capability of making one. Forming the stainless-steel pan might be a problem. I do have a hydraulic press. However I might have the pan custom-made.

4) I am very interested in finding a source for Cobalt-Titanium bits, can any reader suggest a supplier?

Tool design - and lessons learnt

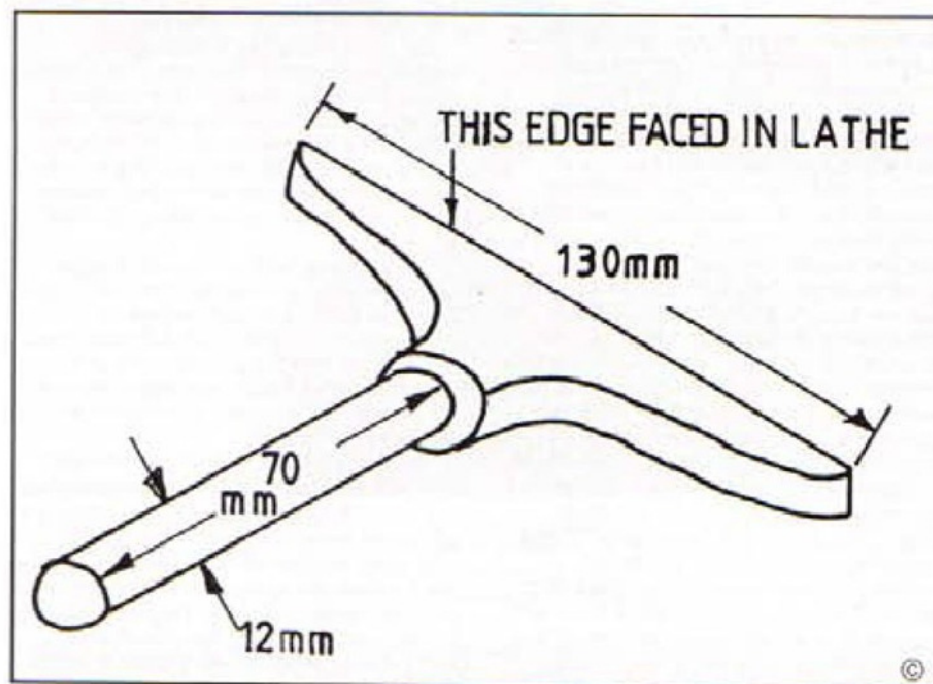
Some further comments on the purpose of designs in M.E.W., this time from Bob Fletcher of Leeds:

I read with great interest the letter from Mr. Chris Ball from Canada, published in M.E.W. issue No. 17. I do so agree with his comments that designs and articles published in M.E.W. should be considered as a starting point.

My view is that articles should be presented as simply as possible so as to encourage the newcomer to the hobby to try their hand and end up with perhaps not an exhibition item but a usable piece of equipment. I feel that the more experienced operator will always incorporate his own ideas and thought into any design. He may, for example choose to elaborate from a simple indexing ring to a full blown 360deg. engraved work of art. I sometimes doubt if it will operate any better than the simple version, but it certainly looks more professional.

To give an example of the useful information given in articles published in M.E.W., to one who has had a workshop for some 40 years. I have been working on a piece of equipment for my workshop which requires the work table to be traversed back and forth, I have spent a number of hours on the drawing board trying out different methods of leadscrew and nut, rack and pinion devices and so on, with no really satisfying results. When the latest edition of M.E.W. arrived on the doormat I thumbed through the pages in my usual manner and came across Mr. Derek Brook's excellent article on a tool and cutter grinder.

I do already own such a tool so I have no intention of making the item but I did spot his method of moving the table by using a chain and sprocket. A quick drawing was made and proved to be the perfect answer to my problem. I had to smack my wrist for not thinking of it for myself. I have to say to Mr Brooks that I have stolen his idea for my



own use but in the context of the magazine ideas are there to be passed on.

To add weight to the brick thrown by Mr. Ball, I too consider the inclusion of advertising within the main body of M.E.W. to be most irritating and a nuisance. I fully understand that advertising is a very important and desirable source of income to the magazine and a useful form of information to the reader. It gives an indication of what is available in the market place, but I do consider that it should be restricted to an advertising section at the front and rear of the magazine, we would at least know where to look for this type of information.

Identifying stock materials

Derek Walters of Tetbury suggests a better way of marking metal bars to ensure that the grade of metal is known all the way down to the end of the bar

I don't wish to criticize our editor and his writings in On the Editor's Bench, issue 17, but if you should forget to re-mark the end of the bar, having just cut-off the end which was marked, then — 00000s — and ignorance is bliss.

May I offer a method that is used in many factories which is more or less "twerp proof".

You will need some large felt marking pencils of say, black, grey, red and yellow, plus a simple paper chart.

Start with a single line along the whole length of the bar of material, then record the details on the chart, perhaps as below:-

1 line, Black = EN1A steel. (Use for all material diameters).

1 line Black, 1 line Grey = EN3B steel.

1 line Black, 2 lines Grey = EN8B steel.

2 lines Black, 1 line Grey = EN16T steel.

1 line Black, 1 line Red = Cast Iron bar (Cont. Cast. also)

1 line Black, 2 lines Red = Nodule or graphitic Cast Iron

1 line Black, 1 line Yellow = Dural - specify grade or coding.

Other materials should be recorded in similar manner.

(I have to admit, I have only done steel and cast iron as yet).

Lathe chuck square

This simple, but none-the-less useful device has been sent in by N.A. Browne of Durban, South Africa:

May I present other amateur engineers with a little magic wand which spares me many moments of irritation and frustration. I call it my Lathe chuck square.

The sketch is self evident and the material for mine was a 15mm slice of railway line, although any scrap may be used. I claim no originality for the idea, as when once made the subconscious has a way of storing things and sometimes presenting them to the conscious when most needed, or least expected.

The square is held in the lathe chuck and the vertical slide, angle plate or whatever brought up to the accurately faced edge at right angles to the lathe axis in both the horizontal and vertical planes.

The square can also be used with the tailstock drill chuck for squaring up thin pieces in the jaws of the self centring chuck.

I have used the square in my drill press for years, to make sure that articles to be drilled are square to the drill axis. should a D.T.I. be necessary for precision the Chuck square will bring you almost there, the rest is touching up.

Southbend lathes - another request

Barry Smith of Goring-on-Thames is also seeking help regarding a Southbend lathe:

I have just purchased a 5in. swing Southbend lathe. It came with a few change wheels and little else. Not being a proper model engineer yet I need help. Can any reader advise how to deal with the five wheels; is there a handbook available, what are the two bolt holes on the back of the cross slide for, and finally is there a U.K. importer/dealer or does anybody know where to write to in the U.S.A.

At the moment I am just looking down a black hole, the smallest help would be much appreciated.

A MICROMETER ADJUSTABLE BORING ADAPTOR FOR 3 JAW CHUCKS

Following his design in the last issue for a boring head using a four jaw chuck, Al Longworth now achieves a similar result by adapting a set of soft jaws for a three jaw chuck.

As well as the obvious advantage of economy when compared to a commercial product, it also has the benefit of being virtually balanced throughout its range. It can often be run at a higher speed than would be practical with other designs

Unless in fairly constant use micrometer adjustable boring tools are expensive items for the home workshop, and, as is usual, many amateurs find other methods. Alternatively they will make their own, which is quite a task.

An easy to make alternative

It was whilst pondering this, that it struck me that the 3 jaw self centring chuck could easily be adapted to perform a wide range of boring jobs. This could be done whilst requiring no modification to its primary function of workholding for turning.

As can be seen from the photographs and drawings, the adaption is of a Pratt Burnard 4 inch self centring three jaw chuck. However, it is obvious that it can equally be applied to any other make or size of chuck. To limit out of balance conditions, it was decided to use three modified soft jaws to cater for a wide range of boring diameters. This would enable the wide range to be achieved whilst still retaining the jaw largely within the diameter of the chuck. This also allows higher speeds than those permissible with the average boring head on larger diameters. The jaws can be extended beyond the diameter of the chuck to obtain diameter up to say 5 inches still with negligible vibration at higher speeds.

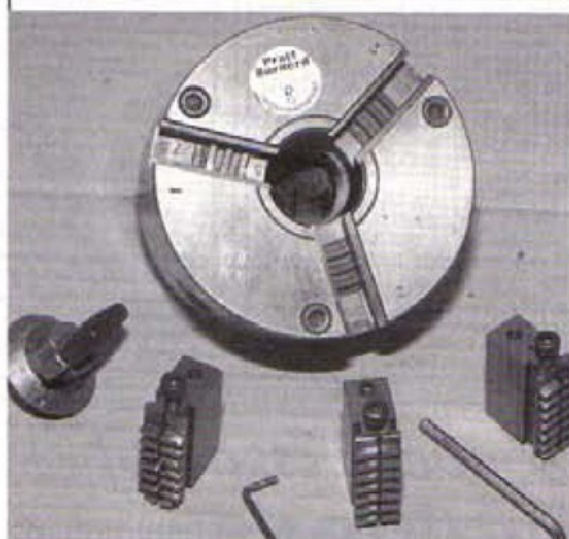
If desired, only one modified jaw may be used at a time the other two being the standard jaws. For the larger diameters the extra weight of the standard jaws will help to balance the weight of the tool bit in the third jaw.

Modifying the soft jaws

The modifications to the standard soft jaws should be self explanatory from the



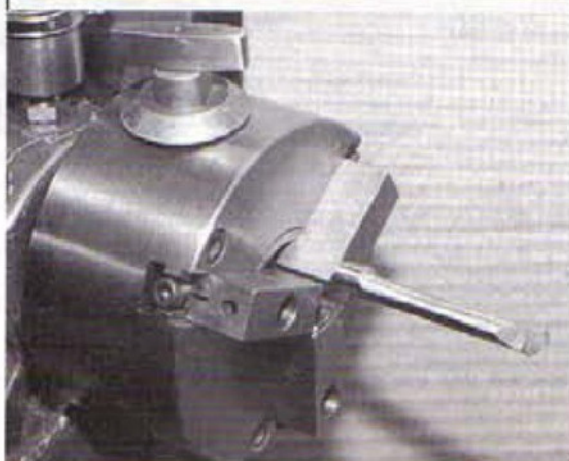
1: The finished boring adaptor, note the calibrated adjustment.



2: The adaptor prior to assembly showing the jaws and how these are split, this permits them to be expanded by means of the screw seen in the end. The arrangement enables the jaw to be locked in position whilst a cut is being taken.



3: Mounted on the lathe with the cutter placed in jaw number one for machining smaller diameters. The key is, of course, removed whilst in operation.



4: Showing the cutter mounted in jaw number three for machining larger diameters.

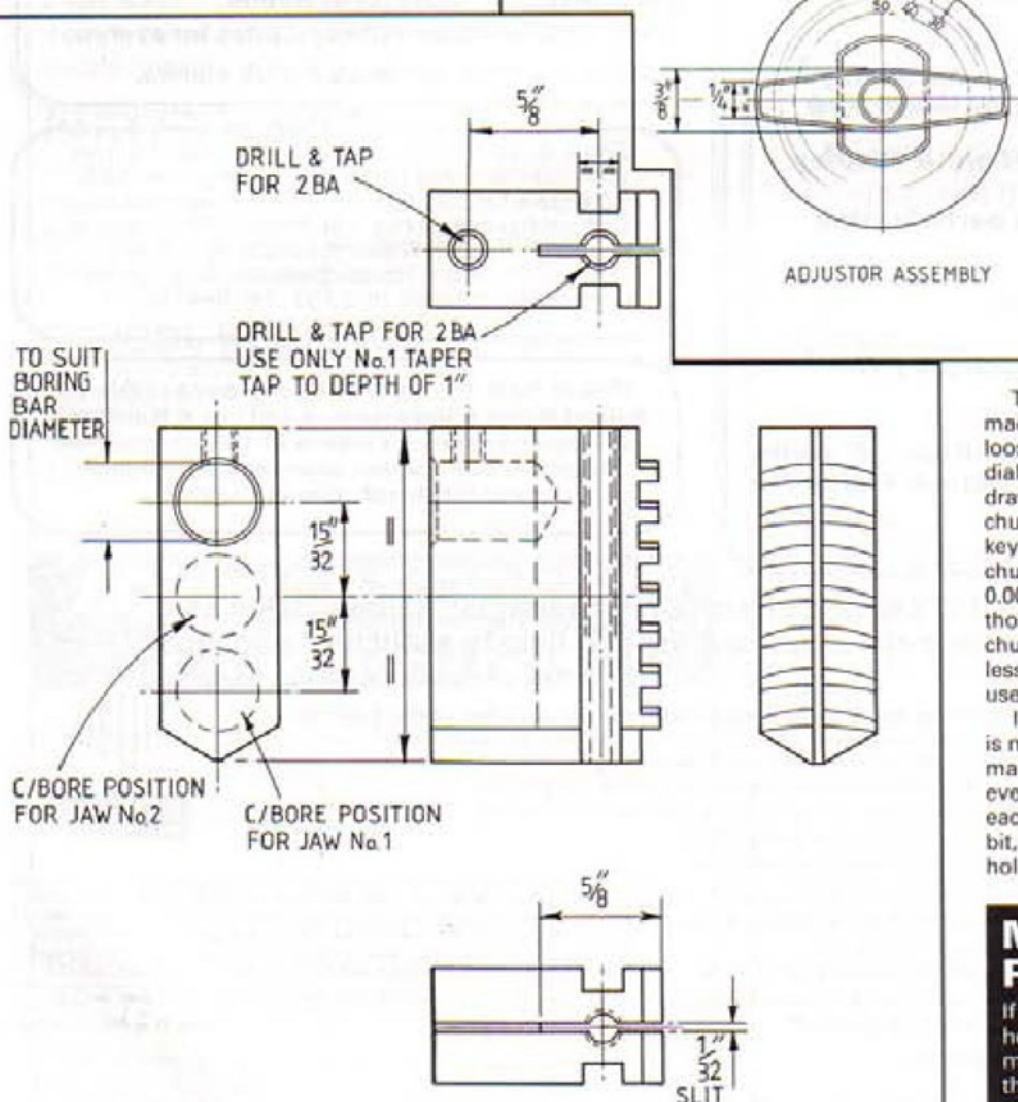
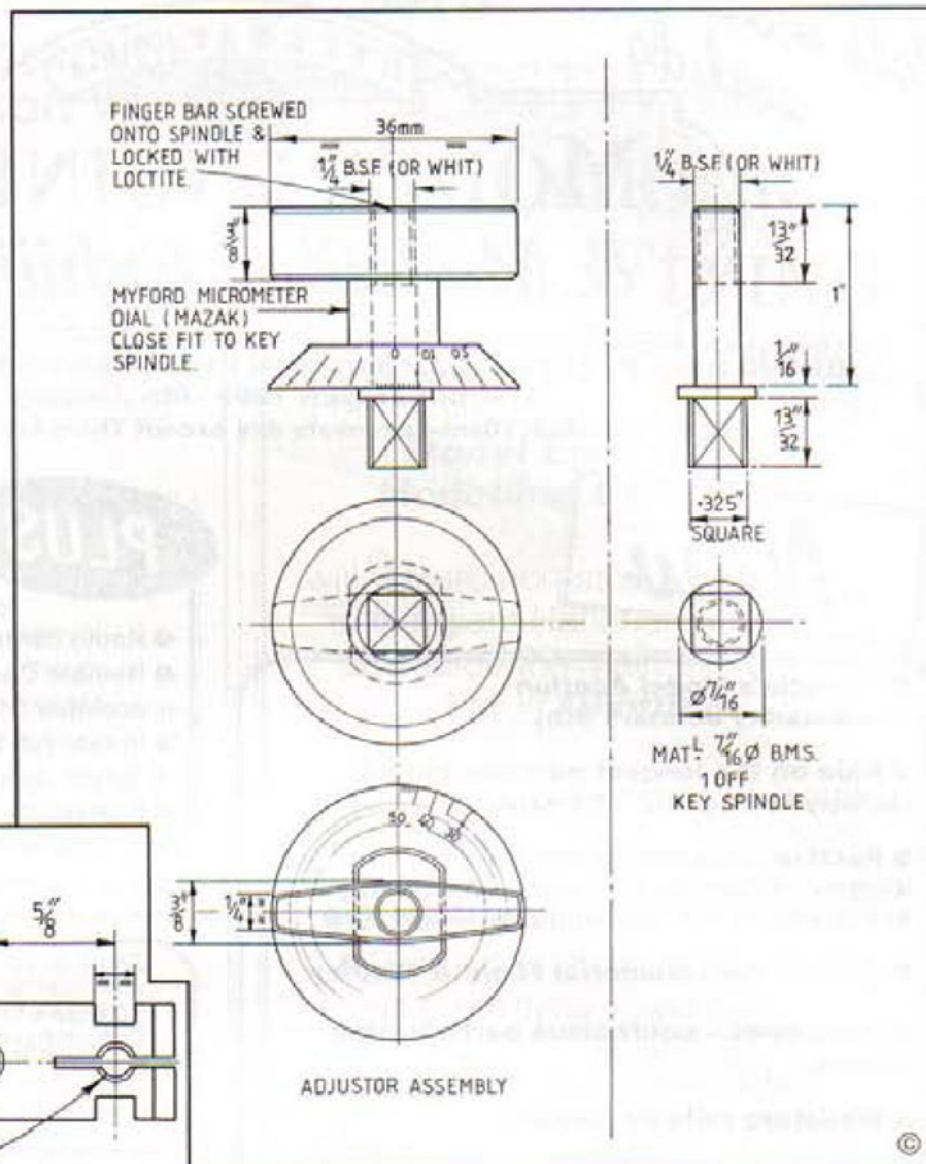
drawings and photographs, and comprise counter bores for the three alternative positions for the boring tool bit. The smaller diameters are catered for on jaw number one and progressive diameters by bores in jaws two and three.

Prior to the slots being cut in the jaws, either by hand or by the use of a slitting saw held in the chuck, a hole for tapping 2BA is drilled longitudinally through each jaw and then tapped with a 2BA taper tap. This will, when assembled to the chuck, be fitted with a $\frac{1}{2}$ in. long cap head screw. This is used to expand the jaw body to eliminate the play which is normal between jaw and body. This play is normally eliminated when the jaw is tightened onto the workpiece being held in the chuck for turning.

It will be seen from the drawing that the tool bit is held into the counterbore in the jaw by means of a grub screw, preferably a cup point type. The tapped hole will of course be deeper for the counterbores in jaws one and two.

Using alternative diameter boring tools

The counterbores can be any size up to 10mm (or $\frac{3}{8}$ in. if Imperial). If this larger size is chosen, smaller diameters can still be accommodated by the use of a split collar.



SOFT JAWS FOR PRATT BURNERD S/CENTRING CHUCK

BORING ADAPTOR FOR 3 JAW CHUCK

To enable measured adjustment to be made to the swing of the tool bit a simple loose chuck key with a Myford lead screw dial is made, the details are shown on the drawing. A cursor mark is scribed on to the chuck body at each key socket allowing the key to be used in any position. For the chuck used, each division on the dial gave 0.0005 in. movement of the bit, giving 50 thou for one complete turn. Other makes of chuck may give a different result, perhaps less logical; but the calibration will still give useful indication of adjustment made.

It will be appreciated that as adjustment is made all jaws will move, therefore maintaining a good degree of balance. For even better balance short lengths of bar, each weighing the same as the tool bit, could be fitted into the unused holes.

MILLING FORMULAE

If you need to mill a square or hexagonal head on a piece of round material, the following formula will give the minimum diameter of material required:

Square: $AF \times 1.415$
Hex: $AF \times 1.083$
Alan Jeeves

*Lots more to see
and do at the*

INTERNATIONAL 63rd MODEL ENGINEER & Modelling Exhibition

GRAND HALL OLYMPIA, HAMMERSMITH ROAD, KENSINGTON, LONDON W14 8UX

31st DECEMBER 1993 - 8th January 1994

OPENING TIMES: 10am-6pm every day except Thursday 6th January 10-8pm.

New

● **Christie's Model Auction**
(Wednesday January 5th)

● **Ride on the longest portable model railway in England - 7½ gauge**

● **Festival of Indoor Model Flight - the biggest indoor flying event ever all day every day in the adjoining National Hall**

● **The Arnhem Memorial Flight & Display**

● **Wargames - continuous participating games.**

● **Miniature railway layouts**

● **Ship and engineering display by The Maritime Museum**

● **Driver of The Year Competition - 2" scale Clayton Wagons (Thursday 6th & Friday 7th January).**

PLUS

● 100's of models on display
- boats, aircraft, cars,
locomotives, science fiction

● Radio control boats

● Remote Control Cars

(December 31st January 2nd, 3rd & 8th)

● Indoor fun flying (DPR January 1st, Midair & SAMS January 6th)

● Scalextric - races for everyone

● 5" - gauge steam railway - rides for everyone

● Associations, societies & club stands.

Show Guide giving a diary of events available from 3rd December. **Auction enquires** ring Tom Rose, Christie's Tel: 071 581 7611. Further information, Competition entry forms and details of RNLI special train from north Wales obtainable from Argus Exhibitions, Argus House, Boundary Way, Hemel Hempstead, Herts. HP2 7ST. Tel: 0442 66551

Grand Hall, Olympia is easily accessible by

● Road ● Rail ● Underground and bus ● Mainline & Underground stations adjacent. Some trains from Brighton, Manchester, Liverpool, Birmingham and Edinburgh stop at Olympia.

Admission: Adults £5, Senior Citizens £4, Children £2, Family Ticket £12
(2 adults & up to 4 children) - 2 day and season tickets available in advance.

Argus Specialist Publications with Hilton hotels are offering special rates for the duration of the Exhibition.

Hilton National London Olympia	Located on Kensington High Street, home of the most fashionable and exciting stores in London	£31.05
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Plaza on Hyde Park	Close to Victoria and Albert Museum & Kensington Palace	£29.90
Sherlock Holmes Hotel	Near Madame Tussaud's & London Zoo	£32.20
The Clive Hotel Hampstead	Small & welcoming, close to Hampstead and its Heath	£24.15

Prices are for each guest each night for Twin/Double Room (£14 single supplement) and include Continental breakfast, (except The Langham Hilton and London Hilton on Park Lane which include English breakfast), private bath/shower, tea/coffee making facilities and VAT (single supplement £30 at both hotels). There is a supplement of £5.50 for full English breakfast.

HILTON

HILTON

Booking Form - International Model Engineer & Modelling Exhibition

Make it a Model Stay

Name _____ Address _____ Postcode _____ Tel No _____
Accommodation required: Double ☐ Twin ☐ Single ☐ No in party _____ No of nights _____

Choice of hotel _____ Dates required _____
Payment by: cheque ☐ Access ☐ Visa ☐ Diners ☐ AmEx ☐ My Credit Card No _____ Expiry _____

There will be a return coach service direct to the Exhibition at a cost of £6.00 per person on the dates shown. Please tick if required: January 1st ☐ January 8th ☐

Return booking form to: Heidi Ross, CRO, Hilton International, PO Box 137, Watford, Herts WD1 1DN. Tel: (0923) 238877

Olympia, Hammersmith
Road, Kensington W.



31st December 1993 – 8th January 1994

ADVANCE BOOKINGS

Adults	at £4.50	No	Amount	£
Senior Citizens	at £3.50	No	Amount	£
Children (5-16)	at £2.00	No	Amount	£
Family ticket (2 adults + up to 4 children)	at £12.00	No	Amount	£
2-day ticket	at £8.00	No	Amount	£
Season ticket (Entire Show)	at £20.00	No	Amount	£

PARTY BOOKINGS (for groups of 10 or more)

Adults	at £4.25	No	Amount	£
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Children (5-16)	at £2.00	No	Amount	£
1 free ticket per 25 people				

SCHOOL BOOKINGS (for groups of 10 or more, one teacher free per 10 pupils)

Teachers	at £4.25	No	Amount	£
Pupils	at £2.00	No	Amount	£
Teachers – free of charge	No			
Total enclosed £				

ADVANCE BOOKING INFORMATION

I enclose cheque/P.O. for the total amount stated above, together with an S.A.E. for return tickets.

Cheques made payable to Argus Specialist Exhibition (AT) and sent to Argus House, Boundary Way, Hemel Hempstead, Herts. HP2 7ST. Tel: 0442 66551.

Name

Address

.....

.....

Closing date – December 10th 1993

ME

FESTIVAL OF INDOOR MODEL FLYING

Hosted by the Model Pilots Association

For the first time ever, this year's
**Model Engineer &
Modelling Exhibition**

will feature non-stop model flying
in the giant National Hall, right
alongside the main exhibition
hall in **Olympia.**

The all-day, every day action will include:

- Bring-and-fly sessions for visitors to operate their models.
- Team racing with **KK Phantoms!**
- Electric and internal combustion control line flying round the pole.

Trade demonstrations include
R/C helicopters and fixed wing designs.
DPR Models and **SAMs** fun-fly events.

Various competitions to enter
with prizes to be won!

Full commentary on all the action.

The events, with the exception of the
model trade demos, are open to all, so if
you've got an indoor model (or even a
small outdoor one!) bring it along
and have fun with the rest of us!

Please note: IC engines must not exceed
1.5cc and maximum permitted line length
for control-liners will be 35 feet.

All models will be the subject of
scrutineering before they are permitted to fly.

Sport or scale, free flight, rubber, electric,
CO₂, R/C, chuckie, RTP and C/L - they're all
welcome and the action promises
to be non-stop.

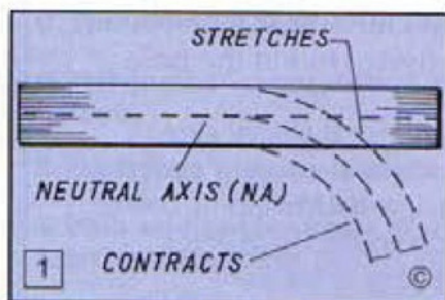
See you at Olympia!

BENDING STRIP MATERIAL

In this article, Mr R Harries offers some useful suggestions regarding bending strip materials using the minimum of specialised equipment. He also includes the method of calculating the required length of the flat strip prior to bending

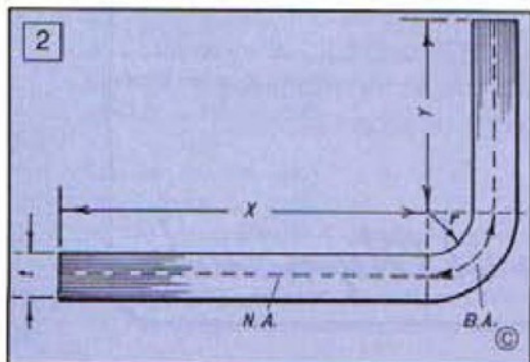
Many useful shapes can be produced from standard materials in rod, strip and sheet form by the process of bending. Industrially, the process has extensive application assisted by complicated press tools but here we are concerned with simple shapes that can be formed by hammering or folding the material round bending blocks and formers.

It might be as well, at this point, to note what happens to material in the course of being bent. **Fig.1** shows a piece of flat material that has been bent and it will be clear that the outer skin is stretched while the inner surface contracts. Approximately halfway through the thickness of the material is a line which remains constant in length (known as the neutral axis or N.A.).

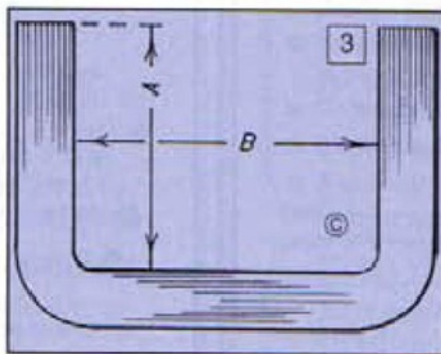


All allowances for material length absorbed in bending should be worked out on this line. No material is ever bent to a sharp internal corner but has a definite radius. The thicker the material and the harder it is, the larger should be this bend radius.

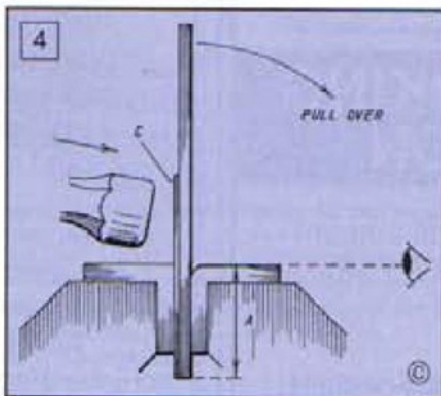
A simple right angle bend is shown in **Fig.2**, from which will be seen the bend allowance (B.A.). Knowing the bend radius and the thickness of the material it is clear that the bend allowance is $90/360 \times 2\pi(r+t/2)$ and therefore the length of material required for such an angle bracket is $X+Y+B.A.$ The bending allowance becomes significant on thick material, with a large bend radius and angle of bend. On more complicated shapes, comprising several bends, the all over B.A. is the sum of the individual B.A.s.



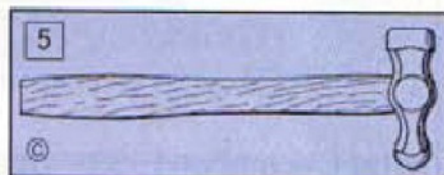
A knowledge of bending allowances is mainly of concern where the complete developed shape of the component has to be cut out prior to bending and all the holes necessary incorporated at this stage. When working with strip material however, the worker can often carry out his sequence of bends on a longer length of material than needed and finally cut off to size after the last bend has been completed. An example will explain this. Suppose we are called upon to bend up the U-shaped bearing bracket, **Fig.3**, the internal dimensions being A and B. The first step is to mark off



length A from one end of the strip, which is then clamped in the vice between angle steel clamps, so that the line coincides with the top face, **Fig.4**. The front angle has been filed to a suitable radius at the bend point. Sight as shown and check for vertical with a try square. Hold the top of the strip and, while pulling over by hand, apply hammer blows to point C.

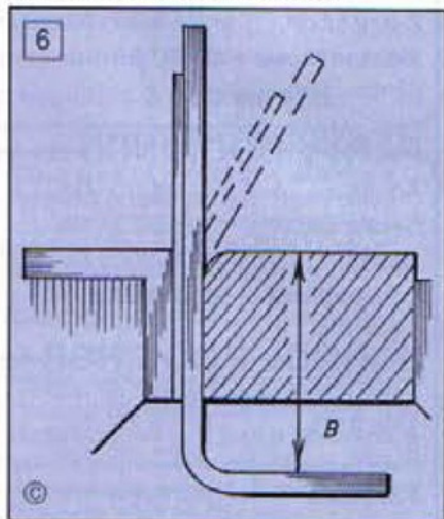


Use a heavy hammer – a ball pein type of about 1lb weight, **Fig.5**, would be a good buy. To avoid the danger of marking the material by the hammer blows, it is a wise precaution to clamp up a piece of scrap sheet material to the back of the strip, as shown, so that the hammer blows land on it first. Alternatively, interpose a block of softer material than the hammer head to strike on, or use a copper headed hammer. If the strip vibrates when being struck and stings the hand, wrap a cloth round it

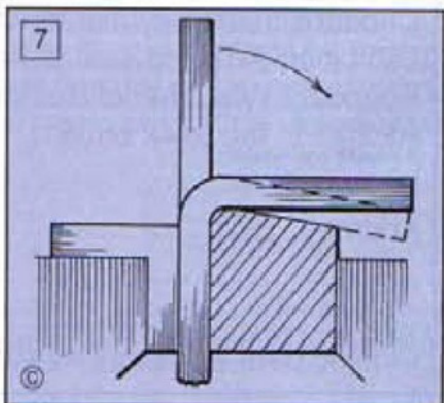


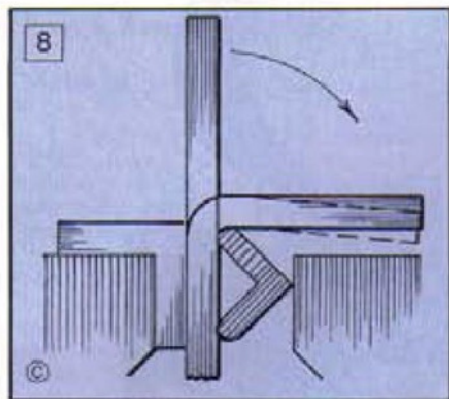
where held.

Having taken the strip over through a right angle, mark off the length B from its inside face and set it up as in **Fig.6**, substituting a bending block for the front angle so that the first bend does not foul the vice. The top of the bending block should coincide with this marked line. Bend over as before and finally cut off the surplus strip so that the arms length A match up.



It will be found in practice that some materials being bent are so elastic that they spring back after being hammered over the bending block and do not hold to their right angle. In such cases it is necessary to overbend in the first instance so that the spring back can be compensated for. To do this the angle of the bending block must be made more than 90 degrees as in **Fig.7**. The block can be located on the back angle bar by means of a dowel pin each end. A quickly improvised bending block for overbending can be made from another angle bar of smaller section, as shown in **Fig.8**.





Another way of producing overbends on a 90 degree block is to raise the strip in the vice after bending and slip a piece of wire between the strip and the radius on the block. Further bending of the strip is now possible beyond the 90 degrees. Correction of excessive overbending is done by levering up the end of the strip against the vice top with a stout screwdriver.

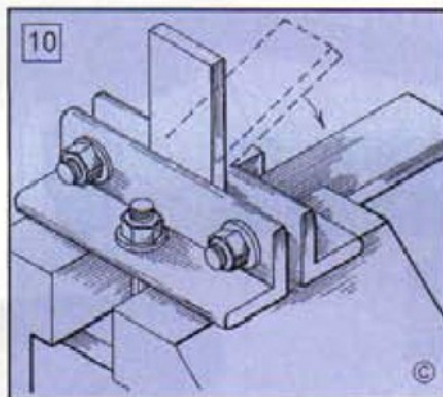
Having shaped the U-bracket, the bearing holes which it carries are then marked out each side at the same height relative to the base, using a scribing block. This ensures that the shaft accommodated in the holes is parallel to the base. If the bearing holes are drilled prior to bending there is a danger that they will not be parallel, line up or even be truly round due to variations in setting and the reaction of the material to the bending blows.

It will soon become apparent that the vice on its own is really not suitable for single bands through angles up to 90 degrees, except on limited sizes. Components with two or more bends, carried through angles of perhaps more than 90 deg. can only be made with special attachments to a vice. Examples of such components are seen in Fig. 9, the shapes being U-form, Z-form, top hat, square loop and stiffened bracket.

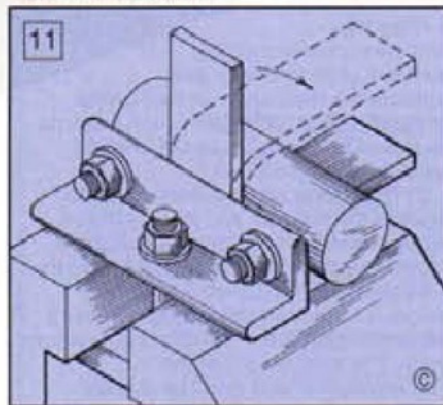
The home-made attachment for performing these more involved bends is seen in Fig. 10 and merely consists of two stout angle pieces bolted together back to back and held on top of the vice jaws with a central bolt, passing down through the nearer angle into a square washer which hooks under the vice jaw ledges. The farther angle has its top bending edge radiused and sloped downwards to allow acute bends to be made. It would be an advantage to caseharden this edge if much use of the device is anticipated.

The strip to be bent is clamped between the angles and also the vice jaws where it

passes down through them. It is therefore automatically positioned at right angles to the bending edge. The forces set up by hammering the strip over the bending edge are resisted by the holding down bolt and the grip of the vice jaws on the strip. The mass effect of the vice also promotes greater rigidity. After each bend the strip is released, moved into the position for the next bend, clamped up again and hammered over. The minimum dimension between the arms of a U-bend or square loop that can be achieved is the same as the section size of the angle. A little thought must be exercised in determining the best sequence of operations when bending up a complicated form.



If the back angle in the set-up of Fig. 10 is replaced by a cylinder, Fig. 11, then it is possible to bend radiused forms. Some of these possible forms are shown in Fig. 12, the last two bends requiring the application of a radiused-end punch to tuck the metal back into the corner.

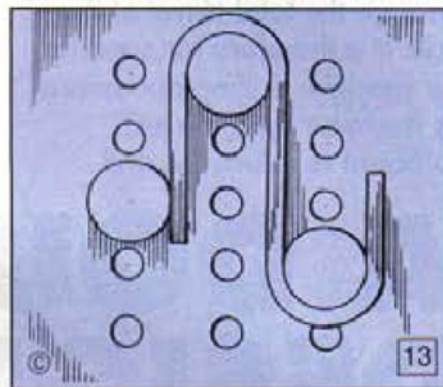


A thick metal plate, into which dowel pegs and blocks can be inserted in various pre-drilled holes, Fig. 13, is sometimes used as an aid to radius bending of strips

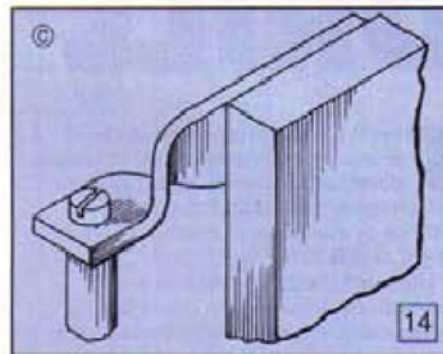


for cleats, etc. In the bend shown, the lower peg is first removed to form the top loop, it is then replaced to make the lower return bend. Thin strip can be bent cold, while heavy strip will need heating to red heat.

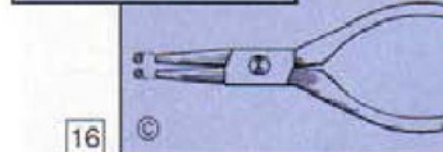
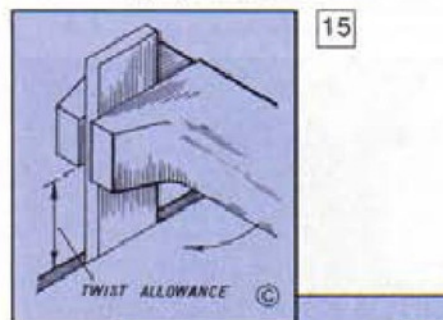
The twisting of strip section is often useful when the plane of attachment one end has to be at right angles to that at the other. A case in point is the bracket to hold a rod along the side of a light beam board, Fig. 14. It is convenient to do this bending



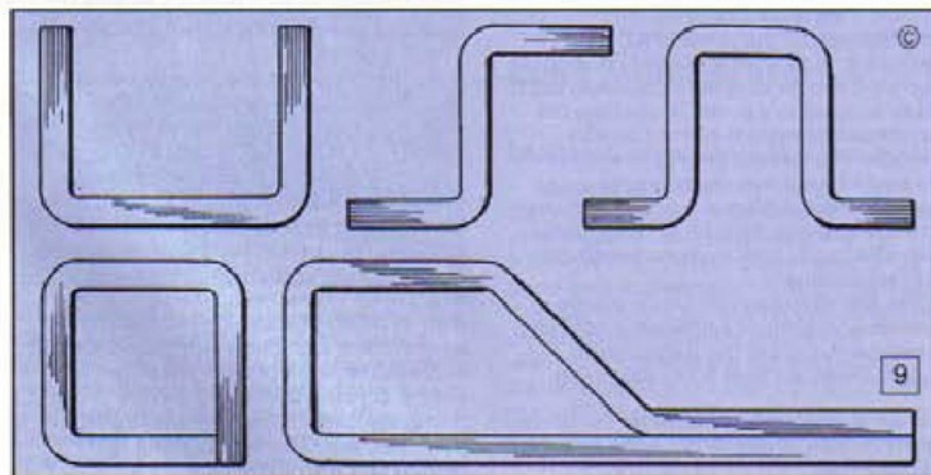
with the end of an adjustable spanner, Fig. 15. The length allowed for the twist will depend upon the section of the rod.



Several articles can be made from wire and rod by shaping in a bending process. The smaller gauge wire can be



manipulated with the aid of round-nosed pliers, Fig. 16, the round tapered nose enabling bends and loops of varying radius to be made. Wire generally comes in coils and should be straightened before any manipulation is carried out on it. The lighter gauges can be straightened by anchoring one end in a vice and gripping the other end in a pliers to give the wire a strong pull.



This small drilling machine has been provided by J Neave. He suggests two methods for the return of the drill to the rest position, either by return spring or by balance weights; the latter scheme has the distinct advantage that the operating pressure remains constant through the total travel of the drill. It is therefore far superior for sensitive drilling operations as it can be set to be just sufficient to return the drill

A DOUBLE DESIGN DRILL

This is a basic design to build a precision drilling machine, of simple construction, using largely standard section materials without the use of castings or complicated machining, to a choice of two systems.

The machine can be built as a conventional type using a return spring between the housing which slides on the vertical column, and the adjustable stop which is locked in the required position on the column. This design works quite well but unfortunately the spring itself creates certain inherent limitations on the operation of the machine, e.g.



(1) As the handle is operated through its stroke the compression on the spring increases proportionally and therefore the resistance on the handle increases, being particularly high towards the end of the available stroke of the machine by the closed length of the spring.

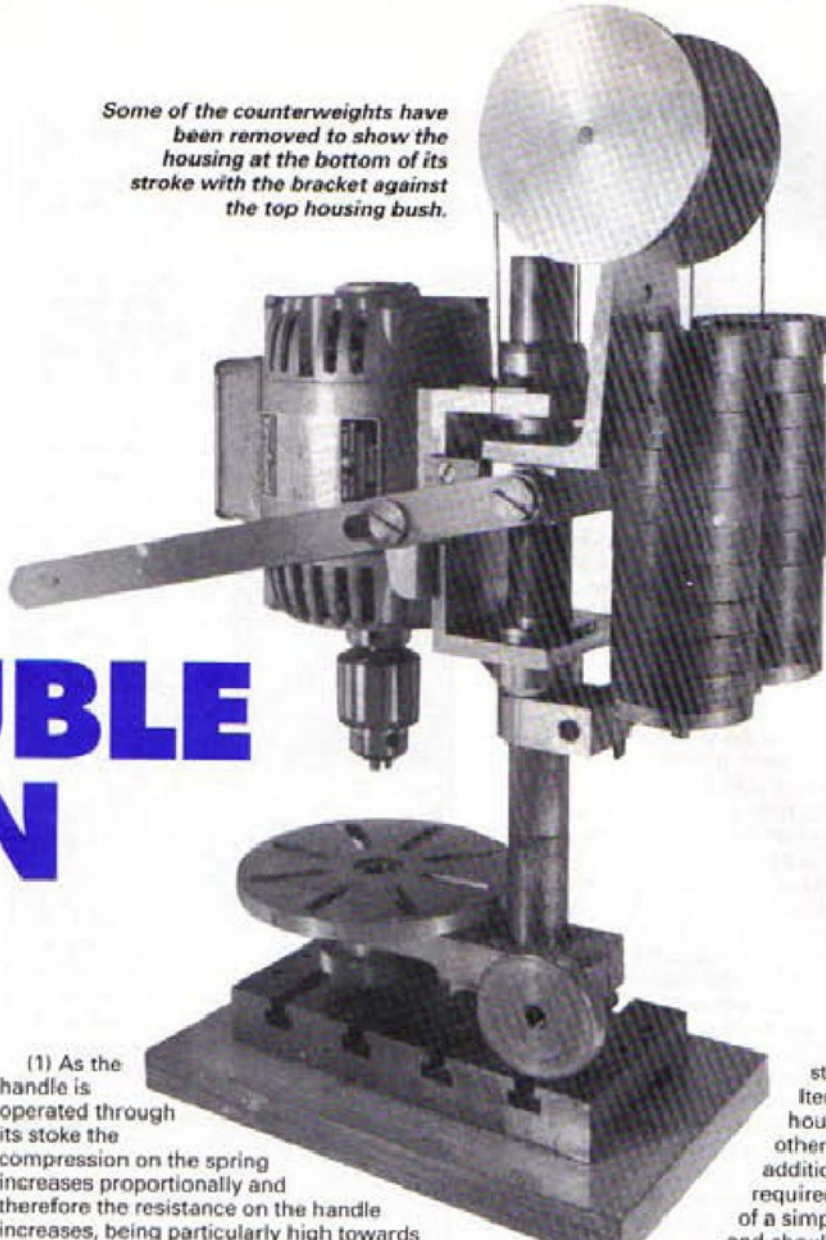
(2) The spring acts a distance piece between the housing and the adjustable stop, reducing the effective stroke of the machine by the closed length of the spring.

An alternative to the conventional design, is to remove the spring and use a counterweight system to activate the return stroke. The total weight of the counterweights used must be slightly greater than the weight of the motor and housing and also overcome any frictional losses in the machine to effect the return stroke. Obviously the overall weight of the complete machine must increase by this amount. This should be taken into consideration by the constructor. If the machine is to be used in a fixed position on a bench it should be quite acceptable, but if it is to be used as a portable machine the counterweight system will not be very practical. The General Arrangement Drawing of the machine shows the counterweight system in position and also shows the spring, item 34, in chain dotted lines. Obviously both systems would not be fitted together.

The alternative weight return design involves some minor additional machining to two items used in the spring return design. These are Item 3, the adjustable

The completed drilling machine, the spring return version. A simple but quite useful machine tool.

Some of the counterweights have been removed to show the housing at the bottom of its stroke with the bracket against the top housing bush.



stop, and Item 6, the housing. The other additional parts required are all of a simple nature and should present

no manufacturing problems to the model engineer or engineering apprentice. The author's machine, which was originally built to the spring return design and subsequently modified to the counterweight system, has now been in use for some considerable time. The result of this alternative system has been to increase the effective stroke of the machine by 100% from 1in. (25mm) to 2in. (50mm), and in addition the counterweights give a very smooth action and a fine "feel" to the machine, the handle of which is working against a constant resistance throughout its increased stroke. This makes it particularly suited to delicate and accurate drilling operations which are often encountered in model engineering.

As the design is based on the use of short lengths of standard sections, hopefully most of these will be found as off-cuts in the proverbial workshop scrap box, which of course helps to reduce the overall cost of the project. The motor used for this machine is a Parvalux SD11 1/2 H.P. shunt wound motor. The motor selected is of course very important. There is not much point in machining the parts to a high standard of accuracy and then fitting an old motor with badly worn bearings and expect a precision performance from it. Similar considerations apply to the chuck being used. A good quality unworn chuck preferably with a taper mounting is required for the best results.

Item 1. Base Board 1 off

Material: Good quality hard or plywood 0.75in. thick

Cut and clean up to overall dimensions (5.5in. x 9.0in.). The hole centres must be held as closely as possible to match the base plate, item 2. If a carpenter's brace and bit is used for the three counter bores these should be put in first, holding the depth, 0.437in. accurately. The three 0.25in. dia. holes can then be put in locating from the centres of the counter bores. The 1.0in. dia. hole could also be bored with a brace and bit. When the point just breaks through from the first side, reverse the wood and complete the hole from the reverse side. This will give a good clean hole. Once the Base board has been checked for alignment against the Base Plate, item 2, it should be given a couple of coats of varnish to preserve and protect it ready for final assembly.

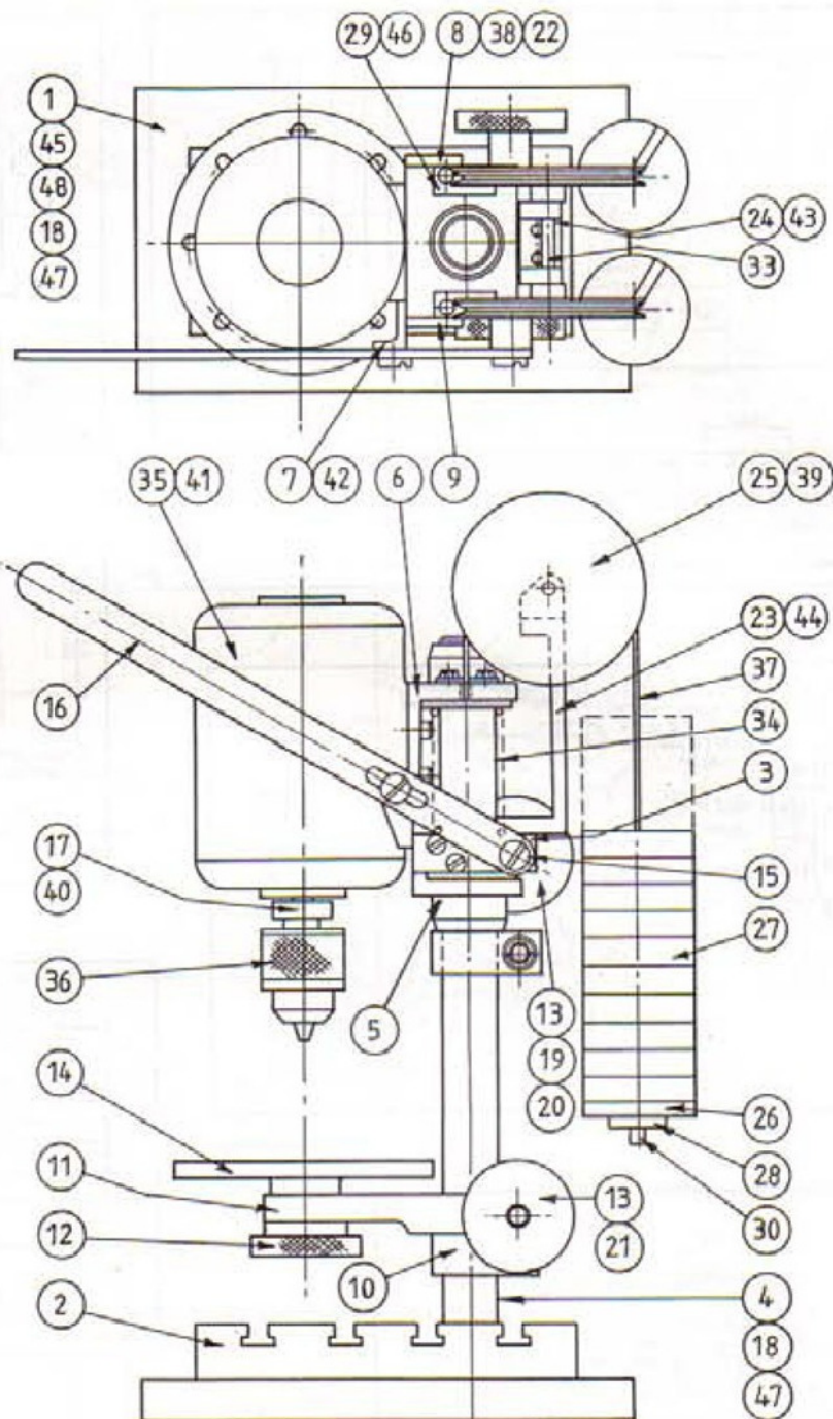
Item 2. Base Plate 1 off

Material: Cast iron

If cast iron is not available a piece of inch thick gauge plate is the next best thing. Machine to overall dimensions (3.375in. x 7.0in.). Both faces must be flat and parallel to each other. Mill the Tee slots to the dimensions shown. These are to Myford size and pitch. Drill and ream the 0.687in. dia. hole square to the base. Drill and tap the eleven M6 holes by 0.625in. deep, tapping drill 5.1mm diameter. The three M6 holes marked 'A' on the drawing should be tapped right through, positioned to match the corresponding holes in the Base Board, item 1.



The Drilling Machine being assembled. The Base Board, Base plate and Column are together, the housing with its bushes and motor in place have been slid down the column to rest on a stop collar. The adjustable stop is also in position inside the housing on the column.



G.A. DRILLING MACHINE

SMALL DRILLING MACHINE

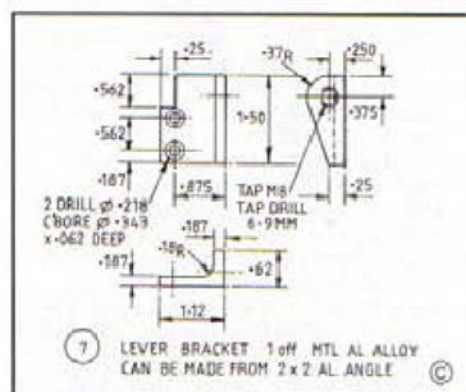
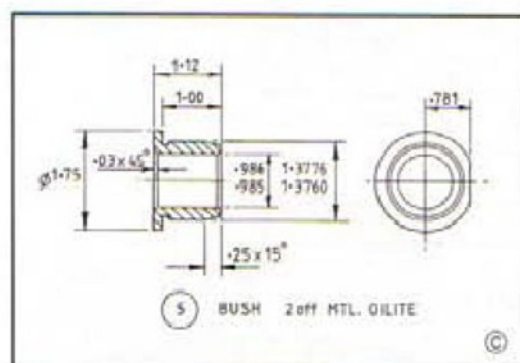
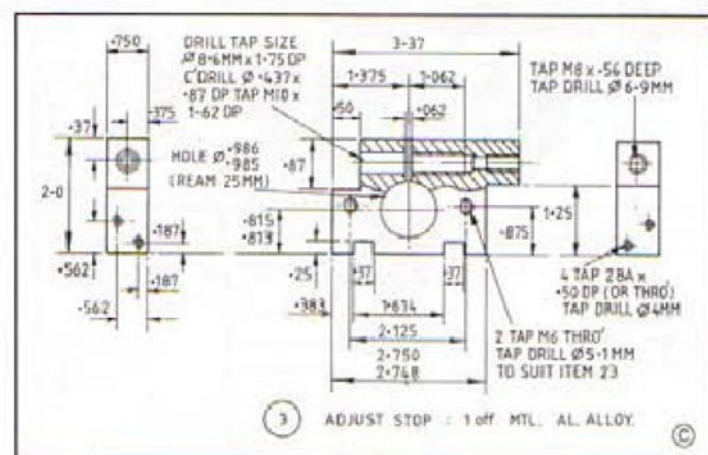
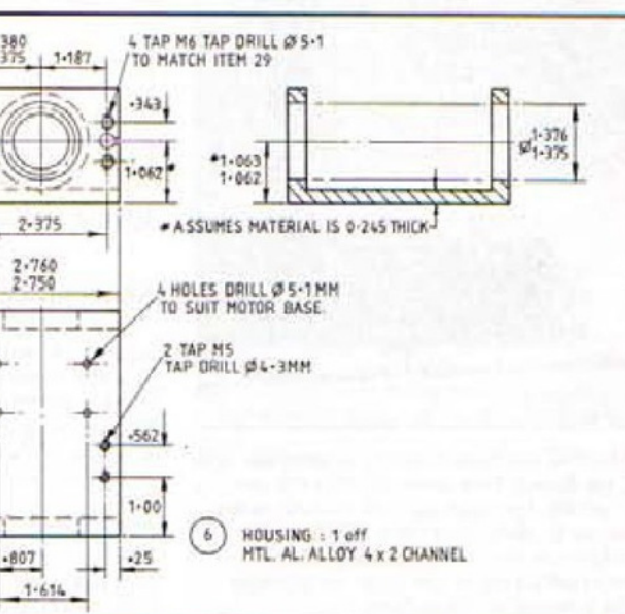
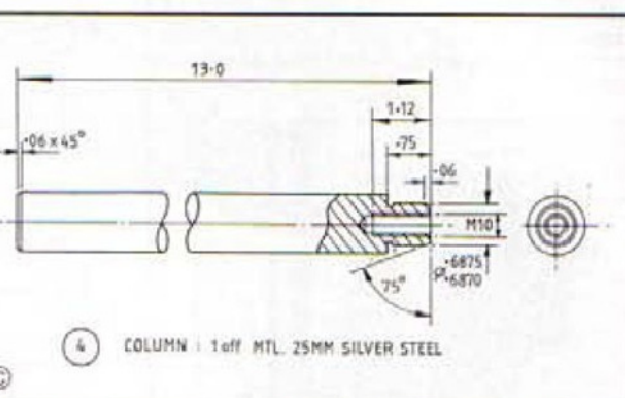
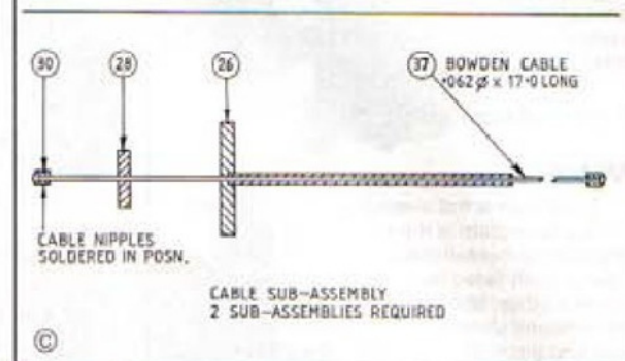
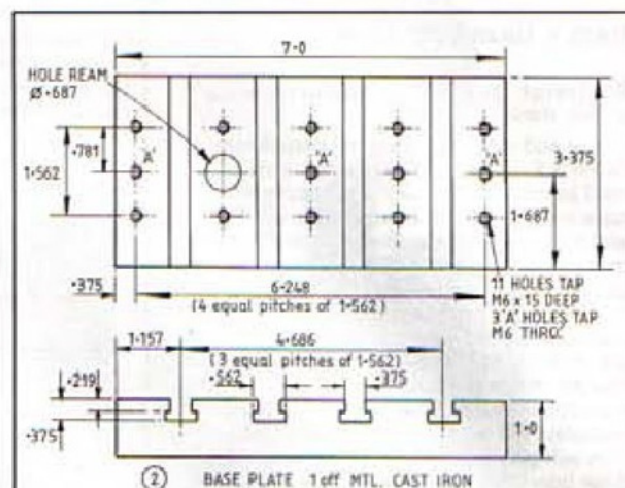
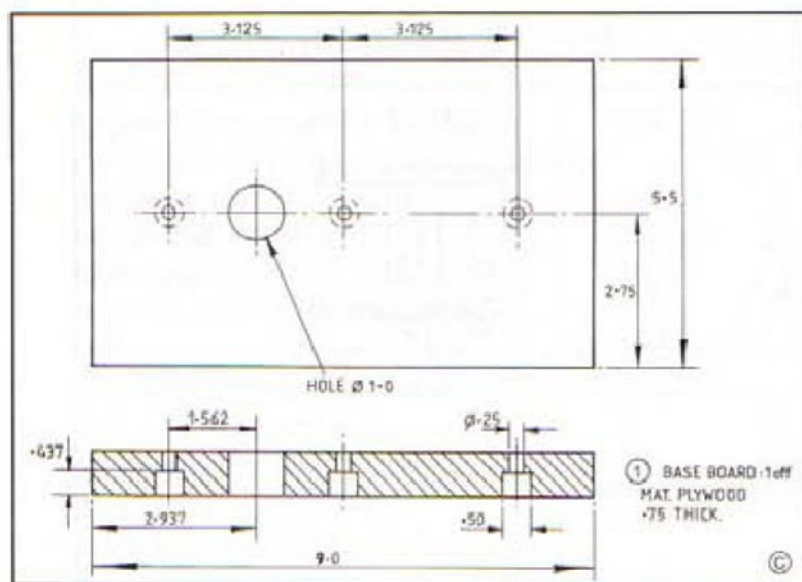
Item 3. Adjustable Stop 1 off

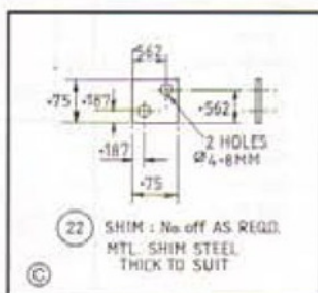
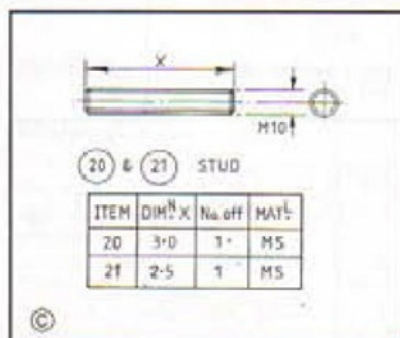
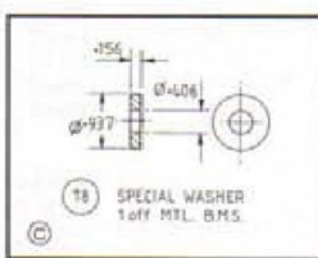
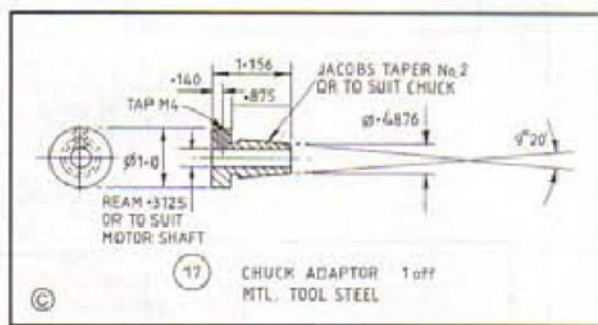
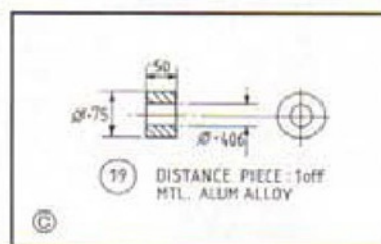
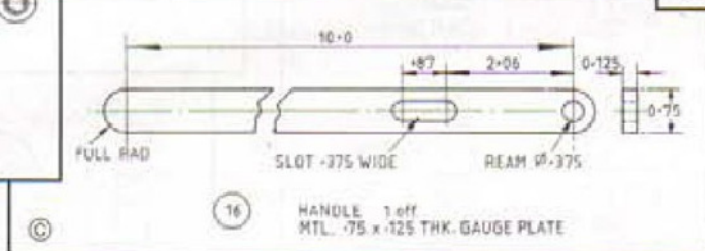
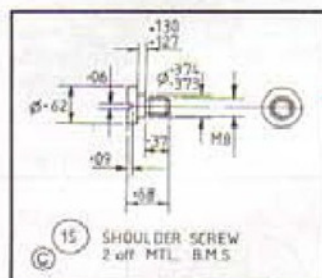
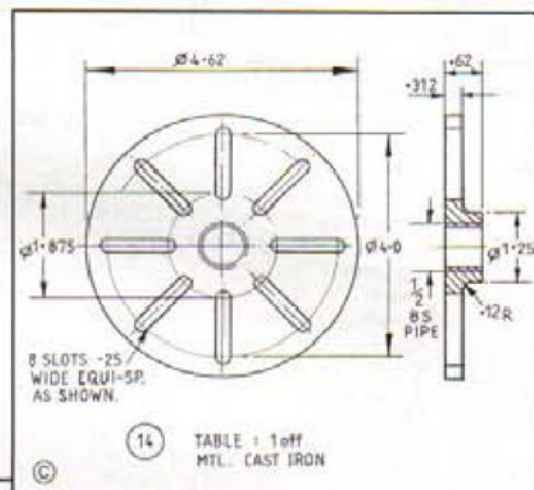
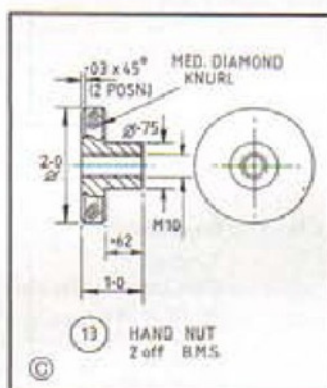
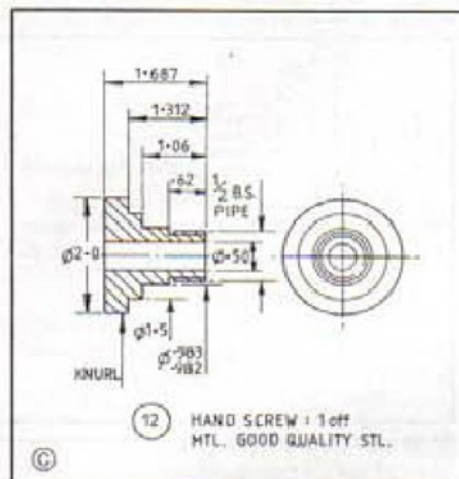
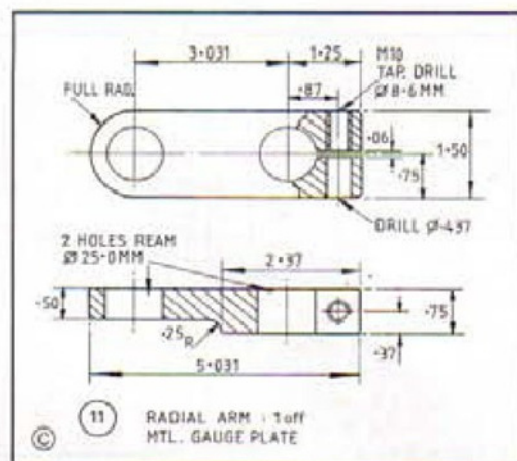
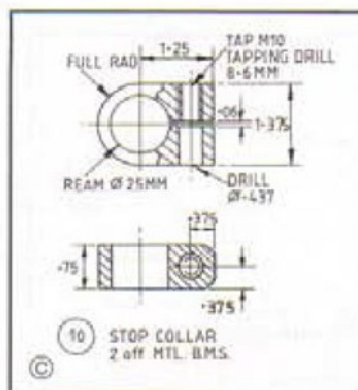
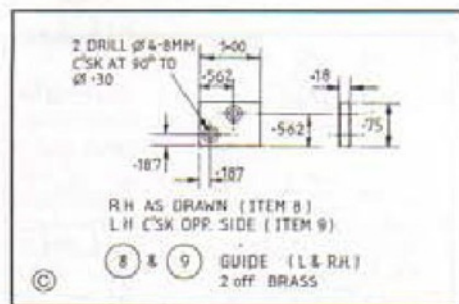
Material: Aluminium alloy 0.75in. thick

Machine to overall dimensions (2in. x 3.37in.). Bore the 0.986in./0.985in. dia. hole, or ream 25mm diameter. Hold the 0.815in./0.813in. dimension closely to get a good slide fit inside the housing assembly. Also the 1.375in. dimension should be held closely to centralise the column on assembly. Machine the two shoulders, 0.87in. x 0.50in. and 1.25in. x 2.750in./2.748in. the latter tolerance is required for assembly purposes later. The two 0.37in. wide x 0.25in. deep slots are to clear the heads of

the screws inside the housing, item 6, holding the motor in position.

If a motor other than the one suggested is used, modification may be necessary. Drill and tap the M8 x 0.56in. thread depth, (tapping drill 6.9mm dia. x 1.75in. deep). Counter drill 0.437in. dia. x 0.87in. deep. Tap M10 x 1.62in. deep (tapping drill 8.6mm dia.). Drill and tap the four 2BA x 0.50in. (these could be M5 - Ed) deep (or through) holes, (tapping drill 4mm dia.). Cut the 0.062in. slot through to the central bore. Drill and tap the two M6 through holes (tapping drill 5.1mm dia.) to suit the Bracket item 23. These last two M6 holes are not required on the spring return version of the drilling machine.





TAPPING BRASS

Brass should be tapped dry, they say. But we've all felt that cold shudder down the spine when, on tapping a deep hole, the tap starts to "creak". Fearing the worst, we then gingerly start to wind the tap out, easing it forward again occasionally, until hopefully all is well. But what about the remainder of the hole - as yet untapped?

Get rid of the swarf as best you can, then put a drop of 3 in 1 oil on the tap. It's clean, smells pleasant, doesn't stain the work (as do some high-sulphur tapping compounds), and you can relax while you finish the job!

Fettler

Item 4. Column 1 off

Material: 25mm dia. silver steel, standard length 13in.

Remember that the cylindrical surface of this item is the working surface of the machine so protect it with a layer of shim steel when gripping it in the chuck. Face the first end and chamfer 0.6875in./0.6870in. dia. x 0.75in. long, this shoulder must be square and parallel to the axis of the spindle to ensure the column is square to the Base Plate, item 2 on assembly. Centre drill, and drill the tapping hole 8.6mm dia., tap M10 x 1.12in. deep.

Item 5. Bush 2 off

Material: Oilite bronze

Although Oilite bronze is the ideal material for this item, brass could be used as a second choice. Tungsten Carbide Tipped tools are recommended for machining Oilite bronze. Tools should be ground with a Vee form having 0.06in. radius at the nose, a top rake and front relief angle of five degrees for the best results. A cutting speed of 200-350 F.P.M., with a 0.06in. depth of cut for roughing, and 0.03in. for finishing. With feeds of 0.02in. to 0.03in. when roughing, and 0.01in. to 0.015in. when finishing. With the correct tools, feeds and speeds these items should present no difficulty. The 0.986in./0.985in. bore dia. should give a slide fit on the 25mm silver steel Column, item 4. If any other material is used for item 4 this dimension should be changed to match it.

Item 6. Housing 1 off

Material: 4in. x 2in. aluminium alloy channel section

Make sure the piece of channel selected for this item is not twisted or otherwise distorted. It must be square and true. During machining this item must be clamped and machined carefully to avoid distortion.

Machine to overall length 2.760in./2.750in. obviously keeping square and parallel. Bore the two 1.376in./1.375in. dia. holes in line, and exactly on the centre line of the item. Hold the height dimension 1.063in./1.062in. closely.

The four 5.1mm dia. holes are to suit the chosen motor, if an alternative is used the holes and positions must change to match it. Drill and tap the two M5 holes (tapping drill 4.3mm dia.) to suit the bracket, item 7.

The four M6 tapped holes (tapping drill 5.1mm dia.) and the two 0.281in. dia. holes with two 0.062in. slots cut through to them, to match item 29, the Cable Anchor, are not necessary for the spring return version, but are required for the weight return version of the drilling machine.

Item 7 Lever Bracket 1 off

Material: aluminium alloy

This item can be made from an off-cut of 2in. x 2in. x 0.187in. equal angle. If this is available, it will save machining time and trouble.

Machine to overall dimensions, 1.50in. x 1.12in. x 0.62in. If machining from solid, mill out to the 0.187in. x 0.187in. x 0.62in. and the 0.18in. radius dimensions. Drill and

tap the M8 hole (tapping drill 6.9mm dia.). This operation must be done slowly and carefully as the tapping drill cuts into the web of the angle. Drill and counter bore the two 0.218in. dia. holes as shown to match the Housing, item 6. Machine, or possibly hacksaw and file, the angle and 0.37in. radius. Remember that this item is designed to fit round the contours of the chosen motor; for other motors modifications may be necessary.

Items 8 & 9. Guide (L/H 1 off, R/H 1 off)

Material: Brass 1.0in. x 0.187in.

Machine to overall dimensions where necessary, 1.0in. x 0.75in. x 0.187in. (two items). Drill the two 4.8mm dia. holes in both to match the Adjustable Stop, item 3. Up to this point these two items are identical, they are handed by the countersinks, so make sure they are opposite.

Item 10. Stop Collar 2 off

Material: B.M.S. 0.75in. thick

Machine to overall size 1.06in. x 1.37in. Ream the 25mm dia. hole, to be a slide fit on the Column item 4. Drill the tapping hole 8.6mm dia. through, counter drill 0.437in. dia. to the centre line, tap M10 to centre line. Cut the 0.06in. slot through to the bore, machine the outside radius.

Item 11. Radius Arm 1 off

Material: Gauge plate 0.75in. thick

The centre distance of the two 25mm dia. holes (3.031in.) shown on the drawing, is of course governed by the centre height of the particular motor being used, and this dimension also controls the overall length shown (5.031in.). Machine to overall length required by 1.5in. wide. Drill and ream the two 25mm dia. holes, adjusting the centre distance if necessary and obviously holding the dimension very closely. Drill the 8.6mm tapping hole through, counter drill the 0.437in. dia. hole to the centre line and tap M10. Cut the 0.06in. wide slot through to the bore. Machine the shoulder 0.50in. deep x 2.37in. long with a 0.25in. radius. Machine the end radius 0.75in.

Item 12. Hand Screw 1 off

Material: Good quality steel

A piece of tool steel would be preferable for this item. En8 would be fine. Machine to overall dimensions shown, the 0.983/0.982in. dimension should be a slide fit in the Radial Arm, item 11. The thread of course matches the Table, item 14.

Item 13. Hand Nut 2 off

Material: B.M.S.

Straight forward turning to dimensions shown. Knurl the outside diameter.

Item 14. Table 1 off

Material: cast iron

Cast iron is the ideal material for this

item which is similar to a lathe face plate. If cast iron is not available, good quality steel should be used, if possible stress relieved before final machining. This item must be turned carefully. The two faces must be parallel to each other and square to the axis of the half inch B.S.P. thread. The slots should be milled using an indexing head.

Item 15. Shoulder Screw 2 off

Material: B.S.M. 0.62in. dia.

Machine from bar stock, chuck and face the end. Turn the shoulder, (0.130/0.127in. + 0.37in. long) by 0.374/0.373in. dia., slide fit for the Handle, item 16. Turn the O/D of the thread and the undercut, cut the thread M8 by 0.37in. long. Part off at 0.68in. long, and cut the screw driver slot.

Item 16. Handle 1 off

Material: 0.125in. thick x 0.75in. wide gauge plate

Cut to overall length, 10.75in. plus. Ream the 0.375in. dia. hole. Mill the 0.375in. wide x 0.87in. long slot. Radius both ends 0.375in.

Item 17. Chuck Adaptor 1 off

Material: tool steel

The design of this particular item depends partly on the output shaft of the motor selected, and partly on the chuck chosen to be fitted to that output shaft. The centre hole should be drilled and reamed to be a good push fit on the output shaft. If there is a flat already on the shaft, this should be ideal for the set screw to bite on, if not a flat could probably be filed on the shaft to match the screw position. The chuck used on this machine is a Jacobs 0.312in. dia., having a No.2 Jacobs taper as shown on the drawing. Obviously these dimensions would need modifications to suit an alternative chuck or output shaft. Whichever sizes or design are decided upon, the bore to match the motor output shaft and the mounting for the chuck must be concentric to each other.

Item 18. Special Washer 1 off

Material: B.M.S. 1in. bar stock

Face end and centre drill, drill the 0.406in. dia. hole x 0.25in. deep. Turn O/D 0.937in. dia. by 0.25in. long. Part off 0.156in. long.

Item 19. Distance Piece 1 off

Material: aluminium alloy 0.75in. dia. bar stock

Face end and centre drill, drill the 0.406in. dia. by 0.75in. deep. Part off 0.50in. long.

Item 20. Stud (3.0in. long) 1 off

Item 21. Stud (2.5in. long) 1 off

Material: M10 studding

If M10 studding is available this can be simply cut to length. If not bar stock will

have to be screw cut.

Item 23. Bracket 1 off (Reqd. for the Weight System)

Material: 4in. x 2in. aluminium alloy channel x 3in. long. (This material is the same section as item 6, The Housing.)

True up the ends to 2.75in. long square and parallel. Put in the two 0.25in. dia. tooling holes shown in the upper centre view of the drawing. The pitch dimensions between the holes (1.562in.) can of course be altered if required. Put in the 0.56in. radius slot shown in the left hand view, using a 1.125in. dia. end mill. Drill the two 0.25in. dia. holes shown in this flange, holding the centre distance 2.125in. to match item 3. Drill the two 0.25in. dia. holes in the opposite flange, holding the 0.500in. dimension to match item 24, the Bearing. Join the 0.56in. radius to the first 0.25in. dia. tooling hole by a saw cut wide slot. This is to enable the bracket to spring with the Stop Plate, item 3, to which it will be attached, when this is being clamped and unclamped. Machine the right hand flange to the 0.75in. dimension shown in the lower view, machine the sides off to the 10 degree angle and 1.500in. dimension shown. Remove all burrs and sharp edges.

Item 24. Bearing 1 off (Reqd. for the Weight System)

Material: brass 0.75in. x 1.0in. x 1.625in. phos. bronze or cast iron could be used as alternative materials for this item.

Face the ends to overall length, 1.50in., parallel and square to the base. Mill out the centre section 0.875in. wide, leaving 0.312in. section all round. Drill and ream the 7mm dia. holes, in line, to be a slide fit for item 33, the 6mm dia. silver steel pin. Make sure the pin rotates quite freely in the bearing. Tap the two M6 holes in the base to match item 24. Machine the 45 degree chamfer and the 0.25in. radius. Remove all burrs and sharp edges.

Item 23, the Bracket, and item 24, the bearing can now be screwed together, using the two M6 x 15 long soc. hd. screws item 43. make sure the bearing is fitted the correct way round, as shown on the assembly drawing.

Item 25. Pulley 2 off (Reqd. for the Weight System)

Material: aluminium alloy 3.5in. dia., about 2.0in. long to make two items and allowing for chucking.

Face the end and centre drill, drill and ream the centre hole 6mm dia. to be a push fit on item 33 the 6mm silver steel pin. Machine the shoulder 0.312in. deep leaving the boss 0.62in. in diameter. Grind a tool to match to match the profile of the groove, 0.03in. nose radius and a 30 degree angle, machine the groove. Part off, and repeat for the second item. Drill and tap the M3 hole through the boss into the bore of each item. Remove all burrs and sharp edges.

Item 26. Weight Carrier 2 off (Reqd. for the Weight System)

Material: 2.0in. dia. x 1.0in. long,

(enough to make two items and allowing for chucking). Brass tube 0.125in. O/D x 25 SWG x 10.5in. long (sufficient for two items).

If a different cable from the cable suggested, item 37, a 0.062in. dia. Bowden cable, is to be used, make sure the bore of the tube will clear the cable selected. Face the end of the 2.0in. dia. brass and centre drill. Drill through at 0.080in. dia., or to suit the bore of the tube being used. Counterbore the hole 0.002/0.003in. dia. greater than the O/D of the tube being used, to allow braze penetration of the joint, by 0.125in. deep. Part off and make a second item. Remove all burrs and sharp edges.

The tube must be as straight as possible, cut two length 5.0in. long. Braze the tubes into the bases, making sure each tube is square to its base.

Item 27. Weight 20 off (Reqd. for the Weight System)

Material: Lead, approximately 15lbs.

The method of manufacture of these items is largely determined by the form in which one obtains the supply of lead. Should it be in bar form the weights could be centre drilled, turned down to finished O/D, parted off and the slot milled in the usual way. The other alternative is to make up a simple mould and cast them in a cylindrical shape milling the slot in afterwards, or perhaps consider moulding the slot in as well. A weight made to the dimensions shown weighs approximately 10 ox. 20 weights were required for this machine, making a total weight of 12.5 lb.

Item 28. Cable Washer 2 off (Reqd. for the Weight System)

Material: Bright mild steel, 1.0in. dia. x 1.0in. long, sufficient for two items plus chucking.

Face and centre drill, drill 0.093in. dia. hole, or to suit cable diameter. Part off to 0.187in. dimension and deburr, make second item in the same manner.

Item 29. Cable Anchor 2 off (Reqd. for the Weight System)

Material: B.M.S. 0.062in. x 0.50in. x 2.5in. long (for two).

Cut to overall length 1.12in., drill the two 0.25in. dia. holes, and the 0.125in. dia. hole, holding the centre dimensions closely to match item 6, the Housing. Slot through to the centre 0.125in. dia. hole 0.062in. wide, or to match the Cable, item 37.

Item 30. Cable Nipple 4 off (Reqd. for the Weight System)

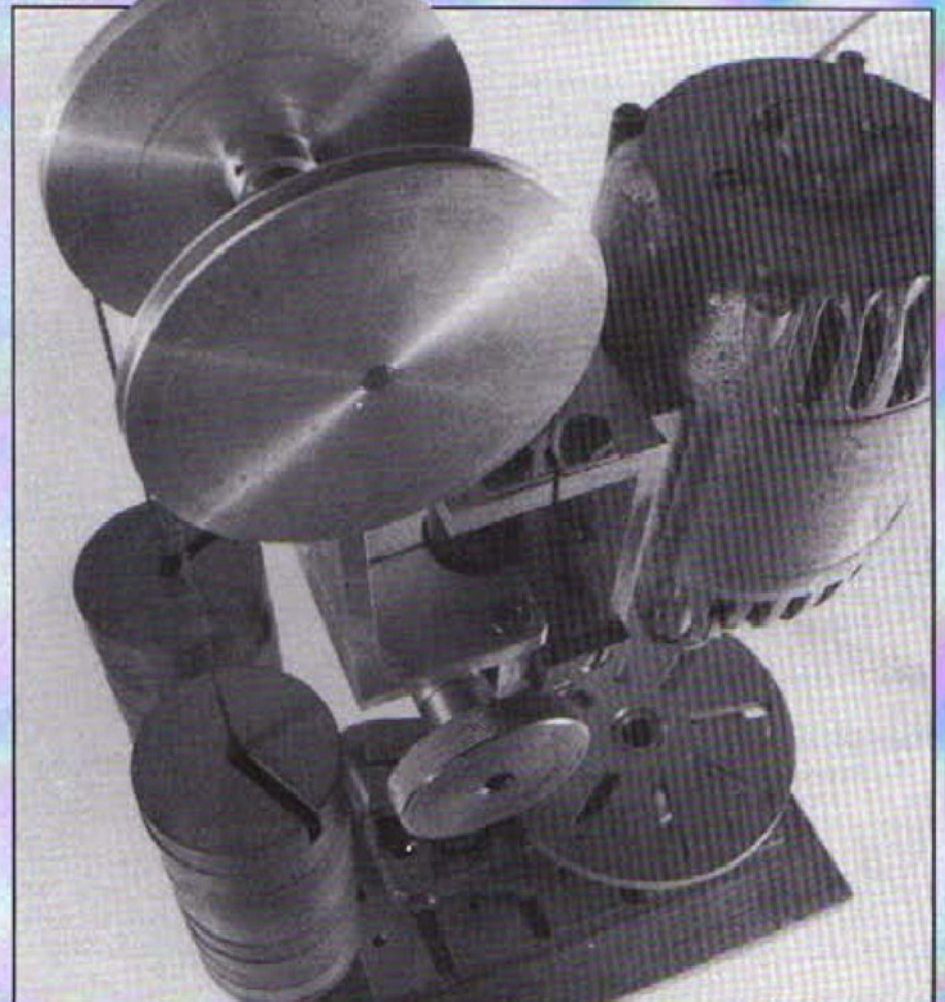
Material: Brass 0.25in. dia. x 2.5in. long

Face end and centre drill, drill centre hole 0.062in. dia. or to suit cable diameter. Put in countersink 120 degrees to O/D, using the tip of a larger drill. Part off to length and deburr. Make three more items.

Assembly

Examine the two bushes, item 5, and make sure there are no burrs or pieces of

Looking down on the machine showing the principal features of the Weight Return System.



swarf particularly under the flanges. De-burr the housing, item 6, especially around the inside of the 1.375in. nominal dia. bores. A piece of steel tube is now required about 1.5in. I/Dia. and about 1in. long. It should be faced off square at both ends. The pressing in of the bushes is best done in a vice. Remember the bushes must be positioned with the flanges innermost, facing each other. Offer the lead in taper on the bush into its bore in the housing, with the flat on the bush flange next to the web. Use a suitable piece of packing over the bush flange and place the housing in the vice with one jaw against the packing piece.

The piece of tube can now be positioned on the outside of the housing concentric with the bore. Tighten the vice and gently press the bush in until the flange is home against the housing. Repeat with the second bush. Now try this sub-assy on the column, item 4. It should be a nice slide fit without play. Should it be too tight, try lapping it in using a small quantity of fine grinding paste and lubricating oil. Hold the housing lengthwise in the vice to avoid bending it and screw a suitable piece of bar across the end of the column to use as a handle. Lapping must be done with great care and not over done. Once the housing is a satisfactory fit on the column it can be set aside.

The next step is to fit the column to the base plate, item 2. Make sure the spigot end of the column is completely clear of burrs and swarf. The same applies to the 0.687in. dia. hole in the base plate. The column must be pulled into position, not pushed, hammered or pressed, any of which would tend to bend it. A couple of longer screws than the final assembly screw, item 47 M10 x 35mm, will be useful to start pulling the column into place. The column should pull down firm and square on the top surface of the base plate, item 2, and be secured with the special washer, item 18, and item 47 the M10 x 35mm screw. Screw the Base Board, item 1, in position under the Base Plate using the three M6 x 20mm screws, item 45, with the three M6 washers, item 48.

The Chuck Adaptor, item 17, can now be fitted to the motor spindle. If necessary file a local flat to match the position of the set screw, item 40. Fit the chuck, item 36, tight up on to the taper of the Chuck Adaptor. Fit the Bracket, item 7, to the housing using the two M5 x 10mm screws, item 42. Fit the motor to the housing using the M5 x 15mm screws, item 41, or screws to suit the motor being used. One of the stop collars, item 10, can now be fitted to the column and slid down almost to the base plate where it can be locked in position with its screw, item M10 x 35mm, item 47.

The Radial Arm, item 11, should now have its stud M10 x 2.5in. item 21, and its Hand Nut, item 13, fitted to it. The table, item 14, is secured in position on the Radial Arm with the Hand Screw, item 12. This sub-assy should now be slid down the column to rest on the previously fitted Stop Collar and locked with its hand nut. Fit the second Stop Collar, item 10, and lock it in position 1.75in. down from the top of the column. The previously assembled motor and housing should now be slid down the column to rest against the Stop Collar. As only one of the housing bushes will be engaged on the column at this stage, it is advisable to have a second pair of hands to support the weight of the motor.

Fit the stud M10 x 3.0in., item 20, the distance piece, item 19, and the Hand Nut, item 13, to the Adjustable Stop, item 3. The Adjustable Stop should now be engaged on the column and slid down to rest on the flange of the lower bearing. It is a good idea at this point to release the stop collar and make sure the housing slides past the still locked Adjustable Stop over the full length of its stroke. If it does not, make any necessary adjustments. If building the spring return system, go back to the original position at the top of the column and fit the spring, item 34, between the top of the adjustable stop and the flange of the top bush.

Both systems

The Handle, item 16, can now be fitted, using the Shoulder Screws, item 15, to the Bracket and the Adjustable Stop. Now lock the Adjustable Stop to the Column and release the Stop Collar. Try operating the Handle to its full travel. If the spring has been fitted, allow the spring to make the return stroke. If it does not, a heavier spring may be required.

Weight Return System only

Cable Sub-Assy. 2 off

Items required:

Item 26, Weight Carrier 2 off

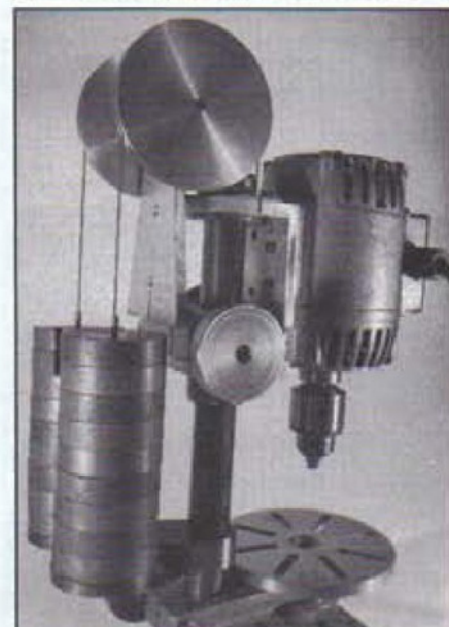
Item 28, Cable Washer 2 off

Item 30, Nipple 4 off

Item 37, Cable, Bowden, 0.062in. dia. x 17in. long 2 off

Cut off the two 17 inch lengths of Bowden cable. Try to get the two pieces exactly the same length for a neat finish. This is best done with a hammer and a sharp cold chisel on a hard surface with the help of an assistant. The next step is to solder the first nipple on each cable. This must be done correctly. Remember the full load of the weights is taken on the nipples. For those without previous experience of soldering nipples on cables, a few words of advice might be appropriate. Lightly clamp the cable end in on end of the vice jaws with about 0.375in. showing above the vice jaws. Slip the nipple, item 30, with the countersink uppermost over the cable. Open the individual strands of the cable end out into a star and gently bend them back on to the countersunk surface. Slacken the vice slightly and apply a little

The housing shown at the top of its stroke. The counterweights are fully extended and the lower housing bush is against the stop



downward tension to the cable to bring the strands into close contact with the nipple and tighten the vice again.

For the actual soldering use tinman's solder, not electricians cored solder, for flux use Baker's fluid, and to supply the heat of a small butane blowlamp would be ideal. Fill the countersinks up with solder and make sure the solder penetrates right through the nipple to ensure a good joint. Wash the joints clean to remove any remaining flux, which may be corrosive. When both cables have one of their respective nipples soldered securely in position, items 28, the Cable Washers, and items 26, the Weight Carriers, can be threaded on the cable. Make sure these items are the correct way round as shown on the sub-Assembly drawing. Solder the second nipple securely in position on each cable adopting the same procedure as with the first.

Secure the Bearing, item 24, in position on the Bracket, item 23, using the screws M6 x 15mm. The Bracket can now be placed in position on the adjustable stop, item 3. Use the two M6 by 25mm long countersunk screws, item 44. Hexagon socket screws will be best but Phillips screws can be used. Fit the two cable anchors, item 29, in position on the housing, item 6, using M6 x 10mm long hex. hd. screws, item 46. Fit the 6mm dia. by 2.75in. silver steel pin, item 33, through the bearing, item 24. Two set screws M3 by 6mm should now be screwed, one each, into the bosses of the two pulleys, item 25, and the pulleys fitted onto the pin and the set screws locked in position. The pulleys and pin should revolve freely in the bearing.

The two cable assemblies can now be positioned as shown on the drawing. The cable nipple, remote from the weight carrier, should be engaged in the slot in the top flange of the housing, item 6, and the cable anchor, item 29. The nipple itself should disappear inside the flange and rest against the under-face of the cable anchor. Feed the cable over the pulley, item 25, and allow it to hang down at the rear of the machine with the weight carrier, item 26, on the end. Repeat for the second cable assembly. The 20 weights, or as many as are required to return the sliding portion to the top of its stroke, can now be added on to the weight carriers.

Both systems

The next step is to fit the Left and Right Hand Guides, items 8 and 9, using the 2 BA x 0.5in. long counter sunk head screws, item 38. Shim, item 22, made from shim steel in various thicknesses should be added under the guides until "a slide fit without play" is achieved between the housing and the adjustable stop.

The Drilling Machine is now complete apart from wiring up to a suitable safe supply.



STEEL WOOL

When the job needs a wipe down, finishing or cleaning with steel wool, it helps if you place a ball of the stuff on a rag pad. This makes it easier to use and protects the fingers from sharp edges. Also, if required, the rag can be soaked in oil or solvent to speed operations.

For safety's sake, dispose of the pad as soon as the job's finished. **Fettler**

ADDING A FLYWHEEL TO A MILL DRILL

Philip Amos of Australia has added a flywheel to his mill/drill and proved that it really does improve its operation. (See readers' letters published in this issue under the heading Backlash, giving their suggestions why this should be.) Philip also details further simple modifications to improve other features of the machine

Drill Mill Modifications

Since their introduction the Taiwanese drill mills have been enthusiastically purchased all around the world and recognised as good value for money, despite a number of deficiencies. Much has been written about them in *Model Engineer* and *Model Engineer's Workshop*, and a number of modifications and improvements suggested to overcome the deficiencies and to enable more convenient use. This article adds a few more ideas along these lines.

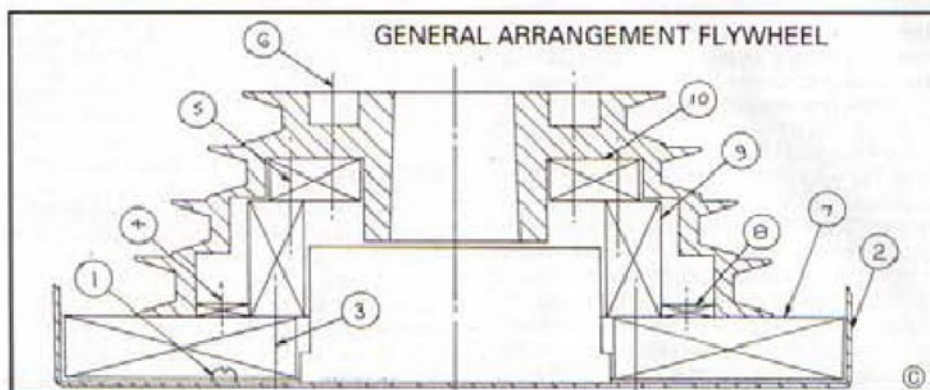
Spindle slog

To allow its use as a drill the spindle is driven by splines engaging in a sleeve which is solidly fitted by a taper connection to the spindle pulley. There must be some clearance in these splines to allow free vertical movement of the spindle. This clearance also allows the spindle to slog back and forth rotationally under intermittent loading as for milling and this slogging gets progressively worse with wear in use.

In an article in *MEW Autumn 1990* G.G. Tardrew described a method of positively locking the spindle to the sleeve/pulley to eliminate this play. No doubt it does this effectively but it must be undone when one wishes to drill, and it eliminates the use of downfeed milling. This did not seem to be a convenient approach.

In a continuing article in *ME* in 1991 at pages 74, 204, 330 etc. G.F. Deane describes the use of Poly V Belt drives and other matters. He mentioned adding a flywheel on top of the spindle pulley with beneficial results. It was decided to try this concept but to attempt to locate the flywheel in a position where it did not impede access for changing belts.

After measuring the existing components it appeared that there was space for a substantial flywheel to be slung under the spindle pulley, although it was a bit of a problem how to attach it to the pulley. The resulting design is shown in the drawing and photos. The odd shaped space inside the pulley is occupied by the



"lighthouse" build up of cylinders allowing the whole assembly to be attached by four roundhead screws to the pulley web at the top. The thin ring at the bottom is for centering the cylinders on the flywheel.

The following notes apply to the drawing.

1. It applies to a machine designated RF15. If a similar construction is attempted the actual machine in question should be checked to ensure the method of appropriate.

2. There may be screws Item 1 holding the belt cover base Item 2 to the body of the machine which will have to be replaced by the countersunk head variety – two in my case.

3. The parts are assembled with four screws in each of the positions shown – Item 3 – ¼in. BSW Csk Hd 1½in. long on pcd 111mm

Item 4 – ¼in. BSW Rd Hd ½in. long on pcd 144mm

Item 5 – ¼in. BSW Csk Hd 1in. long on pcd 101mm

Item 6 – ¼in. BSW Rd Hd 1in. long on pcd 75mm

Lockwashers are used under the round heads, and all are Loctited in place.

Screws Item 5 are displaced 45 degrees in plan to ensure no interference with screws Item 3.

4. Flywheel Item 7 is a piece of 20mm steel plate flamecut roughly to size and then machined on inside and outside diameters to 98 and 239mm respectively.

5. Spacers Items 9 and 10 are respectively slices of 5in. and 4½in. steel bar machined internally to diameters of 93 and 59mm and lengths of 36 and 13mm respectively.

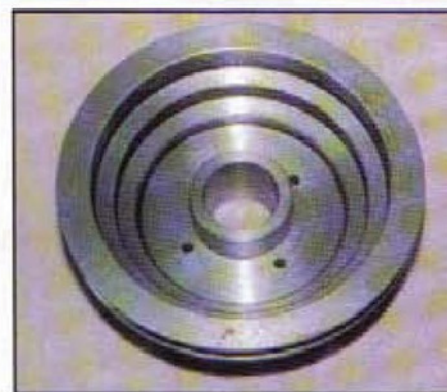
6. Item 8 the location ring is of ¼in. sheet steel and was attached to the flywheel and was machined to inside and outside diameters of 127 and 160mm respectively to fit the OD of the spacer item 9 and the ID of the pulley.

From top to bottom: The drill/mill pulley with added holes for fitting the flywheel.

Flywheel ready for fitting.

Pulley with flywheel fitted, top view.

Pulley with flywheel fitted, bottom view.



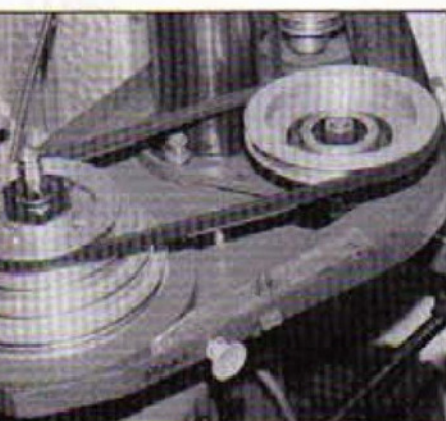
This modification produced a notable improvement in performance both for milling and for drilling. However I am unable to produce an explanation which satisfies me as to why this is so. It may be that the energy stored in the driving system is so much greater than it drives the cutter through the material without significant loss of speed, and maintains the pressure on one side of the splines at all times.

Brake

One consequence of the modifications was that the system takes appreciably longer to stop after switching off than previously so a brake was devised which overcomes this problem. This is shown in the accompanying drawing and photos. It



The simple brake assembly, note the position of the hold off spring.



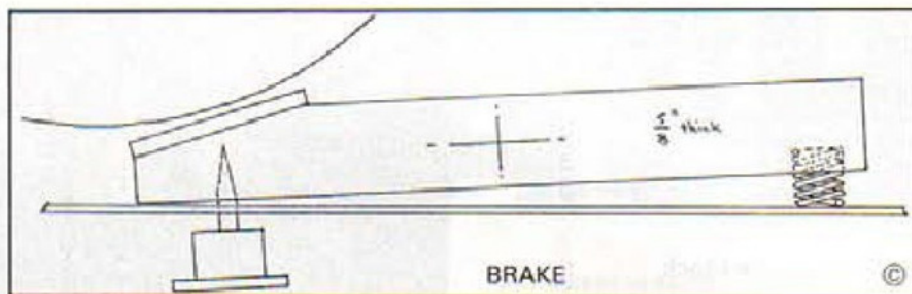
View of brake showing how this acts on the flywheel periphery.

comprises a wooden arm 8in.x1in.x $\frac{3}{4}$ in. pivoted near the centre with a compression spring ($\frac{1}{2}$ in. diameter 7 turns of 1mm steel wire) set in a $\frac{1}{4}$ in. deep recess at one end to hold it away $\frac{1}{4}$ in. from the flywheel.

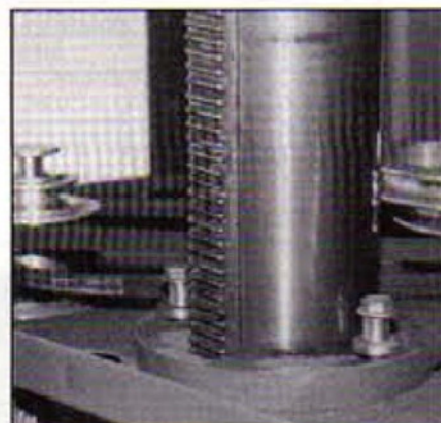
The other end has a knob extending outside the casing which permits that end to be pressed against the flywheel. The knob is from an old kitchen drawer attached by a 12G woodscrew cut down and threaded to fit the knob. On the working face is glued a piece of cork 2in. long x 4mm thick (a slice from a champagne stopper) as the books say that cork on steel yields the highest friction. The pivot is a $\frac{1}{4}$ in. BSW Rd Hd screw entering from below the casing with a nut and washer, then the brake lever, then a washer and two locknuts.

Centre pulley mount

The centre pulley of the belt drive



system is mounted on a cast iron bracket attached to the main body casting by two screws passing through the sheet metal lower casing. If these screws are done up tight then the bracket cannot move readily in belt changing. If not tight they rattle loose allowing the bracket to tilt. So longer screws ($\frac{1}{2}$ in. BSW x 2in.) have been fitted with substantial washers (23 $\frac{1}{2}$ x 8 x 5mm thick) to spread the load to the sides of the slots in the bracket and with springs ($\frac{1}{2}$ in. diameter 1in. long 6 turns of the 1.4mm steel wire) added and done up nearly solid. This seems to work well. (If you can get disc springs of suitable size these will give a compact arrangement and work very well. Ed.)



The springs added to the centre pulley bracket to permit easier movement of belt for speed changing.

Belt length adjustment

The various belt arrangements require the centre pulley and motor pulley to be in different relative positions, and there is provision on the machine for adjustment. The motor mounting plate is hinged on two bolts at one side and bears against a stop rod at the other. This rod is held after

The modifications to permit easier changing of the rear belt position.



setting by a wing screw. Because of the geometry it is difficult to make the stop rod retract against its spring when in the fully out position.

To assist in this process a transverse rod $\frac{1}{4}$ in. diameter and 3 $\frac{1}{2}$ in. long with rounded ends has been fixed in the stop rod $\frac{1}{4}$ in. from the outer end, which allows fingers to get a grip on it to push back against the spring. Also a lever of 40 x 5mm steel bar has been attached to the motor mounting plate to get some purchase on the motor system. This bar projects some 7in. from the side of the machine. The end of the stop rod had originally been very roughly machined hemispherical by the manufacturer and a rubber chair leg cover fitted. This had been cut through by the rough end, so the end was smoothed up and a new cover fitted.

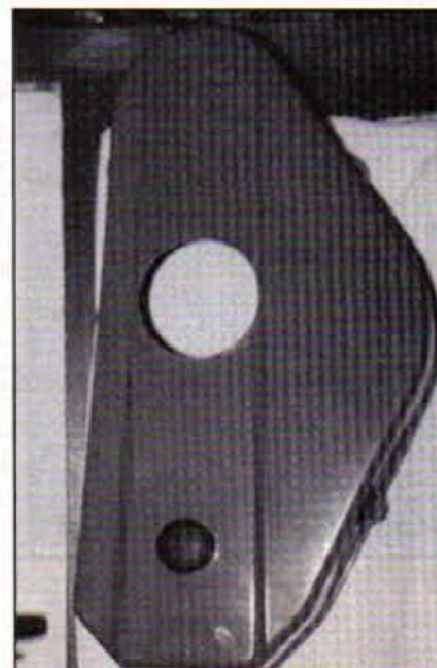
Belt cover

Originally this item was attached to its base with 4 toggle catches. As it was tedious to undo and do up again these catches every time a belt change was required, they have been held out of the way with masking tape. The cover rattles when the machine is in use but the tedium is saved.



The arrangement for parking the belt cover whilst belt changing.

The belt cover parked whilst belt changing.



When the cover is removed for belt changing it has to be put somewhere, and to regularise this a block of wood of part circular shape (3in. radius 7in. long 2in. thick) has been attached to the wall, with a nail in its upper surface that engages with a $\frac{1}{8}$ in. diameter hole in the cover. The cover can then hang stably out of the way right beside the machine.

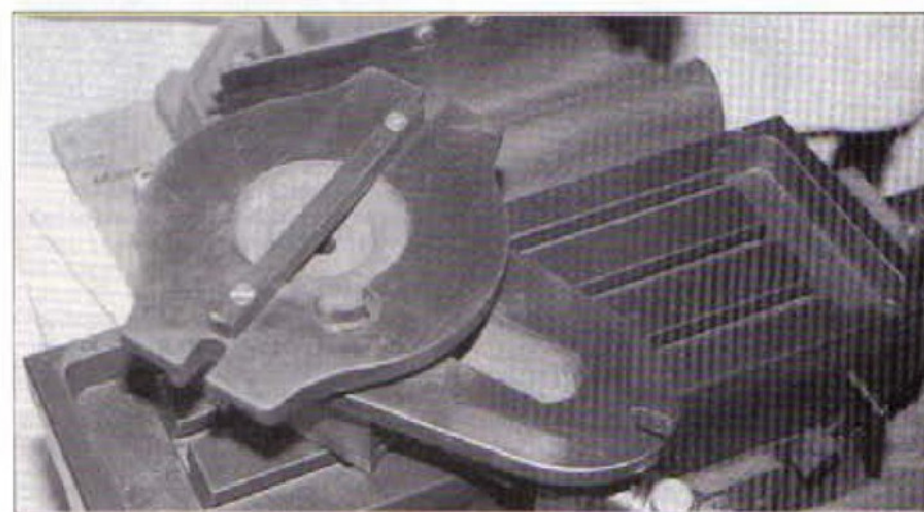
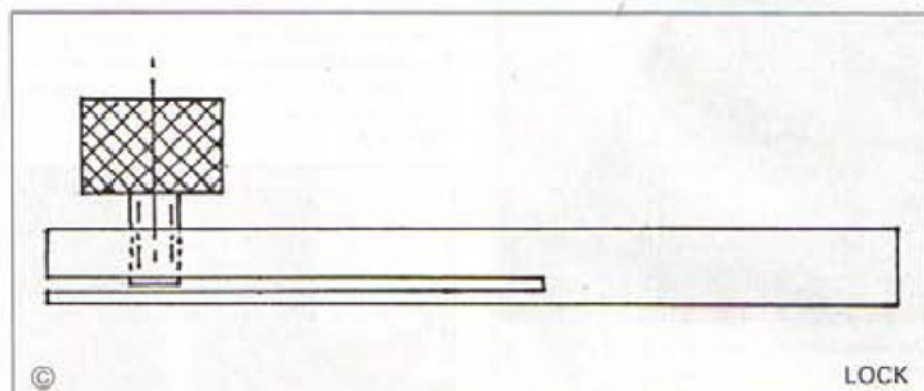
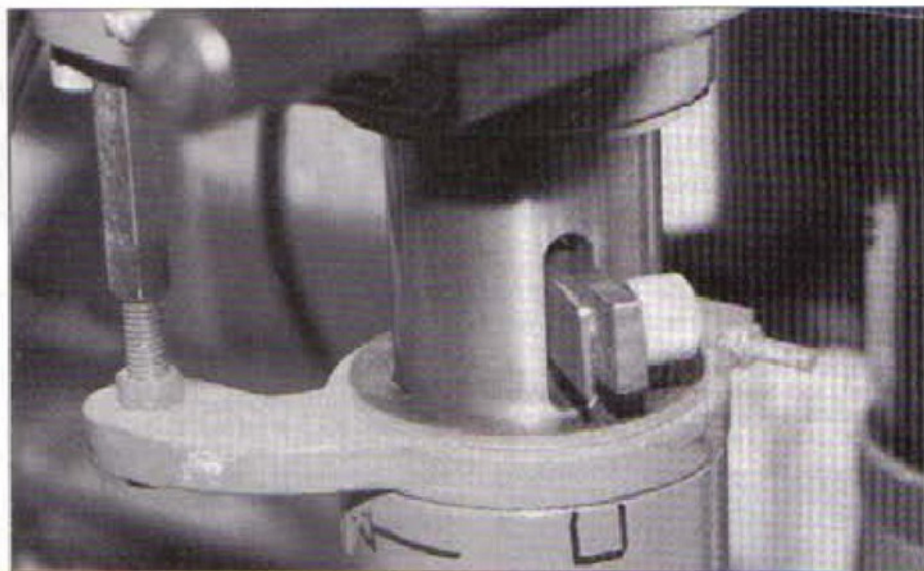
Quill to spindle block

At times it is desired to lock the spindle against rotation as for example when using a dial indicator in the chuck while manoeuvring the table. For this purpose a gadget has been devised as shown in the drawing and photo. It is a piece of 20 x 10mm steel bar 117mm long in which a $\frac{1}{8}$ in. slot has been cut for 68mm at a distance of $\frac{1}{8}$ in. from one side. There is a hole 15mm from the end tapped $\frac{1}{8}$ in. NF through the thicker ($\frac{1}{8}$ in.) portion only. A brass thumb screw with a knurled head $\frac{1}{8}$ in. diameter $\frac{1}{8}$ in. high and $\frac{1}{8}$ in. long passing through this hole bears on the thinner piece expanding the device to fill the slot through the quill and spindle provided to knock out taper shank drills. The quill is also locked by the normal clamp handle mechanism provided to the left of the machine.

Milling vice

A milling vice which can be rotated 360 degrees was purchased with the machine. To facilitate its removal and accurate replacement on the table, a piece of $\frac{1}{8}$ in. x $\frac{1}{8}$ in. steel bar was filed to a close fit in the machine table slot and the attached to the bottom of the vice with two $\frac{1}{8}$ in. BSW Csk Hd screws. After bolting to the table the top part can be rotated and set accurately in line with the X or Y feed axes and will retain this accuracy well, after removal and replacement on the table.

The vice handle is removable and has a square hole engaging a square shaft on the vice itself. It kept vibrating off during service, and after it had landed on my feet several times the problem was addressed by tapping a $\frac{1}{8}$ in. BSW hole in the handle and fitting a brass thumbscrew with knurled head $\frac{1}{8}$ in. diameter $\frac{1}{8}$ in. high and $\frac{1}{8}$ in. long which secures the handle in place.



Top: The quill to spindle lock in position.

Right: Milling vice with added locating bar.

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BACKLASH

This time, under the heading Backlash we have some readers' views explaining why they consider that adding a flywheel to a mill/drill will improve its performance. Elsewhere in this issue we have an article describing how this can be achieved

Your request for information (see *On the Editor's Bench Oct/Nov '92 issue*) on the use of a flywheel in milling reminded me of my apprenticeship with an aircraft manufacturer during the 1950s. One of the older horizontal mills in our experimental machine shop was set to cut a vee notch in samples of various materials used in highly stressed aircraft components. This notched bar impact test assessed the toughness of the sample - whether the fracture was ductile or brittle at certain low temperatures.

A single fly cutter was used to generate the specially shaped notch which had to be held to very tight tolerances. A large flywheel was mounted on the arbor. It was explained to me that the flywheel served to keep the speed of the cutter constant through each revolution. The speed did not vary as it entered and exited the cut, and chatter barks were eliminated.

I have a Sandvik milling handbook which comments on the use of flywheels as follows:-

"The application of a flywheel considerably reduces torsional vibration caused by intermittent machining. Carbide cutters are coarsely pitched, and for this reason it is usually better to apply a flywheel. The basic rule is to use the largest diameter wheel the set up will allow, as the effect is proportional to the moment of inertia.

"Choose the smallest possible cutter diameter so that the spindle speed can be increased for a given cutting speed.

"A small and low powered machine needs a flywheel more than a large powerful one!"

As to the expression "Negative Rate," this should be "Negative Rake". Positive rake requires less power to remove a given amount of material, but if the cutting edge wears too quickly then the use of negative rake means that first contact moves back from the edge of the insert up the top surface. (Requiring a lot more power to remove the same amount of material).

Hope this is some help to you.

**Jeff Edwards,
Australia.**

In the October/November 1992 issue of *M.E.W.*, you call for an explanation of the use of a flywheel on a mill/drill machine. I hope the following will be found useful.

The active spindle of a the normal home workshop mill/drill machine has a small Moment of Inertia. It is so small that in belt driven machines the actual speed of the spindle is not constant, but varies minutely, according to:-

- 1.Type of cutting tool, and whether sharp or blunt.
- 2.Hard spots in the workpiece.
- 3.'Drag in' of swarf.
- 4.Flexibility and slackness of drive belt.
- 5.Clearance in spindle bearings,
- 6.Absence of rigidity of machine at tool face.

There are others all of which could combine. There are circumstances in which the spindle, for a millisecond, could almost stop.

When a flywheel is added to the spindle, the drive system undergoes a change, and any tendency of the spindle speed to vary is opposed by a force equal to mass (flywheel plus spindle) times acceleration or deceleration in radians per second², in which case force becomes torque at the spindle. This torque acts directly and instantly on the tool cutting edge, and is plus or minus to anything provided by the motor. Any tendency of the spindle speed to change is opposed and damped, and the spindle runs more smoothly giving a smoother finish to the workpiece.

**Sir Arnold Linley,
Shipley.**

I am no expert, just a life long practical engineer and designer, so here goes, with my contribution to this matter of flywheels on machine tools.

Is not the purpose of the flywheel to smoothly take up and store, then smoothly release that stored energy?

If it is, as I think it is, then with a large endmill cutter having several blades, each taking a fairly large slice out from the workpiece, the energy store in the input is more smoothly released to each individual blade in turn as the speed of rotation of the cutter will be more constant than if the cutter and its spindle are driven by a light alloy pulley and belt only, as the tendency is to slow each blade as it enters the cut.

This can be shown on an oscilloscope by measuring the power absorbed by each blade which will vary if being hand fed, but will be more constant if feed is by power.

It is possible to see this in practice if a large flat surface is being flycut in one sweep at a large radius, the cutter rotating at a speed of 150rpm or less, can be heard to increase and decrease in speed with each sweeping cut taken.

Add a flywheel to the spindle end and the pulsing is considerably reduced, again this can be demonstrated on an

oscilloscope as above.

So yes, a flywheel can be beneficial to a mill and also to a toolroom lathe; all our toolroom lathes were so fitted. I believe that some jig borers were similarly equipped.

Very little difference could be found when using small cutters or a flycutter at small radius and high speed, with or without a flywheel, as power input is low and the cutter bites are more constant. This research was carried out whilst I was engaged in designing a torque limiter for Beaver Tools.

**Derek L. Walters,
Tetbury.**

Re your request in *On the Editor's Bench* column of Issue 13 for experiences with milling spindles used in the lathe.

I had trouble cutting clock wheel teeth in 1/2in. thick brass blanks, which were mounted on a mandrel in the lathe headstock. The tooth faces were left with a ripple effect, not detrimental to the running of the clock, but it did not look right.

Mounting the blank between more substantial supporting washers made a slight improvement. I was using a Thornton milling cutter 1 in. dia. with 12 teeth with 1/4in. between tooth tips. The cutter was run at approx. 5000 RPM in ball races and driven by a 3/4in. dia. Polyurethane belt.

After a lot of thought, I reasoned that the cutter was moving in a series of jerks, stopping and starting some 5000 x 12 times per minute, the elasticity of the driving belt did nothing to prevent this from happening, a 2in. length of 2in. dia. mild steel was cut, bored to suit the milling spindle and carefully fitted and balanced. This cured the problem.

I hope this information will help you.
**Geoff Gray,
Nantwich.**

SMOOTH OPERATOR

Invest some of your hard earned salary, or pension, in a two ounce tube of Rocol Anti Scuffing paste (ASP). This is a highly concentrated paste (grease based) of Molybdenum-Di-sulphide. A touch of this on threads, taper pins and keys will ensure they will never seize or rust and are readily removable.

When assembling shafts into bushes or bearings, etc., a slight rub of the paste on a barely dirtied finger end will ensure against any risk of seizure.

Also, and this is a real boon, rubbed onto steel or iron surfaces with a finger tip prevents rusting to a remarkable degree. I am a very satisfied user. (Rocol Ltd. Tel. 0532 888511).

M.E. Stevenson

Most readers will, at some time, have found the width of a micrometer frame at the fixed anvil inconveniently wide. The micrometer being discussed in the article has a removeable narrow anvil to almost eliminate this problem. Its rather special construction enables it to perform a range of very useful measurements.

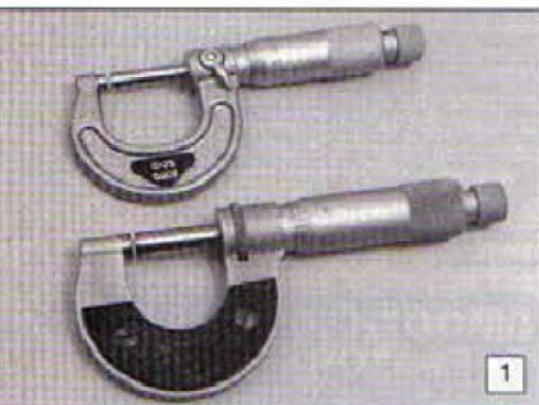
Also illustrated are other special micrometers; these could be of use in the home workshop, but their high cost will make them of academic interest only for almost all readers ...

It is highly probable that all readers will have, at some time, taken a micrometer to make a reading between two faces, only to find that the width of the frame behind the fixed anvil prevents the micrometer from gaining access to one of the faces.

Owners of some of the very good economy micrometers from eastern Europe will have found these to have particularly wide frames at this point – why this is would appear to be without explanation.

Photograph 1 shows two micrometers, one having a frame width of 16mm whilst the other has a more respectable 11mm width. Even the narrower one will be unacceptable in some cases.

Some manufacturers of quality



1: Two typical economy micrometers. Note the differing frame widths at the fixed anvil.

micrometers produce a very special version that goes a long way to overcome this problem. Typical of these is the Mitutoyo Uni Micrometer illustrated in **photograph 2**. Unfortunately, being from a quality manufacturer and also being rather special (even from them), makes it doubly expensive. Another factor, as can be observed from the photograph, is that the micrometer cannot be used to measure diameters in the normal manner above about 12mm, due to the shape of the frame. This situation makes it essential to own a conventional micrometer, so the cost cannot be justified on the basis of not

MICROMETERS WITH A DIFFERENCE



2: The Mitutoyo Uni Micrometer, series 117.

requiring a normal micrometer. However for the reader who does have a little money available for such a purchase, the micrometer will be found invaluable.

As can be observed from photograph 2 the micrometer is fitted with a removeable anvil. In fact, two anvils are supplied, one being 1.6mm thick whilst the other is 3mm diameter. The first anvil allows measurements to be made from narrow slots, whilst the round one will permit measurements to be taken from inside curved faces. Not so obvious from the illustration is the fact that, with the anvils and clamp piece completely removed, the micrometer can be used for height measurement. This is possible because the face onto which the anvils are clamped is exactly at zero.

Height measurement

Photographs 3 to 5 illustrate the micrometer being used whilst a part is being turned on the lathe. In **photograph 3** it is being used to measure the length of a spigot being turned. Even though the width of the shoulder from which the micrometer was taking the measurement was rather narrow it performed this function satisfactorily. It would, however, be easier to use where the area for the micrometer to stand was



3: With the fixed anvils removed, using the micrometer for height measurement.

rather larger.

There are numerous instances where a step measurement needs to be taken, either *in situ* on the lathe or milling machine, or a component on the surface plate or in the hand. In these cases the micrometer would perform the task admirably within the limit of its 25mm capacity. The enterprising reader should also be able to make add on packing blocks to extend its range, and whilst these will not have the high degree of accuracy associated with such measuring equipment, they should be adequate for most requirements.

Back face measurement

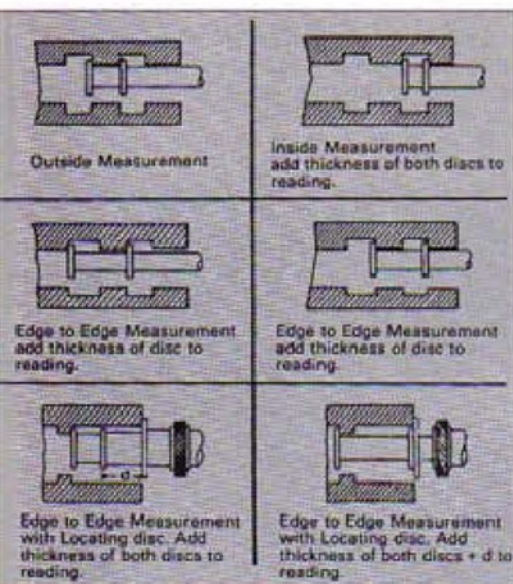
Photograph 4 shows a situation where a component requires a groove to be added whose position is critical to a face already turned. Providing the groove is



4: Fitted with the flat anvil, enabling measurements to be made from within a narrow slot.

larger than the 1.6mm thickness of the flat anvil, the task of measuring its position will be possible with ease.

Frequently, when parting off a component being turned on the lathe, it will be preferable to part off to an accurate length. To do this, commence to part off deliberately making the component a little on the long side. When the tool has been taken in by around 3mm, the lathe can be



stopped and a measurement taken using the 1.6mm flat anvil. Having measured the length, the tool can be repositioned to make a final cut giving the length required.

Tube wall thickness measurement

With the round anvil, the wall thickness of a piece of tube can be measured and this procedure should be easy to visualise.

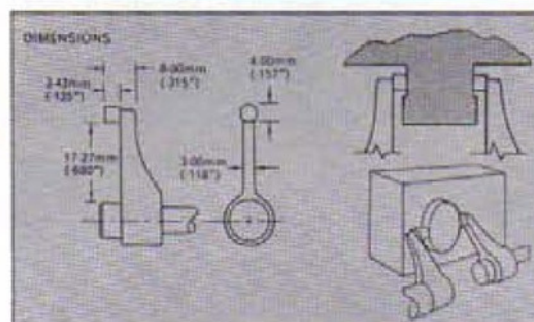
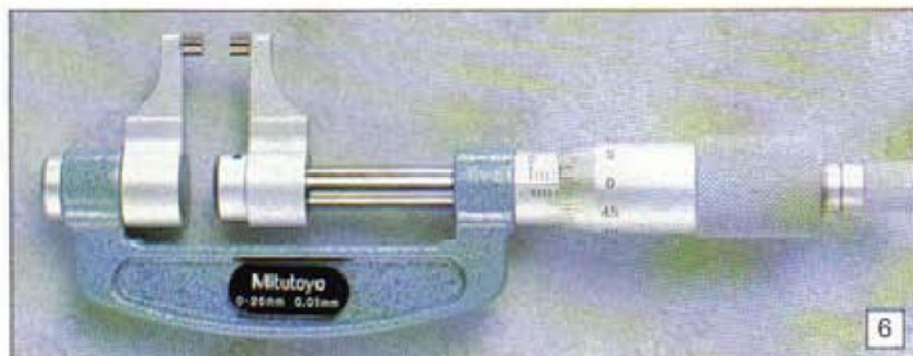
Photograph 5 shows the part already illustrated in the previous photographs, now having had a bore added. Making the bore at the same visit to the lathe as turning the outer diameter should ensure concentricity, but to confirm this has been achieved, the wall thickness can be measured at, say, three or four places around the circumference.



5: Measuring wall thickness using the 3mm circular anvil. By measuring outside diameter and wall thickness the inside diameter can be calculated. This is easier and probably more accurate than using the inside facilities of a vernier calliper.

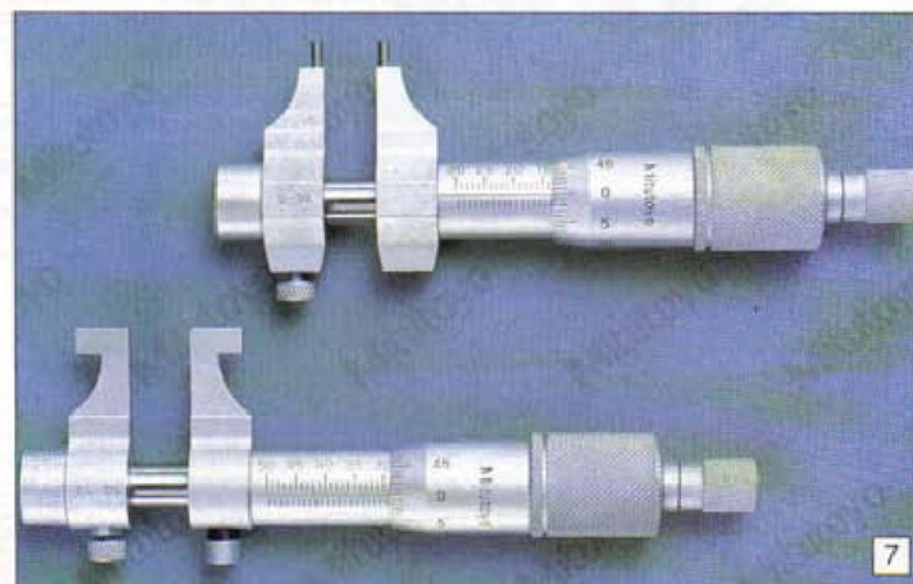
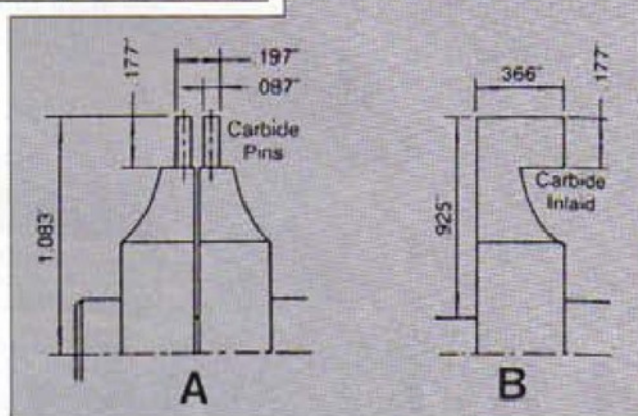
Measuring the inside diameter of a bore is usually a task for the inside jaws of a vernier calliper, and with considerable care and also some skill gained over the years, a quite accurate result will be obtained. Most will probably find it a task fraught with a degree of uncertainty but using a conventional micrometer to measure the outside diameter, then the Uni micrometer to measure the wall thickness, the inside diameter can be calculated with ease.

Of course, taking two measurements to



6: A Caliper micrometer, for making measurements where the dimension to be inspected is inaccessible to a normal micrometer. This is a Mitutoyo series 143 and is available 0-25 and 25-50mm ranges.

7: The Mitutoyo Inside micrometer series 145, available in four sizes up to 100mm, minimum dimension readable 3mm.



arrive at one is bound to reduce the accuracy of the result, but should still be better than using a vernier calliper. In either case, if a high degree of precision is necessary, a hole gauge is the only method likely to give the result required.

Another use for the micrometer when fitted with the round anvil is to use it for measuring the distance from the edge of a round hole to the edge of the material. If the hole diameter is known then its

distance from the edge of the material can be calculated. In a similar manner, if a hole is to be placed centrally in a strip, then if the measurement to the side is taken both sides, any error can be determined.

Other special micrometers

Those readers who do not come from an engineering background, and have never therefore had the opportunity to scan the



8: A groove micrometer designed for measuring grooves, recesses and shoulders located inside a bore. This is the Mitutoyo series 146 and is available in four sizes up to 100mm.

pages of an industrial micrometer catalogue, may be surprised to learn the number of special micrometers that are available!

Typical of these very special micrometers is a micrometer with a very deep frame which enables measurement of sheet thickness to be taken up to 300mm from its edge. Another special is called a disc micrometer; this has a large disk on the end of each anvil, and is used to measure gear tooth thickness. Because a rotating disc would make it difficult to take a measurement, especially where only the edge of a disc is being used, the spindle on this type of micrometer does not rotate, but is arranged to just move in and out. The large diameter anvils also make this type of micrometer useful for measuring paper thickness.

Micrometers are available with the fixed anvil in the form of a small vee block and these are used for measuring the diameter of such items as three- and five-flute taps

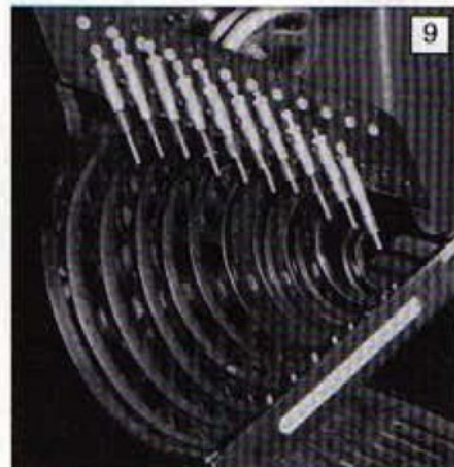
and milling cutters. The geometry of this requirement is such that there has to be one micrometer for three-flute, and another for five-flute measurements.

A few rather special micrometers are of a type that could find occasional use in the home workshop, but their very high cost, coupled with their limited use, makes them of academic interest only. Three such micrometers are shown in **photographs 6, 7 and 8** and the purpose of these is described in the caption with the photographs and also illustrated by the line drawings.

Wider range micrometers

Finally, I consider most readers will be aware of the outside micrometers that are made with a frame to suit, say, a maximum reading of 100mm but with four removeable anvils enabling it to measure 0-25, 25-50, 50-75 and 75-100mm. However, did you know that this principle is applied

to micrometers having ranges up to 900 to 1000mm? Also micrometers that cover only a 25mm range are made in all sizes up to 600mm – see **photograph 9**. Whilst this article up to this point has only mentioned metric ranges, of course imperial equivalents are still being made.



9: A set of micrometers measuring up to 12 inches, seen for sale at Home and Workshop Machinery. See supplier visit elsewhere in this issue.

Mitutoyo micrometers

The more common Mitutoyo micrometers and verniers are stocked by most suppliers to the home workshop; no doubt these suppliers could obtain the Uni Micrometer if requested. It is, however, listed in the Tilgear catalogue (tel. 0707 873434).

STOP!

If you are considering the purchase of a small machine tool; are you familiar with the standards of excellence that Cowells have been setting for many years?

Cowells machines are all hand built to exacting standards by experienced engineers, and to a very high degree of precision. Unlike some other small machines on today's market, Cowells products are solidly built on proven traditional designs. Each machine, being a complete unit is therefore portable. If necessary*, it could be used on the kitchen table, and when not in use, stowed in a cupboard.

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CENTRE HEIGHT OVER BED
400mm (16") OVER CAP 120mm
DISTANCE BETWEEN CENTRES
200mm (8") CROSS SLIDE TRAVEL
100mm (4") TOP SLIDE TRAVEL 25mm
BACKGEARED TO ENABLE
SCREW CUTTING 3 SPINDLE
SPEEDS 500 RPM 2100 RPM SET
OVER TOOL REST ADJUSTABLE
TRIP TO AUTO FEED 150W INPUT
CONTINUOUSLY RATED MOTOR

COWELLS 90 CW LATHE ACCEPTS
8mm (5/16") DIAMETER COILS 15
0-4000 RPM THROUGH ELECTRONIC
CONTROL ADJUSTABLE HEIGHT
TOOL POST LEVER FEED SADDLE AND
TALL STOCK NO VOLT CONTACT FOR
SWITCHING LIGHTS CONTINUOUSLY
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VERTICAL 15mm (5/8") DIA. CHUCK
WITH HEADSTOCK WITH
ADJUSTABLE BEARING CAST
IRON CHUCK AND 1/2" DIA.
SLEEVE 15mm (5/8") DIA. 4000 RPM
THROUGH ELECTRONIC
CONTROL 150W INPUT MOTOR
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Many readers extol the virtues of purchasing secondhand machine tools, enabling one to have more choice and, in some cases, more machine for your money, assuming that you have the space available. Home and Workshop Machinery, the subject of our supplier visit in this issue, have plenty of machines and accessories to offer

We visit HOME AND WORKSHOP MACHINERY

Home and Workshop Machinery of Sidcup, Kent, commenced business some ten years ago, being started up by two brothers, Steve and Chris. Their aim at the time was to deal almost entirely in used Myford machines, which proved a very successful operation. However, it was soon realised it would be preferable to deal in other makes of machine, whilst still limiting the size of machines to those found in the home workshop, albeit that the larger machines are only to be found in a minority.

Steve and Chris are still owners of the business and their original aim to sell Myfords is still very much in evidence, there usually being at least 20 such machines available. The range of machines now on offer is wide, but size is limited; typically to the Colchester Chipmaster, for a lathe, and in the case of a milling machine the popular Bridgeport mill. These sizes of machine are of course limited to a small percentage of home workshops, but there are a very large number of smaller machines, more suited to the majority of users.

Large stock

Total number of machines in stock at the present is around three hundred, but this is not the full story as there are also a very large number of machine tool accessories, measuring equipment and hand tools held in stock and for sale.

Machine tools are bought in from home workshops, schools and from industry. In the case of those from industry most are fitted with three phase motors and, whilst in the case of smaller machines it may be economical to replace the motor, for the larger ones a single to three phase converter is a better approach. To minimise this problem, Home and Workshop Machinery are agents for Transwave converters, which can then be supplied with the machine as a complete package.

Some new items are sold

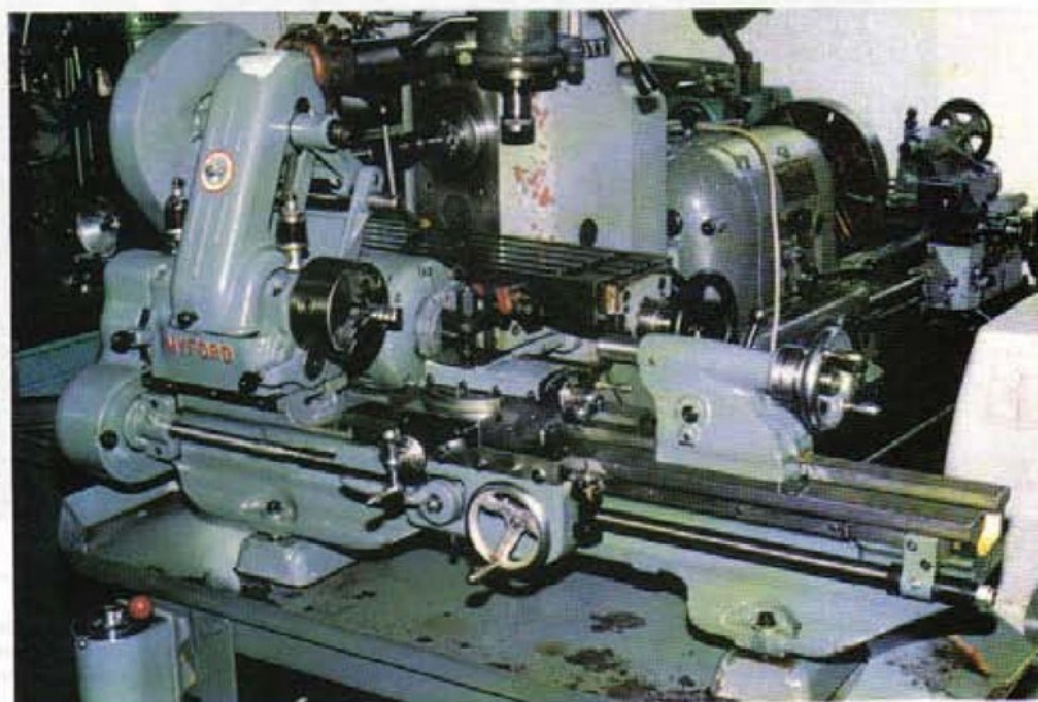
These converters are of course new, as are a small number of other items on offer. They are agents for Hobbymat machines and also sell a medium size drill/mill, there are also some new electric motors available.

Machines are fully checked and new parts fitted where considered necessary, they do not however have beds reground as they feel this would put many machines financially out of reach of the typical home workshop owner, which group incidentally are responsible for a very large proportion of their business.

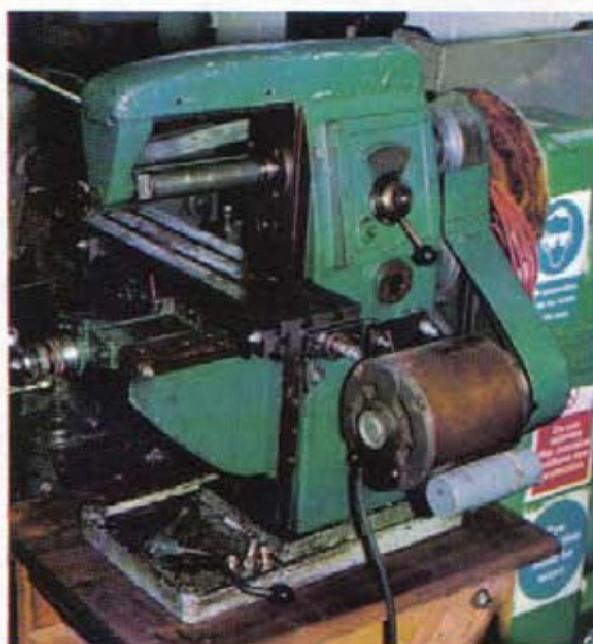
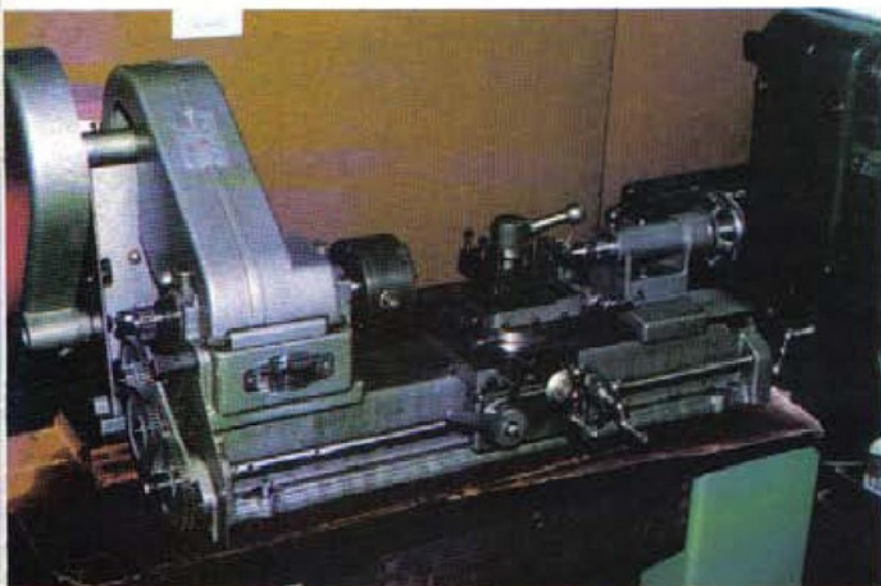
Delivery is, in the southern half of the



This highly polished 1959 Ford Thames Trader is taken to vintage vehicle shows, another vehicle is used for the machine deliveries.



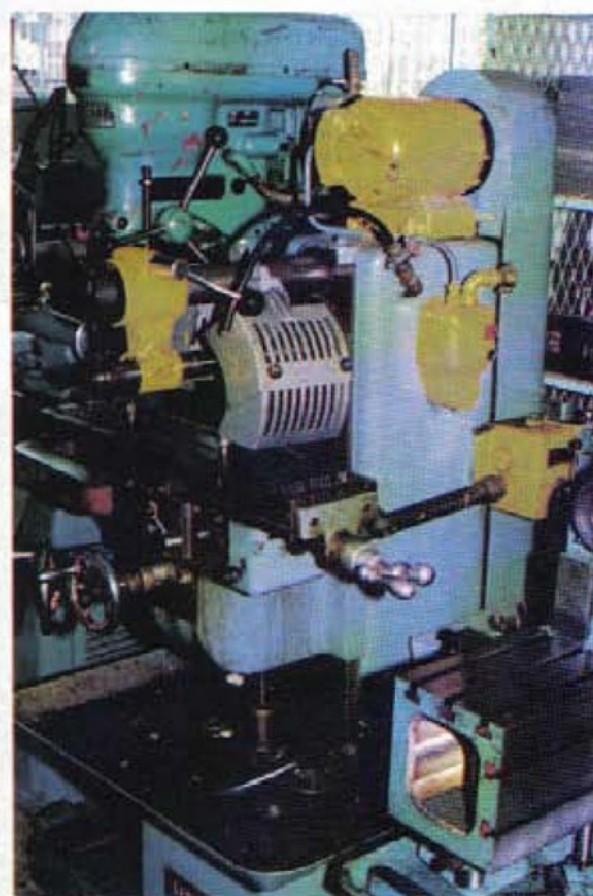
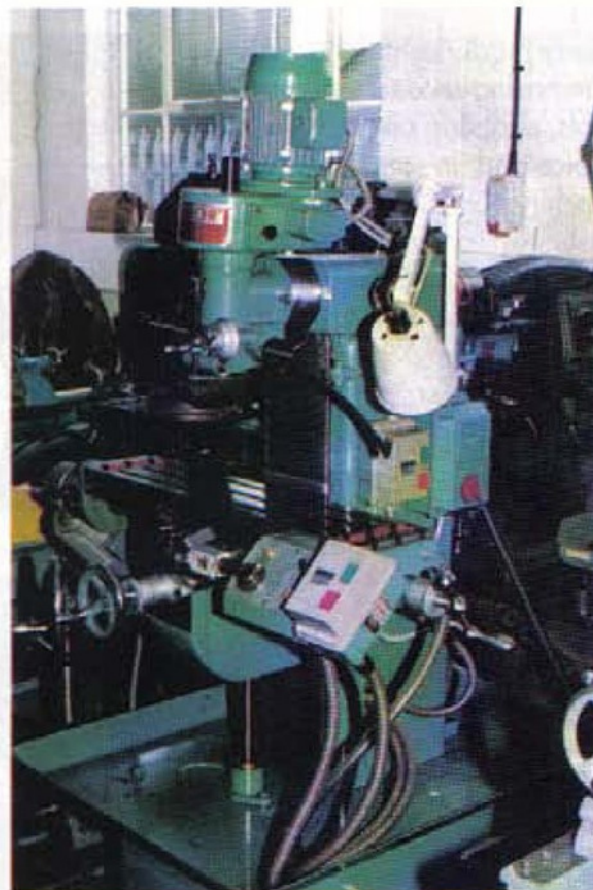
Typical of the large stock of Myford Series Seven lathes available.



Other Myfords such as this ML10 are also available.

The popular Centec 2A horizontal milling machine.

A Tom Senior universal milling machine in almost new condition.

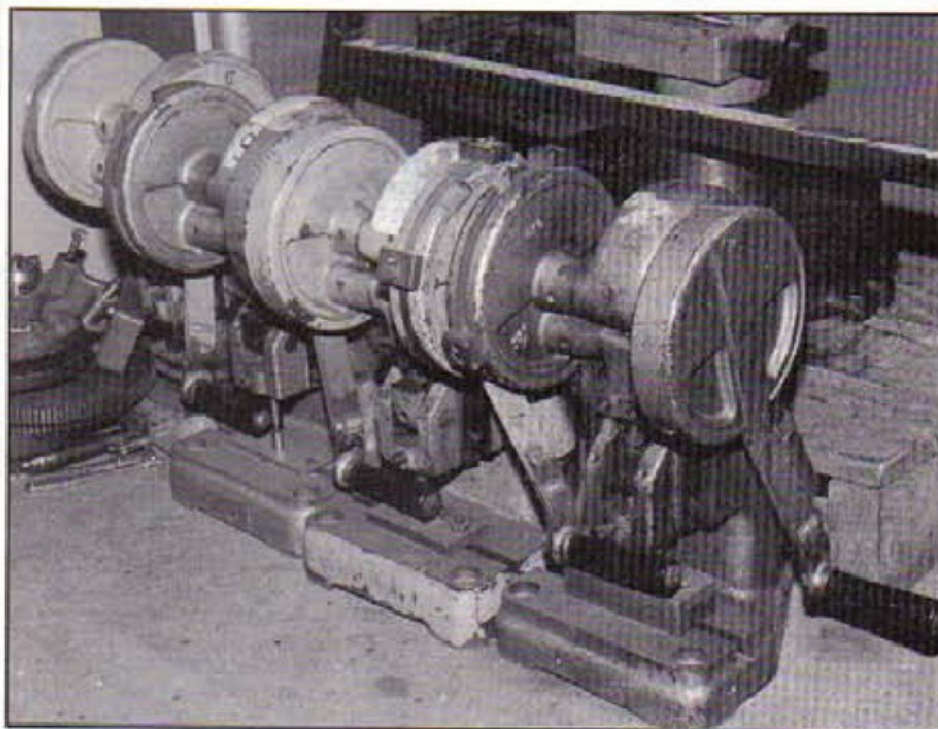


A Tom Senior horizontal milling machine.

Many of the larger machines have three phase motors, new converters manufactured by Transwave are available to enable them to be run from single phase 240 volt.



A small fly press, of a size ideal for the home workshop.



A number of small toggle presses.

U.K., by their own transport. This is not by the highly polished 1959 Ford Thames Trader seen in the photograph which is used for showing at numerous vintage transport displays around the country. Chris says that if you do see them on the road en route to one of the events, do give them a wave. For deliveries beyond this distance a commercial transport organisation is used for deliveries, with which Home and Workshop Machinery are well pleased.

Providing transport is one thing but it requires delivering to a reasonably easy

point for off loading. The company will always be prepared to discuss assisting with moving a machine into its final location, when it is being delivered on their own transport.

Most would-be buyers wish to inspect the item before making a purchase. Travel to their premises is easy, being just ten minutes drive from junction 3 of the M25 motorway. They are open Monday to Friday and also Saturday morning, parking is available on the site. A map of the location is given on the stock list available.

Stock list

This list, to date, has been difficult to

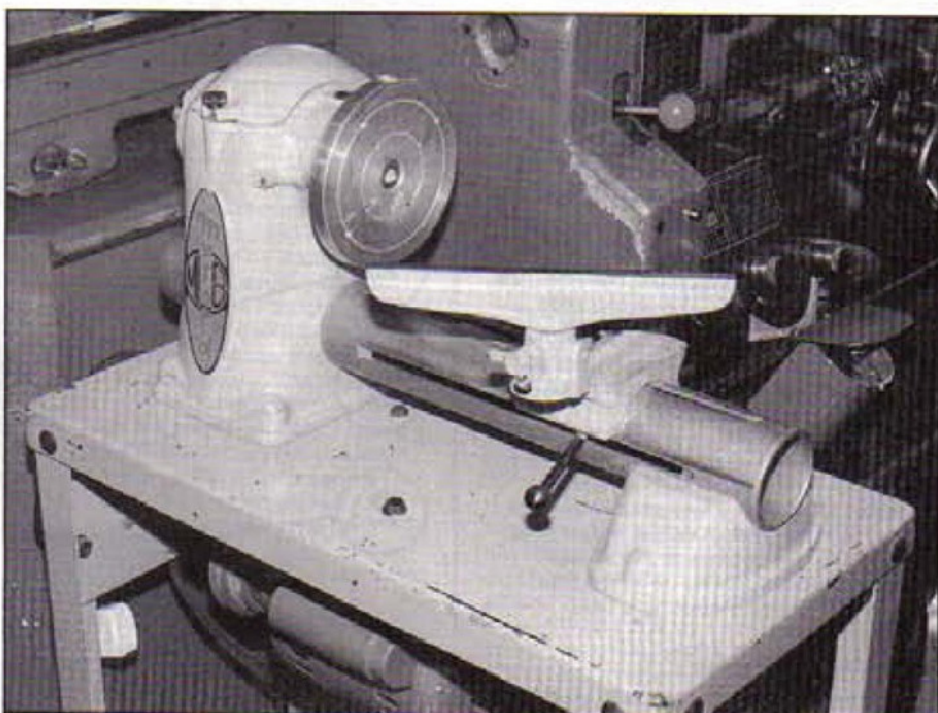
keep up to date in view of their continually changing stock; a computer is now being installed for this sole purpose, which should make it possible for lists to be provided that are totally up to date.

However the presence of a computer will not diminish the personal attention given to customers, Home and Workshop Machinery pride themselves on this aspect of their operation.

For a copy of their latest list send to Home and Workshop Machinery, 144 Maidstone Road, Footscray, Sidcup, Kent, DA14 5HS. Tel. 081-300 9070 (evenings 0959-532199). Fax 081-309 6311.



This very well preserved lathe, apparently by Drummond, but having a Buck and Hickman name plate, is not just for show but is available for sale. Apparently such older machines are quite often available.



Whilst predominantly metal working machines are stocked, a small number of woodworking machines are always available, this one a Myford bowl turning lathe.

THE PLANER, SLOTTER AND SHAPER

PART 1

Don Unwin describes how, as a result of the continuing improvements in the early lathes, there was a need for this to be matched by advances in the methods of producing flat surfaces. This was initially achieved by the introduction of the planer, closely followed by the slotter and shaper. The article is in two parts, with the development of the slotter and shaper being described in the next issue

One of the problems facing the early metal workers was the production of flat straight surfaces, particularly as the quality of the lathe improved and the need for steam-tight slide valves on the new steam engine.

Up until the beginning of the 19th century, flat surfaces had to be produced by chipping with a chisel and filing, working to a straight edge. Surface plates were made by rubbing two plates together with an abrasive such as sand between them, the result being very imperfect planes due to the uncontrolled action of the abrasive.

James Nasmyth, who had worked for Henry Maudslay, tells us in his autobiography "... The importance of having Standard Planes caused him (Maudslay) to have many of them placed on the benches beside his workmen, by means of which they might at once test their work ... Three of each were made at a time so that by the mutual rubbing of each on each the projecting surfaces were effaced. When the surfaces approached very near to the true plane, the still projecting minute points were carefully reduced by hard steel scrapers ..." Later Nasmyth says "... This art of producing absolutely plane surfaces is, I believe, a very old mechanical 'dodge' ..." However this method is usually credited to Joseph Whitworth who said that it was whilst he was working for Maudslay in 1825 he introduced the technique of hand scraping mutually three plates to plane surfaces. It seems likely that as Nasmyth joined Maudslay some four years after Whitworth, with his autobiography written in 1883, his recollections were somewhat hazy and Whitworth's claim that he developed the method whilst with Maudslay is true.

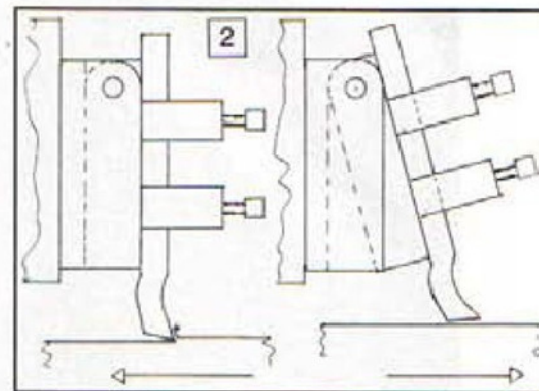
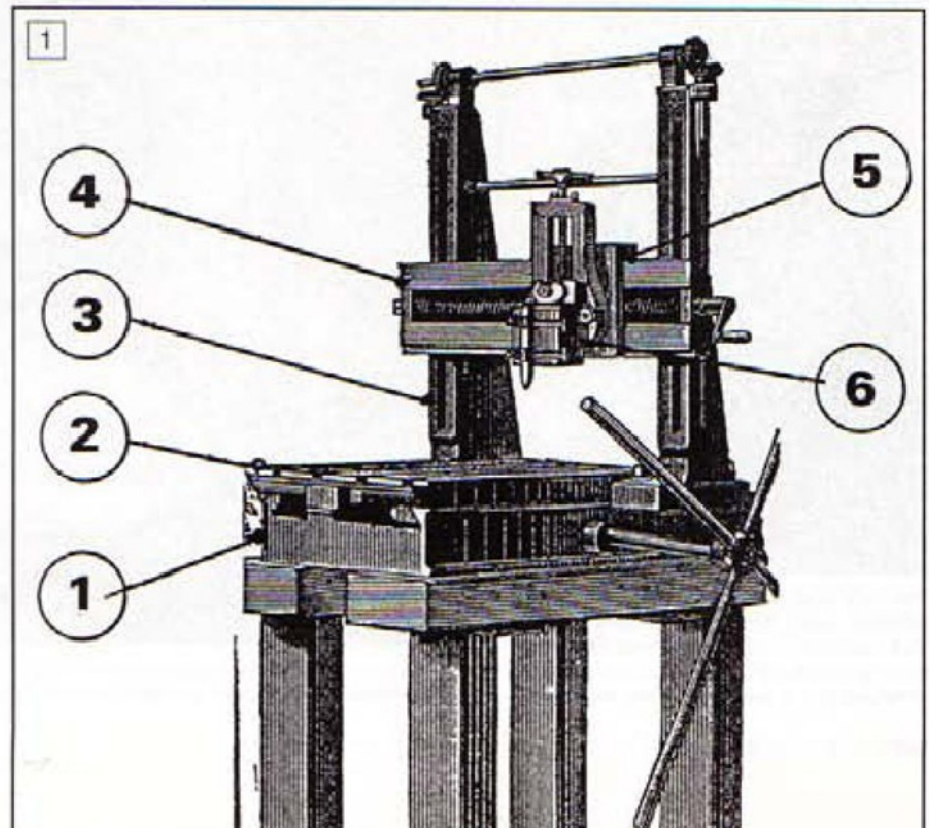
A mechanical dodge

For those not familiar with "the very old mechanical dodge" three plates of the same size labelled 'A', 'B' and 'C' were finished as flat as possible by file, or

nowadays by machining, then a thin film of some marking material such as a dye in oil or thinned paint was smeared on 'A' which was then rubbed on 'B' and 'C'. Then the high spots indicated by the marking fluid were removed from all the plates with a hardened flat scraper. Plate 'B' was then coated and rubbed on 'A' and 'C', all high spots again being scraped down. The process was repeated again, marking 'C' and rubbing 'A' and 'B' once again scraping all high spots. This sequence was repeated until all three plates showed equal marking all over their surfaces indicating that they were similar true planes.

Some machine to produce the flat surfaces of lathe beds and slideways was badly required and it was the invention of the planing machine, or planer, which satisfied that need. Without doubt this self-propagating machine was second only to the lathe in its effect on mechanical engineering progress. The machine, **Fig. 1**, usually consists of a work holding table (1) which rests on the slideways of a heavy bed casting (2) and is reciprocated backwards and forwards by some means. Mounted on the bed, one each side of the table, are two stiff columns, or standards (3), with slideways and between the columns is a cross beam (4) which can be adjusted up and down the column slideways by screws. On the cross beam, also having slideways, is a screw traversed carriage (5) on which is mounted the tool slide (6) with angle adjustment rather like the top slide of the lathe. The toolholder on the slide has means of lifting the cutting tool from the work on the return stroke, often a 'clapper box' **Fig. 2**, or some alternative arrangement to permit cutting

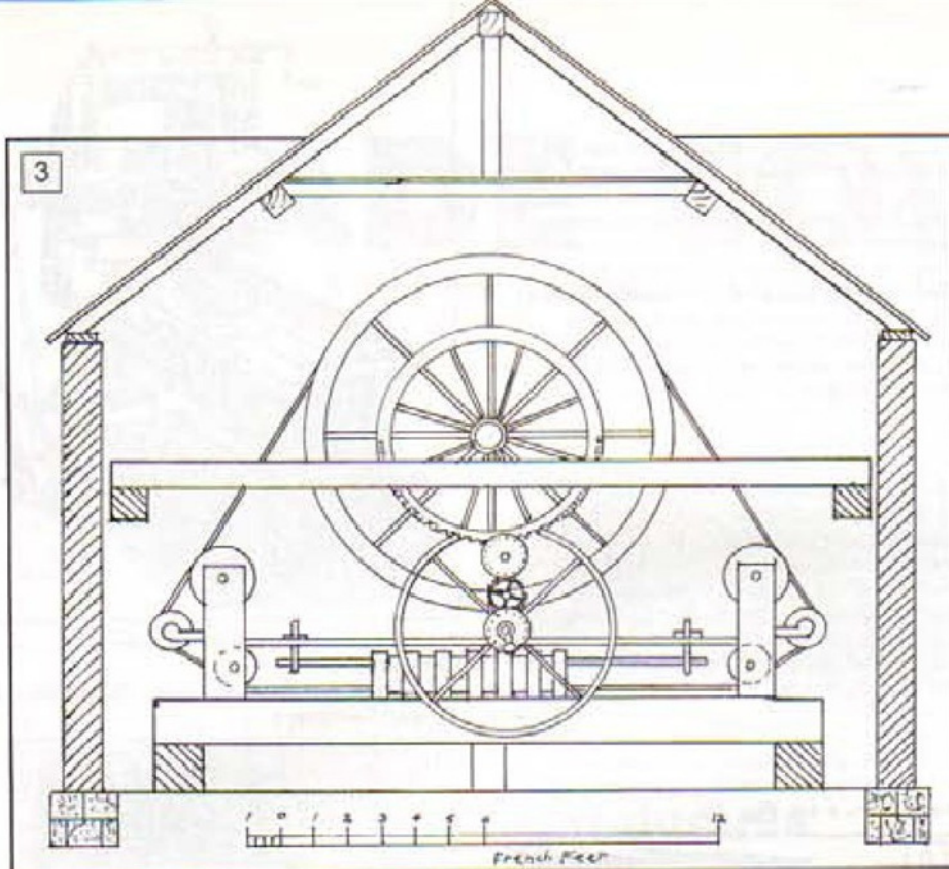
1: The basic planing machine.



2: Diagram of planer clapper box.

in both directions. In operation the table with the work mounted upon it is traversed back and forth, the tool being advanced between each pass along the cross beam by hand or a self-acting screw traverse, the depth of cut being adjusted by the tool slide, which is also used for machining angles or the side of work. The table was moved by a chain over two sprockets or more usually by a rack on the underside driven by a pinion mounted on a shaft in the bed casting. This shaft could be driven by hand on small machines or by belts and pulleys. Reversing was achieved in various ways such as open and crossed belts on fast and loose pulleys or a cluster of bevel gears. At first reversing was accomplished manually then later by some form of striking mechanism operated by trips on the table. Self-acting feeds to the tool were also added later.

Unlike the engineers lathe which was



3: Planing machine by Nicholas Forq, 1751. French foot (pied) = 12.79in.

clearly the work of Henry Maudslay, the invention of the planer had several claimants.

A French clockmaker Nicholas Forq invented a planer in 1751 for machining the pump barrels of the Marly waterworks which supplied the fountains of Versailles. The barrels which varied between 7 and 10 feet long, 4 to 10 inches in bore, were made up of wrought iron bars held together by iron hoops. The principle of the machine is shown in Fig. 3.

Then in 1754 Plumier the French writer on workshop matters, described a machine for making ornamental knife handles which was essentially a planer. Plumier said that it was an English invention which had been in use for several years. It consisted of two parallel bars on which slid a carriage holding the cutting tool and driven by a lead screw. The work was mounted between the bars and the tool passed along it with a planing cut.

William Murdock is believed to have invented a planer to machine 'D' slide valves in 1786, which was later improved by Matthew Murray in 1802. An old workman of Murray's said that it had been in use many years before he joined the firm in 1814.

Other claimants were Sir Samuel Bentham in a patent of 1793 and Joseph Bramah in his patent of 1802, whilst Samuel Smiles says in his 'Industrial Biography' that Spring of Aberdeen was an inventor of a planer but gives no details.

The oldest survivor

However all these are written references and the oldest surviving planer in existence is that designed and built by Richard Roberts in 1817. It can be clearly seen that all the slideways and flat surfaces on this machine were finished by chisel, file and scraper. Robert's planer had all the elements of the modern machine, having vertical and horizontal feeds, angular adjustment to the tool slide, separate tool feed and a hinged tool box which allowed

the cutter to be lifted clear of the work on the return stroke. The table which was 52in. by 11in. was manually reciprocated by a chain and hand wheel.

Robertson Buchanan, an English writer, in his 'Essays on Millwork and Other Machinery' 1841 describes a planer made by George Rennie, brother of Sir John Rennie and son of John Rennie senior who built the famous Albion Mills in London in 1788. The table was traversed by a screw and to enable cutting to take place in both directions had a revolving tool holder.

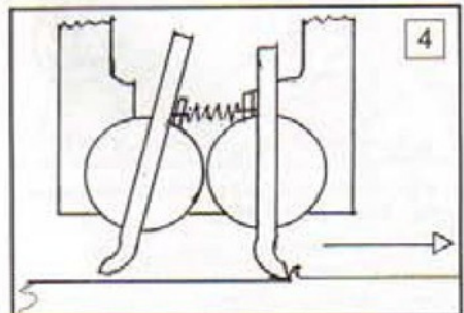
Then by 1820 Joseph Clement had made a planer for machining the lathe slideways with the tool holder having vertical and horizontal motions but it is not known if it had self acting feeds. It was so successful that he built his second much larger 'great planer' in 1825. Clements was a very accomplished draughtsman and drawings of his machine exist from which it can be seen that the bed ran on 2ft. diameter flanged rollers mounted on massive masonry foundations. It could plane work 6ft. square cutting in both directions made possible by a two tools mounted on the swinging cross beam and self acting feeds. The table was traversed by a long screw, reversed by a cluster of bevel gears but manually driven, normally by one man but on long work by two. It could even be adapted to cut long racks by traversing the tool along the cross beam, spacing the teeth by a calibrated dial on the lead screw. For ten years it was the only machine able to take such large work which enabled Clement to charge 18/- (90p) a square foot of machined surface which earned £10 a day or £20 for the frequently needed double shift.

James Fox, another manufacturer who had to devise and make machines for his product range, in this case textile machinery, was another early builder of the planer. According to a former employee Samuel Hall, Fox made a planer in 1814 which had self-acting ratchet motion for the compound tool slides, clapper box tool holder and rack driven table with self-

acting reverse using a bevel cluster almost exactly the same as that used by Clement some years later. Although the date 1814 is unconfirmed Fox had certainly made a machine by 1820.

Whitworth made planing machines as early as 1835 designed to cut in both directions. To achieve this he used a single tool held in a tool box, he called it 'Jim Crow', which was automatically rotated through 180 deg. at the end of each stroke. To reverse the direction he used two belts one open and the other crossed. The table drive shaft had two fixed pulleys separated by a loose pulley all of the same diameter. The belt striking gear was actuated by the trips on the table causing either the open or crossed belt to move to one of the fixed pulleys. This method of reversing was considered to give smoother action than the clutch and bevel gear cluster system used by Fox and Clement.

The basic form of the planer had been established by 1840, from then on there was a considerable increase in size and other improvements in details. Several tool retraction devices other than the simple 'clapper box' and mechanisms to enable cutting in both directions such as Wicksteeds rocking twin tool holder Fig. 4

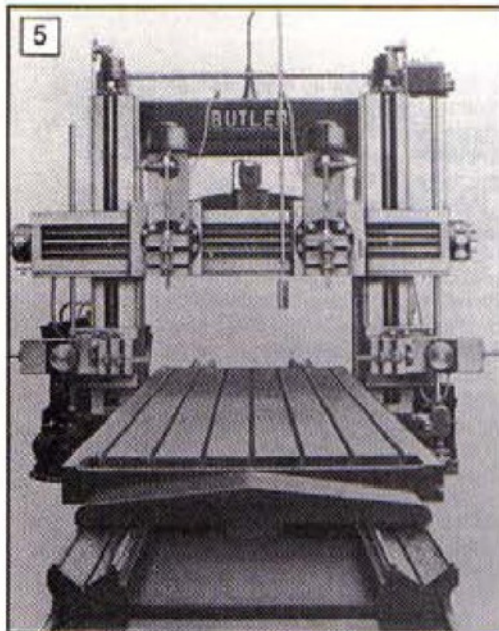


4: Wicksteed's two-direction tool holder.

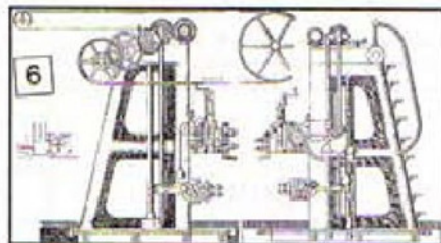
appeared, whilst fast return of the table on the return stroke which was shown by Whitworth on a small machine at the 1851 Exhibition are a few innovations. Many table drive and reversing arrangements were devised including Seller's spiral geardrive to the table rack in 1860, electric motor drive with electrical reversing introduced about 1900 and actuation of the table by hydraulic cylinders. Large machines appeared with more than one tool slide on the cross beam and even tool slides mounted on the side columns enabled the simultaneous machining of several surfaces. Fig. 5. Later electrically driven machines often had solenoid tool retraction devices, seen on Fig. 5.

In 1834 a French engineer La Moriniere devised a travelling standards planing machine in which the tool was traversed instead of the work, a type which was sometimes called the 'French' form. Joseph Whitworth patented a similar machine of this type in 1835 but with different methods of supporting the toolhead and traversing it along. A quite large machine of the type about 1860 is illustrated in Fig. 6. The method used to drive each standard along by racks and pinions and the rather complicated belt loop to keep constant tension as the standards moved along is interesting.

For very long work the travelling tool wall planer was devised. Fig. 7 shows a machine of this type installed at the Soho Foundry about 1830. As with many large machines of that period it was built into the

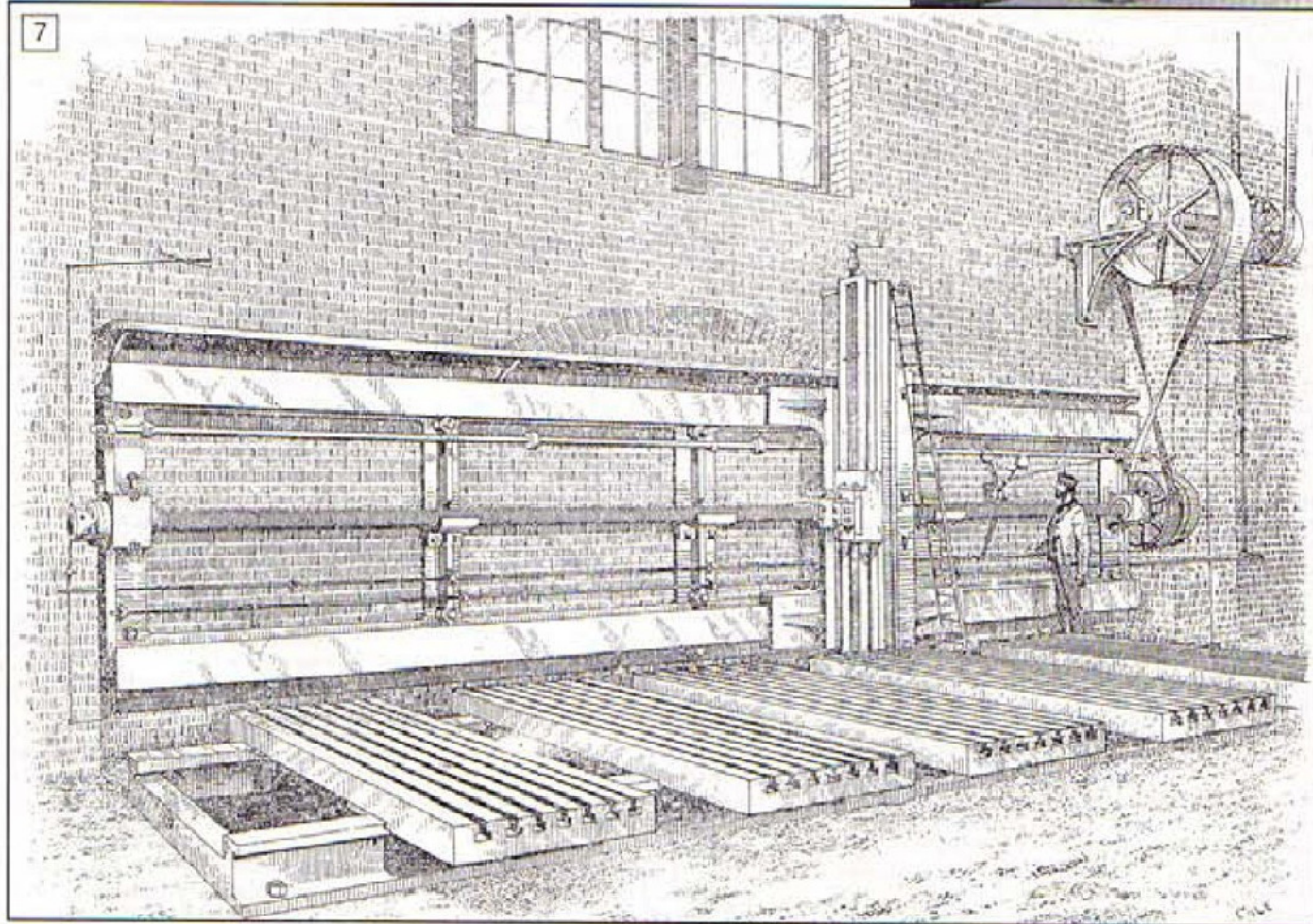


5: Large planer with multiple tool holders, c1930.



6: Wm. Sellers travelling standards planer, c1860, Engineering 1866.

7: Soho Foundry wall planer, c 1830. Engineer, 1895.

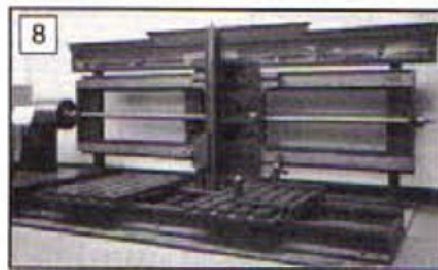


structure of the building. Notice that the artist has omitted the open belt on the drive on the right hand end of the lead screw!

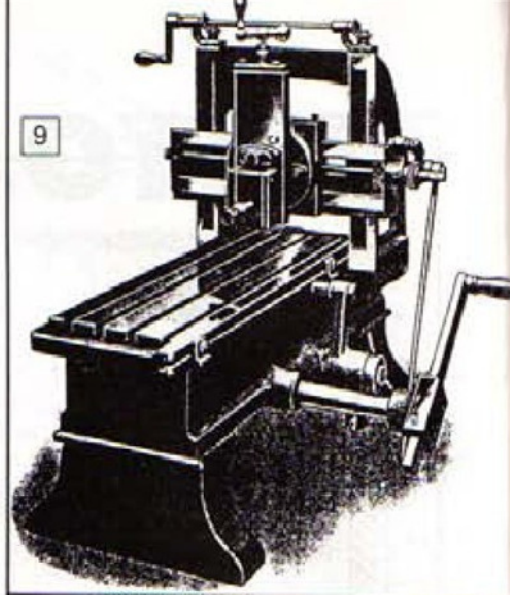
Fig. 8 shows a smaller self contained machine, often known as a side planer, also from the Soho Foundry and now in the Birmingham Museum of Industry. Another form for wide work was the open side planer, a 1917 example shown in **Fig. 9**. Notice the antiquated individual electric motor and the open and crossed belts to provide the table reversing.

One variant, the plano-miller is more a milling machine than a planer and will be described later in the series.

Apart from Clement's 'great planer', the first machines were fairly small, at the 1851 exhibition one was described as 'for opticians', the range of sizes gradually getting greater as the demand for large machines developed. However as it required no expensive cutters the small machine remained popular in the small workshop long after the introduction of the milling machine as well as among amateurs, in fact Tom Senior was still advertising a range of small machines in 1939, the smallest being 12in. x 6in. x 4in. **Fig. 10**.

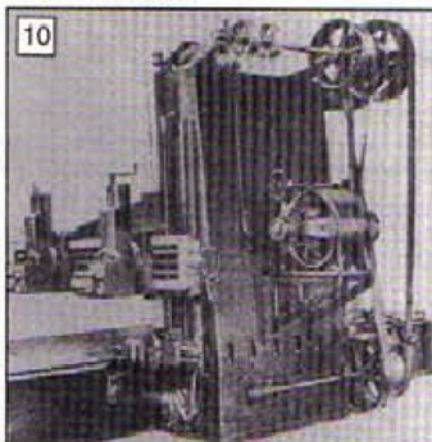


8: Side planer, Soho Foundry, c 1830, Birmingham Museum of Industry.



9: Open side planer, Alfred Herbert Catalogue, 1917.

10: 'Senior' No. 3 hand planer, 1939. Buck & Ryan Catalogue.



TRADE COUNTER

A first look at products which may be new to you

Machine Mart move into Scotland

The Machine Mart network was further expanded recently with the opening, in Edinburgh, of the 33rd superstore.

Located at 163-171 Piersfield Terrace, Portobello, this new superstore is the company's first in Scotland and is to be the Scottish regional mail order centre and Service base.

The store has 8500 square feet of shop floor space and carries the company's entire product line of power tools, garden mowers, compressors, welders, hand tools, garage and leisure equipment. At the same location there is a separate Service department which will undertake any product maintenance or repairs.



The Trihone from Chronos

As a result of a special purchase, direct from the U.S.A., Chronos are able to offer the Arkansas Trihone at reduced prices. These are £14.95 for the TR1 and £18.95 for the TR6. Prices include VAT and postage.

The TR1 hone is an excellent sharpening aid and comes complete with three quality stones, Medium Arkansas to smooth the steel and edge, Fine Arkansas to finish and polish the edge and a special man made coarser grade stone for very dull or nicked edges.

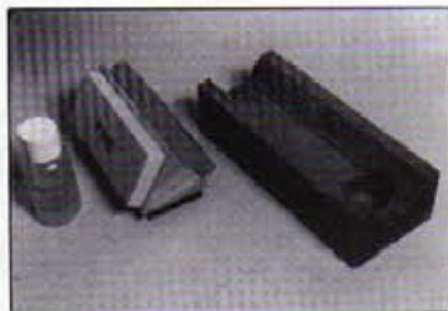


Trihones are mounted on a purpose made wooden stand, are convenient and sturdy, and come complete with honing oil and an instruction sheet.

Two sizes are available: the TR1 having 4 x 1 1/4 x 1/2 in. stones, whilst the TR6 has 8 x 1 1/4 x 1/2 in. stones.

To order these, or for a free special offer list detailing these and many other

sharpening aids including slipstones, deburring stones and gift sets, contact Chronos, 95 Victoria Street, St. Albans, Herts, AL1 3TJ. tel 0727 832793, fax 0727 848130.



Catalogues received

Two catalogues of interest have been received; if requesting copies for your own collection, please mention M.E.W.

The first is from Castell Engineering Supplies, and contains a very wide range of cutting tools, drills, taps, dies, end mills etc. Taps and dies are available in both carbon and HSS. Of particular interest is the inclusion of roll taps (see M.E.W. issue 7 page 52).

I have not seen these offered in any other suppliers catalogue for the home workshop, and rarely in those offered to industry. Having no flutes they are very robust and are particularly good for tapping thin sheet.

For a copy send to Castell Engineering Supplies, Western Gardens, Ealing, London, W5 3RS. Tel. 081-992-5893/4, Fax 081-992-0466.

The other this time is from Bidwell (Machine Tools and Equipment) Ltd. containing a very wide range of, in the main, used machine tool accessories and spares, cutting tools, measuring equipment, hand tools, electric motors and many other types of equipment. Also listed is a smaller range of used machine tools including sheet metal working tools.

For a copy send to Bidwell (Machine Tools and Equipment) Ltd., Unit 2B, Benbridge Industrial Estate, The Square, Heybridge, Maldon, Essex, CM9 8XP. Tel 0621 858150, Fax 0621 856275.

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Whistons

A number of readers have enquired where they can purchase the items which were previously available from K.R. Whiston of Stockport. The entire stock of this company was purchased by Proops Bros who retained some items, whilst others were dispersed to other outlets, and some scrapped. The items cannot therefore be obtained from any one supplier.

Erratum

Polyurethane Products Ltd.

Please note the telephone number for PPL given on page 16 of issue 18 should be 021 772 8669. Our apologies for any inconvenience.

MAKING A LATHE FILING REST

**PULL OUT
PLAN**

As a result of the increase in the use of milling techniques in the home workshop it is probable that some readers may consider the lathe filing rest to be an obsolete form of workshop equipment. However it is often the case that one needs to form a flat, a short length of square or even hexagon section on a job which is already in the chuck after a previous operation. Given a little thought it is apparent that such can be formed very much more quickly using a filing rest, than setting up the milling machine specially for such a simple operation. The rest featured in this article, provided by Bob Fletcher, incorporates a calibrated adjustment and is therefore capable of accurate work

A filing rest for the lathe can be a very useful accessory, but sometimes controversial when it comes to safe usage by the operator.

In my younger days when employed as a turner and engineer it was common practice in my employers to set on a number of school leavers in one intake.

After a short introductory period these



The tool assembled and ready

for use.

lads would be allocated by the works foreman to train with a qualified man. The skilled men were expected to take the lad under their wing, so to speak and guide him through the normal working practices and to assist with his night school home work when necessary.

It was recognized by the company that it would not always be possible to keep the lads gainfully employed; such times as between jobs or when waiting for materials to be supplied by the stores. At these times it was normal to set the lad an ongoing project which had to be approved by the management.

The most common exercise to be set was the making and scraping in of a small but useful surface plate, using the firm's large surface plate as a master. As an engineer I was expected to be able to scrape in mating surfaces when required. I must admit that scraping was a job that I found the most boring, and so it was placed at the top of my jobs to be avoided list.

I made up a set of drawings for a small filing rest and submitted them for approval. I had difficulty in getting them passed as the management was of the opinion that there would be a great temptation for the implement to be used when the lathe was in motion. With a little persistence on my part, permission was given but I had to instil on the apprentice that the tool was intended to be used in producing flats, triangles,

squares and hexagons on round stock held in the lathe chuck. If I ever caught him using the tool with the machine in motion he would feel the rough end of my tongue and even worse from management.

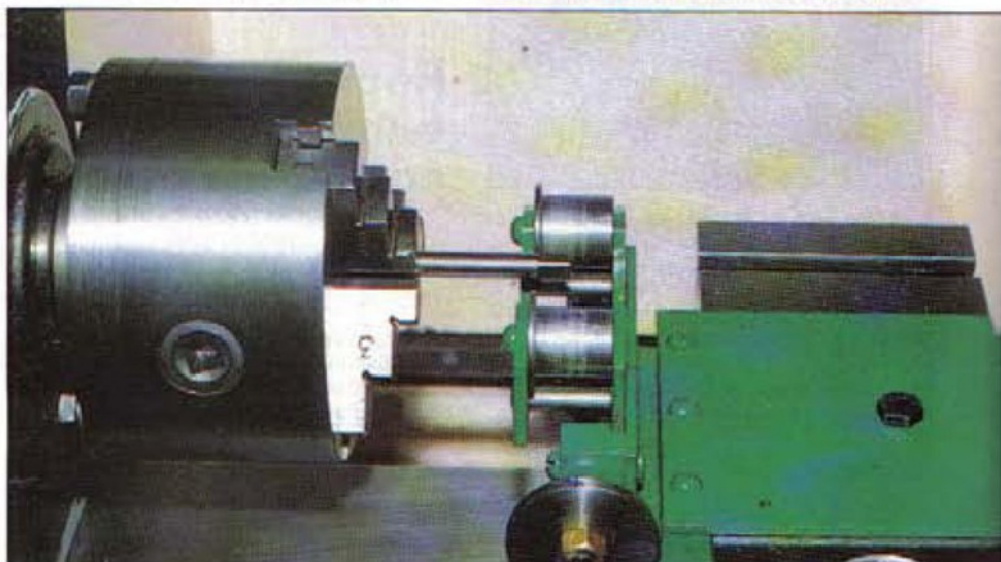
I believe that safety in the workshop and the use of workshop tools is ultimately the responsibility of the operator and is largely dependant on commonsense.

The drawings and tracings which were used to produce blue prints have long since disappeared, so I have made a new set of drawings for this article. I must say that the method used for raising and lowering the rollers is not mine, I have seen it described elsewhere, but I cannot remember the source. I have a vague feeling that it may have had something to do with the late E.T. Westbury, but cannot be certain.

Construction

The materials and dimensions chosen for the making of the tool were influenced by the material already on my stock shelf, by the same token I am sure that builders will adjust the dimensions to suit the material they have to hand. The article is intended

Showing a square being formed on the end of a stainless steel rod which will be made into a stop valve for a tender drain cock.



All the parts made and ready for assembly.

for the newcomer who is interested in making tools to build up his workshop. The more expert will probably already have a similar tool in their equipment and those who have not will I have no doubt made their own arrangements.

For the newcomer I will outline the making of each component starting with the base assembly. This requires two parts to be made, the first being the baseplate (**Item 1**), 3mm thick and cut slightly over size. The plate is filed up to size and squareness. Those who are lucky enough to own a milling machine will probably use this to make the plate square. It could be flycut using the lathe.

Once this stage is reached, cover the surface of the plate with layout blue and carefully mark out the position for the holes and drill to size. The 6mm dia. hole is for the anchor bolt and "T" nut in the cross slide of the lathe, so before drilling, check to see that the position is suitable for your machine.

Buttress plate (Item 2)

The next part to be made is the buttress piece. From the drawing it will be seen that it is made from a piece of 25 x 20mm BMS cut to a length of 95mm. There is a recess to be milled along one edge as shown in the drawing. The holes can be marked out, drilled and tapped M5. The two holes marked D1 will be drilled and tapped later.

Fixed plate (Item 3)

This is made from 3mm BMS as used in the base plate and in the same way. You will see from the drawing that a 6mm slot must be cut on the horizontal plane. A series of holes can be drilled and then joined up with a file but it would be better done by placing a slot drill in the three jaw chuck and mounting the plate on a vertical slide, then the slot can be milled out by traversing the cross slide. Remember to place a wood packing behind the plate so that the slot drill will not mark the vertical slide when it breaks through the plate.

The holes are marked out and drilled. The two M5 holes at the top of the plate will be drilled later.

Slide plate (Item 4)

This part is made from 3mm BMS, the same as Items 1 & 3 and is cut and shaped by the same method. The slot cut at an angle will be produced in the way as the horizontal slot in the fixed plate. The plate will require to be set over at the necessary angle.

Support plate (Item 5)

The plate is cut and filed up to shape using 3mm material as before. The holes are marked out and drilled as shown in the drawing.

Guide block (Item 6)

Two guide blocks are required and the way I made them was to cut a length of $\frac{1}{2}$ x $\frac{1}{16}$ in. BMS just over 100mm long. This was then set up and a recess milled along one edge.

After milling the bar was cut in half and filed up to give two blocks 50mm long. The holes are marked off and drilled as shown in the drawing.

Take note that the holes in the centre for

the lead screw are of different size, the hole in the left hand block is 3mm dia. and the hole in the right hand block is to be drilled 6.4mm diameter.

When the parts described so far have been made and cleaned up by deburring all edges and rubbing all over with fine emery cloth, they are assembled by fixing the buttress piece to the base plate with three M5 screws. The vertical plate is positioned and held by two M5 screws; next position the left hand guide block and hold with a screw in the top hole. Place the sliding plate in the recess and fit the right hand block, hold in place by a screw in the top hole. The guide blocks should now be squared up with the edge of the vertical plate and given extra grip with the use of two small clamps. The two bottom holes D1 can be used as a drilling jig, drill through the plates and just spot into the buttress. The buttress piece can now be drilled and tapped M5 and screws fitted and tightened up. The type of fit required on the moving plate is good sliding fit with as little shake as possible.

Rollers (Item 7)

These are a straightforward turning job and require no comment, except as to the choice of material. I made mine from BMS and with a straight from the tool finish. If you wish to harden the rollers then a case hardening compound could be used, or a high carbon steel such as silver steel. If this latter option is selected harden and temper them to mid straw.

I did not harden my rollers because I have an objection to bringing my files into contact with a hardened surface. I consider that the amount of wear taking place on the rollers in relation to the number of times the tool is used is acceptable.

Just in case, and as I had enough material to hand, I made up a spare set of rollers which are kept in my workshop. These can be fitted to the tool in a matter of minutes should wear on the original rollers ever become a problem.

Roller bushes (Item 12)

Two bushes are made to the dimensions given on the drawing. They are made from 8mm dia. silver steel. Drill down the centre then harden and temper to mid straw.

Support spacer (Item 13)

Three are required and are made the same as the roller bushes, except that the centre hole has to be drilled 4.1mm clear. They do not need to be hardened, so BMS can be used for these parts.

Adjusting shaft (Item 8)

The shaft is made from 12mm dia. M/steel and machined up to the dimension on the drawing. The thread was screw cut on the lathe. I have specified $\frac{1}{16}$ in. x 40 TPI on the drawing as this was the thread that suited my own purpose. It gives a very fine adjustment to the rollers; you may consider it to be too fine for your use, a $\frac{1}{16}$ in. x 20 TPI may be more in keeping with your needs. Any standard $\frac{1}{16}$ in. thread could be used if you wish, say $\frac{1}{16}$ in. BSF or BSW, or if you prefer metric M6.

Adjusting wheel (Item 9)

This part is just a plain disc and is again

a straight forward turning job. The centre is drilled and tapped with the thread of your choice.

Die block (Item 10)

This is made from 12mm square stock. Set to run true in the four jaw chuck and then machine a 6mm dia. peg 6mm long. Centre, then drill and tap M4 to a depth of 8mm. Part off to the dimension shown on the drawing, reset in the four jaw chuck and cross drill and tap using the same thread which you used on the adjusting shaft.

Die block keep plate (Item 11)

This is no more than a piece of 20 x 3mm BMS cut and filed up to length with a 4.1mm hole drilled in the centre.

Lock nut (Item 14)

A nut will be required to lock the adjusting wheel to the shaft. A standard nut can be used if you have chosen a standard thread for the shaft. If not then a special nut will have to be made.

Assembly

To put the tool together should be quite straightforward, with the help of the G.A. drawing.

At first I thought it would be unnecessary to index the adjusting wheel but after using the tool a couple of times I came to the conclusion that an index scale could be useful. To graduate the edge of the adjusting wheel it is necessary to know how much the rollers will move with one revolution of the adjusting shaft. This can of course be worked out mathematically, this would assume that the angle slot had been machined at exactly the required angle. It may be better to use a more mechanical method.

The procedure that I used was to set up the tool on the lathe cross slide and fix a dial test indicator using a piece of flat bar across the two rollers for the gauge's plunger to rest on. A temporary mark was made on the wheel and the adjuster turned clockwise at least two full turns, to rule out any free play, the gauge was zeroed and the adjuster moved one full turn. The amount the rollers had lifted was noted. The procedure was reversed by turning the adjusting wheel anti-clockwise two full turns, the DTI was zeroed again and the wheel moved in the same direction one full turn; this time the amount the rollers had lowered was noted. This should be the same as the first reading.

The rise and fall of my rollers turned out to be exactly 0.006in. per revolution. I indexed six equi-spaced divisions on the wheel; each division representing 0.001in. movement of the rollers.

If you are unlucky and produce a part of a thou. then round the reading up or down accordingly, the amount of error spread over a number of divisions will be negligible for a tool of this type. You may of course wish to calibrate in metric divisions.

That concludes my building notes, all that remains for is that I hope you find the tool to be an interesting project and a useful accessory for your workshop.

I will sign off in my usual way, have fun in your workshop and please work safely. Your eyes and fingers only grow once so for all our sakes please look after them.



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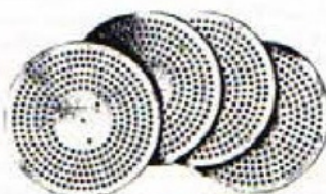
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3/4	8.60	5.16
1	7.82	4.69
1 1/4	10.71	6.42
1 1/2	10.40	6.24
1 3/4	11.84	7.10
2	10.40	6.24
2 1/4	15.86	9.51
2 1/2	12.25	7.35
2 3/4	15.45	9.27
3	12.05	7.23
3 1/4	15.55	9.33
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DIVIDING-COMPUTER PROGRAM

H.M. Turnbull provides us with a simple computer program for working out the divisions that are available from a division plate and range of gear wheels. If you have a computer but have not attempted to use the Basic software that was probably supplied with it, why not give it a try with this short program? If, as Mr Turnbull suggests, you leave out the lines starting with REM, then there are only around 40 lines to enter – surely worth the effort!

Why

The dividing equipment that I use on my modern lathe is the usual, change wheel on the mandril meshing with a worm, type. My one and only division plate is a direct copy of the divisions on the bull wheel of an old H. Milnes lathe, circa 1880. Deciding which wheel, circle and number of holes to use for the required number of divisions takes time, so I turned to my old computer, circa 1988, to do the job for me.

What

Referring to the article by Dr. Phillips in MEW 7, I would add a third use for the computer, and that is to calculate and print tables or charts of useful parameters, i.e. tapping drill sizes. The following computer program is used to print out a table of all the divisions possible with the equipment available. From the two sample printouts it can be seen that the result is a neat table giving, L to R, divisions, number of whole turns, number of holes, and in which ring, then finally the number of degrees (decimal) of each division.

How

First the computer will ask for the number of teeth on the wheel being used, if the table is going to be used for direct division then enter 1. Next the maximum number of divisions is asked for, I usually enter 360. Then the number of rings of holes on the plate, followed by the number of holes in each ring. And that's it. Providing everything is correct you should finish with a table as shown in the sample.

Now to make sure that everything is correct, a few notes on the listing.

The original was written on a Tatung Einstein, but as far as I can tell the

statements I have used are common with other BASICs. If you wish all REM and CLS statements may be left out.

Line 120: If a single wheel is to be used then change this to T= (no. of teeth on wheel), it saves an input each time the program is run.

Line 216: This may require altering to suit your equipment, if no printer is available then print to screen.

Line 404: The tabs make neat spacing on a standard 80 column printer.

Line 552: The reverse of line 216.



60 Tooth Wheel

No. of divisions required = 50

DIV.	URNS	HOLES	RING	DEG.
2	30	0	0	180
3	20	0	0	120
4	15	0	0	90
5	12	0	0	72
6	10	0	0	60
8	7	24	48	45
10	6	0	0	36
12	5	0	0	30
15	4	0	0	24
16	3	36	48	22.5
20	3	0	0	18
24	2	24	48	15
30	2	0	0	12
32	1	42	48	11.25
35	1	40	56	10.28
40	1	24	48	9
48	1	12	48	7.5

No. of divisions possible within the maximum of 50 is 17, using 2 rings of 48 & 56 holes.

1 Tooth Wheel – direct division

No. of divisions required = 60

DIV.	URNS	HOLES	RING	DEG
2	0	24	48	180
3	0	16	48	120
4	0	12	48	90
6	0	8	48	60
7	0	8	56	51.42
8	0	6	48	45
12	0	4	48	30
14	0	4	56	25.71
16	0	3	48	22.5
24	0	2	48	15
28	0	2	56	12.85
48	0	1	48	7.5
56	0	1	56	6.42

No. of divisions possible within the maximum of 60 is 13, using 2 rings of 48 & 56 holes.

```

1 REM *****
2 REM *
3 REM * DIVISION PLATES. *
4 REM *
5 REM *****
100 REM *****
104 REM ***** INPUTS *****
108 REM *****
120 CLS:PRINT:INPUT "No. of Teeth on Wheel ? " :T
124 CLS
126 INPUT "No. of Divisions (max) = " :DIV
132 CLS
134 INPUT "No. of Rings = " :RING
140 CLS
144 DIR R(RING)
148 FOR I=1 TO RING
152 PRINT
156 PRINT "No. of holes in Ring " :I : INPUT X
160 R(I)=X
164 NEXT I
168 D=2
200 REM
204 REM *****
208 REM *** OUTPUT ***
212 REM *****
216 PRINT:REM ** SWITCH OUTPUT TO PRINTER **
220 PRINT "1 TOOTH WHEEL" :PRINT "NO. OF DIVISIONS REQUIRED = " :DIV
224 PRINT " DIV. UURNS HOLES RING DEG."
228 PRINT
232 DIR P(D)
236 IF D=DIV+1 THEN GOTO 512
240 FOR I=1 TO D:PRINT:NEXT I
244 TRN=T/D
248 REM
252 REM *** CHECK WHOLE TURNS *****
256 REM
260 IF TRN=INT(TRN) THEN P(1)=DIP(2)=(INT((360/D)*100))/100:P(3)=TRN:GOTO 408
264 REM
268 REM *** CHECK PART TURNS *****
272 REM
276 EX=TRN-INT(TRN)
280 FOR N=1 TO RING
284 H=SIN(N)*EX
288 IF H<=INT(HLS) THEN P(1)=DIP(2)=(INT((360/D)*100))/100:P(3)=INT(TRN)+P(4)
292 NEXT N
296 D=D+1:GOTO 236
300 STOP
400 REM ** PRINTOUT **
404 PRINT TAB(10);P(1);TAB(16);P(3);TAB(20);P(2);TAB(24);P(4);TAB(40);P(2)
408 D=D+1:GOTO 236
500 REM
504 REM *** ENDING ***
508 REM
512 PRINT:PRINT " No. of DIVISIONS POSSIBLE WITHIN the maximum of " :DIV : " is " :
C(1),USING "I(RING)
516 IF RING=1 THEN PRINT "Ring": GOTO 524
520 PRINT "Rings":
524 PRINT " of " :
528 FOR N=1 TO RING
532 PRINT R(N) :
536 IF N=RING-1 THEN PRINT " " :
540 IF N=RING THEN PRINT " & " :
544 IF N=RING THEN PRINT "holes."
548 NEXT N
552 PRINT:REM ** SWITCH OUTPUT BACK TO VDU. **
556 END

```

DIE DUPLICATION

Taps and dies designated Whitworth fine or WF include model engineers' series, B.S. Brass series and old B.S. Conduit series threads which means that when buying these items, care must be taken not to duplicate ones you already have which are exactly the same but are marked differently. **Alan Jeeves**

USING A BENCH PRESS

PART 1

The absence of a bench press in the average home workshop may be due to lack of space, money, or perhaps knowledge regarding the benefits of owning such a machine. This short series attempts to fill in the background of owning a press, and the advantages of making such an addition to the workshop.

In the first part the question of the type of press is discussed, and then how to use it to punch holes. The series will be in three parts

A bench press is probably amongst the least found items in the home workshop, the reason almost certainly being that most of the operations it will perform can be done by other methods; space required will frequently also be a deterrent. However, it will not be realised until such a machine is used, how much easier operations can be when it is employed in favour of more usual home workshop methods.

One will be of particular benefit for making holes in thin sheet metals, especially where a number of identical parts are to be made. This is but one area where a press will win hands down, others will be covered as the article progresses.

Types of press

If a bench press is to be obtained, what are the types available and the necessary considerations, also, having chosen the type where can one be obtained? A quick look through the catalogues of most suppliers who advertise in *M.E.* and *M.E.W.* showed that only one, Graham Engineering (Midlands) Ltd., advertises fly presses. I would be happy to learn of others should I have missed any. Of course those who specialise in selling second-hand equipment, and there are many of these in *M.E.* and *M.E.W.*, are also likely to have presses of many types and sizes available.

Like most machines to be considered for the home workshop, there are choices to be made when deciding to obtain a bench press. The decision is not that straightforward, for, unlike choosing most machines where it will be a question of size and then only minor differences from there on, there are a number of quite different types of press available. The type of press most likely to be considered are the hydraulic press, toggle press, lever press and fly press.

Hydraulic press

This press, seen in **photograph 1**, can achieve a quite high pressure for its size



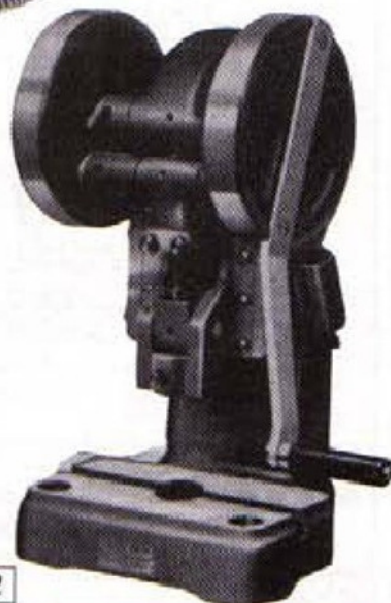
1

Typical 10 ton hydraulic bench press supplied by Machine Mart.

and cost, the one in the photograph being capable of 10 tons. Unfortunately their operation is slow and not really suitable for the type of work being considered in this article. They are good for pressing bearings, shafts, pins, etc., into or out of their housings, perhaps also straightening or bending of bars. These presses, in addition to Graham Engineering, are also to be found in the Machine Mart catalogue.

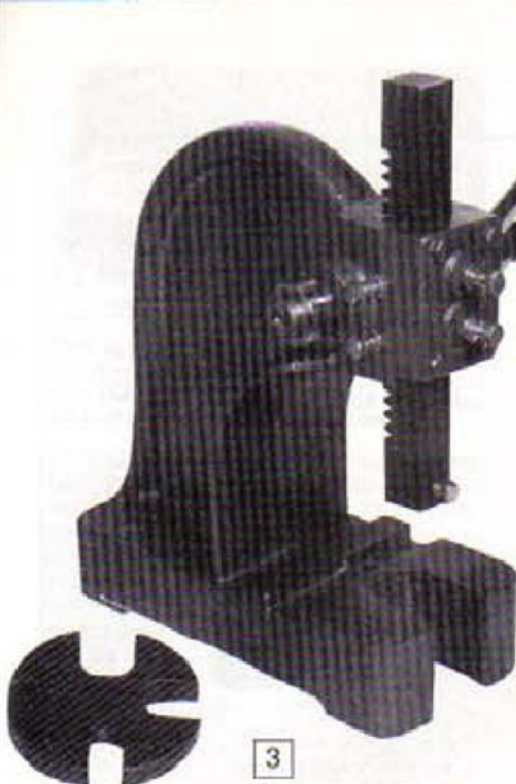
Toggle press

These are mainly quite small and are limited in terms of depth of throat and travel of ram. **Photograph 2** shows a typical type of toggle press which is available with pressures of one and two tons. Using a toggle action, the pressure can be achieved with only limited manual input; on the other hand, the maximum pressure is available only over a short distance, being at the point at which the pivots making up the toggle are in line. The pressure is likely to fall to around 20% of its rated value only some 2-3mm of ram



2

A toggle press having a 1 ton capacity, the 1 ton is unfortunately only available over a very short stroke, say 2mm.



3

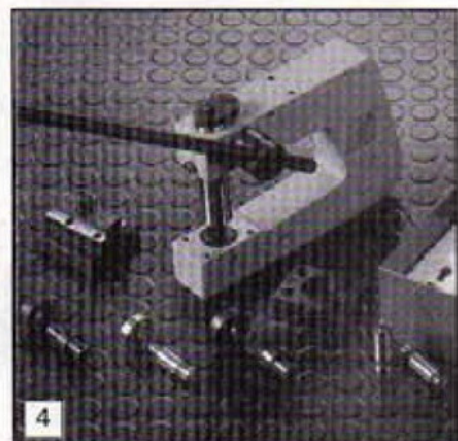
A small arbor press of the type available from a number of sources, this one from Tilgear. Note the absence of any fixings for accessories on the press bed, also the pairs of screws for taking out play in the ram. This type of press would require some minor modifications if to be used for punching holes and bending.

movement away from the point of maximum pressure. Unless the requirement is quite small, say for someone involved in small scale modelling, these presses are unlikely to be satisfactory.

Lever presses

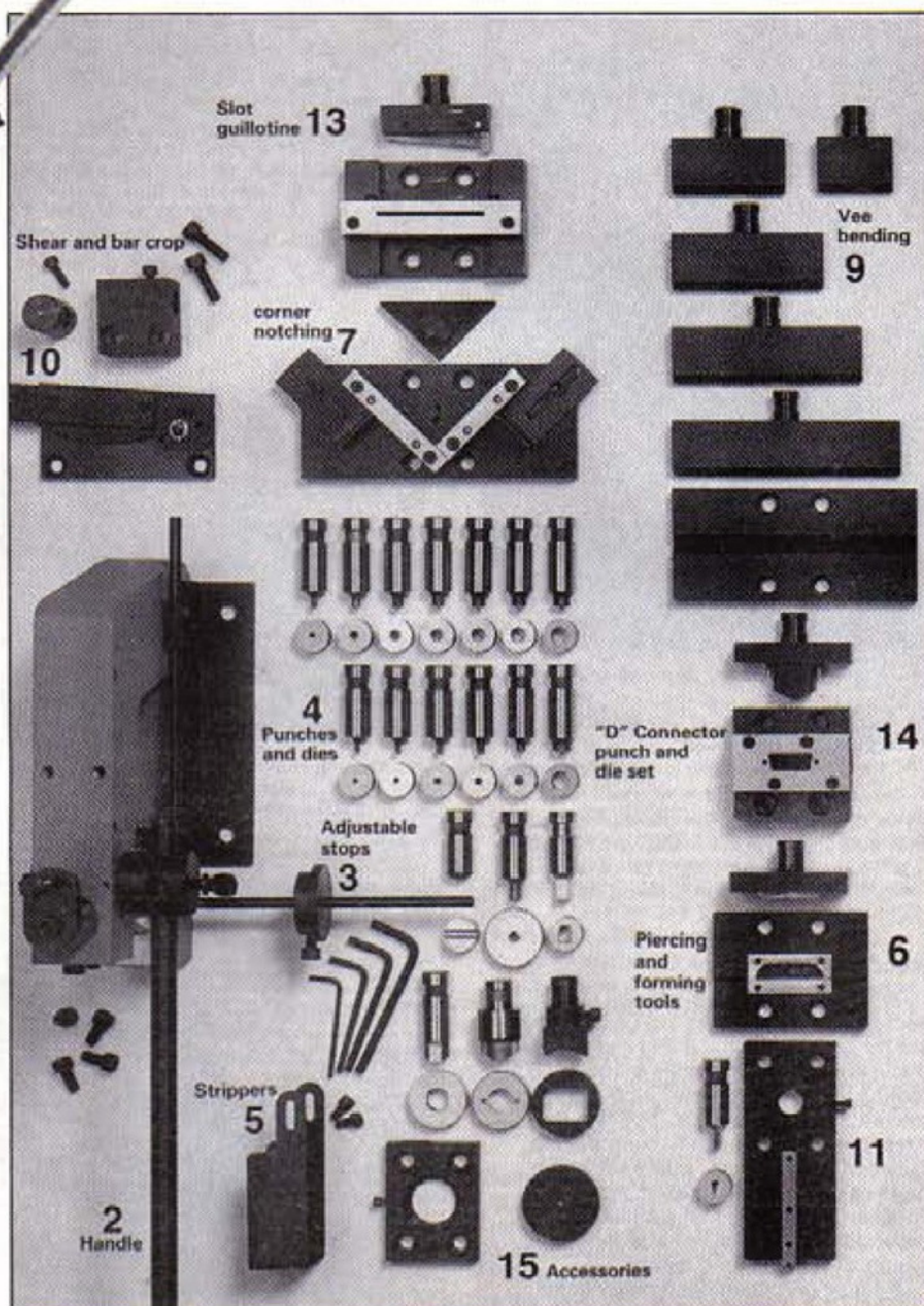
The action of these is most often in the form of a rack and pinion, not unlike the action of a drilling machine though of course much more robust. A readily available and cheap version of these is the arbor press, as seen in **photograph 3**. These are available from ½ ton pressure up to 3 tons, maybe more. A 1 ton press with a stroke of 5 inches and a throat of 4 inches is likely to cost around £60.

The arbor press is mainly intended for forcing items into, and out of, their housing, in the same way as is the hydraulic press. They would easily perform bending operations and, with a little care and adaptation, they probably could be made to be capable of punching also. If space is not available for a fly press, to be



4

A very nice one ton lever press as supplied by Manuform.



mentioned later, and/or cash is limited, then an arbor press may be worth considering. It will however require some work done on it to make it suitable. (Perhaps this could be the subject of another article.) These are available from Graham Engineering and also Tilgear.

Other lever presses are available with the intention of their being used for the full range of press duties. These have pressures up to about 2 tons and can be obtained with all the accessories for hole punching and material bending, and even more demanding operations such as punching louvers. These are more expensive, maybe up to £400 even without the accessories. **Photograph 4** shows a very nice lever press available from Manuform Ltd who have also a very wide range of accessories for their presses, some of which can be seen in **photograph 5**.

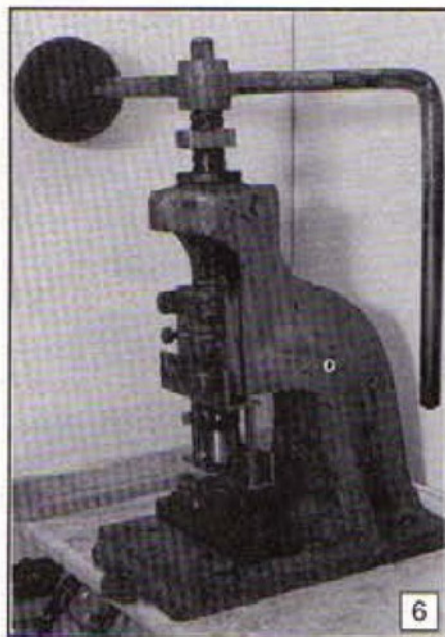
The action of the lever press means that the pressure possible is available through the completed travel of the ram.

Fly presses

These are the presses capable of the

greatest pressures, also depth of throat and travel of ram. The price to pay for this is that they are quite large and heavy. In view of this they will require a substantial bench and plenty of room around the machine for the operation of the handle, as this has to pivot completely around the press. This can be seen in **photograph 6** – even this machine has had its handle shortened to minimise the space required. The weight on the end of the arm, which helps to create maximum pressure at the point of impact, normally sits on an upturned portion at the end of the arm. In this case, it would have fouled the wall at the rear of the press, the extension was therefore cut off and the weight is now retained by a sizeable washer and a screw which have been added to the cut end. Larger fly presses would even have two weights, one at each end of the arm.

The smaller ones, such as the one in the photograph, are still quite large and heavy, and will produce pressure of about 5 tons. Larger ones are then made in various sizes, the largest probably capable of 25 tons. Only the smallest size is likely to be acceptable in most home workshops.



A fly press, well worn, but still working.

This type of press is the most likely to be found second-hand, and a price of around £80 for the smallest size is a probable cost. A new press of the same size will be about twice this price. Without doubt, if space is available the fly press is the best choice as it will have the greatest pressure over the longest stroke, also the greatest height and depth of throat.

Accessories

Any press purchased will still require accessories to be added, that is unless you are buying second-hand and it comes with the previous owner's range of tooling. This tooling could considerably increase the overall cost of the system, but with the exception of the hardened components, punches and dies, etc., many items can quite easily be made oneself. Again I consider it probable that suppliers of second-hand presses will also have a supply of second-hand tooling.

A range of tooling has already been shown in **photograph 5**; this, intended for the lever press, is probably rather small for use on a fly press. Another company who has supplied accessories for fly presses for many years is Hunton Ltd. Typical of this company's die holding arrangements is that shown in **photograph 7**. The main portion of this kit of parts is called the bolster, which can also be seen in **photograph 8**. The main features of this are the adaptors, typically items B to G, which enable dies with differing outer diameters to be fitted. This avoids the necessity of smaller sizes having to be made from large and expensive pieces of tool steel.

Also included in the bolster is a range of tapped holes, both in the top and sides, which enables various attachments to be fitted. Typical of these are the material stops seen in **photograph 7** and various other items to be described later.

It is not that difficult to make the punches and dies, even odd shaped ones, the problem comes when hardening the dies which can rather easily crack, especially the non-round ones. It is not impossible however, and any reader experienced in the art of hardening and tempering will not find it that difficult. One

Punch Holder for Punches $\frac{1}{2}$ " to 2" diameter.
Punch Holder for Punches $2\frac{1}{2}$ " to $3\frac{1}{2}$ " diameter.

Main Bolster Frame with adjustable Gauges. Receives Dies from $2\frac{1}{2}$ " to $3\frac{1}{2}$ " bore diameter (supported by Ring H) and also Die Holders B, C, D, E, and G. Drilled and tapped to take square plate Dies $3\frac{1}{2}$ " to $3\frac{3}{4}$ " bore diameter.

Holder for Dies $1\frac{1}{2}$ " to $1\frac{3}{4}$ " bore diameter (supported by Ring F); also receives smaller Die Holders C, D and E.

Spanner for punch-retaining nut on Punch Holder K.

Holder for Dies up to $\frac{1}{2}$ " bore diameter.

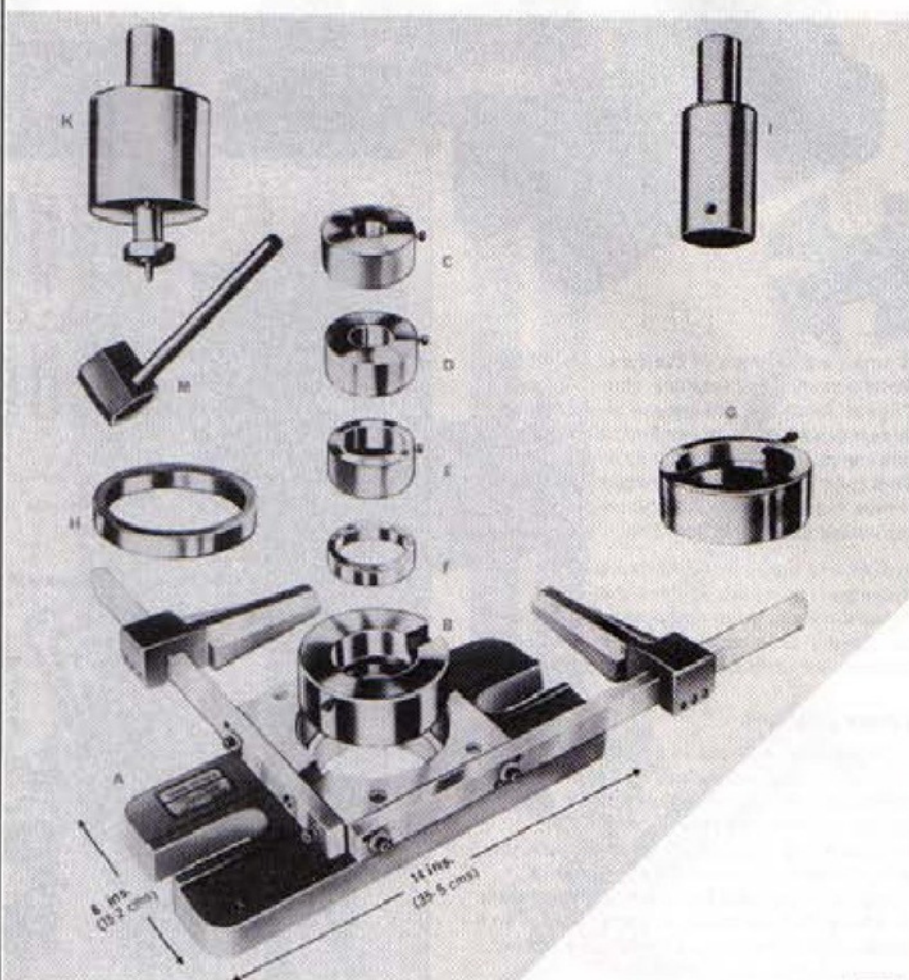
Holder for Dies $\frac{1}{2}$ " to $\frac{3}{4}$ " bore diameter.

Holder for Dies $\frac{3}{4}$ " to $1\frac{1}{4}$ " bore diameter.

Supporting Ring for Dies $1\frac{1}{2}$ " to $1\frac{3}{4}$ " bore diameter in Die Holder B.

Holder for Dies $1\frac{3}{4}$ " to $2\frac{1}{2}$ " bore diameter.

Supporting Ring for Dies $2\frac{1}{2}$ " to $3\frac{1}{2}$ " bore diameter in Bolster Frame A.



The gauges and bars shown fitted to the Bolster frame are supplied as an optional extra.

The very widely used Universal bolster outfit as supplied by Hunton Ltd.

well-known company actually advertises, for limited use, larger sizes of punches and dies made from steel and case hardened.

Some information will be included in a later part of this series regarding the requirements, shape and clearances, etc., for making punches and dies.

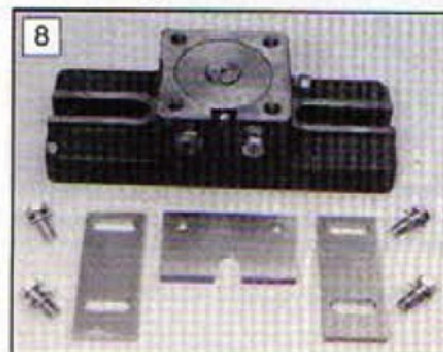
Operations performed

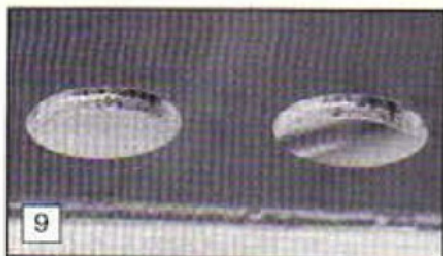
Apart from the hydraulic press, most types will be able to perform the whole range of operations normally associated with a bench press, the arbor press with some modification. Some however will be very limited in the size of work that can be undertaken by their minimal pressure, height, and depth of throat, etc. The remainder of this article will be illustrated and explanations given with a fly press in mind, and this is probably the best buy if space is available together with a very strong bench. If not, the lever presses of

the type supplied by Manuform and Hunton are very good, and the range of available tooling makes them an extremely attractive proposition.

Without doubt the two main functions carried out on a bench press will, in simple terms, be punching and bending. The

Close up of the bolster together with guide pieces and stripper plate for fitting to it, as seen in **photograph 14**. These additional items made by the author.





9
Close up view of two 13mm dia. holes punched through 2.5mm aluminium plate. Note the distinct difference between the top and bottom halves of the hole.

remainder of this first part of the series will deal with hole punching and allied operations. It will continue in part two with the topic of mainly bending operations, but also comment on a few other tasks that can be performed. The series will conclude in part three with detailed instruction for using a bench press and some ideas for making one's own accessories.

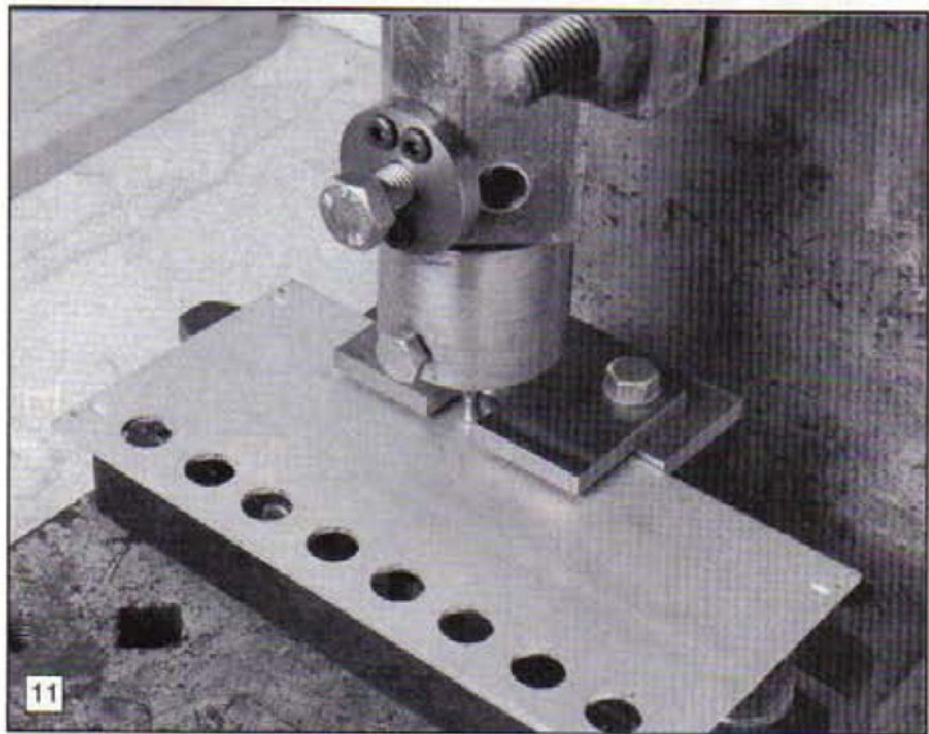
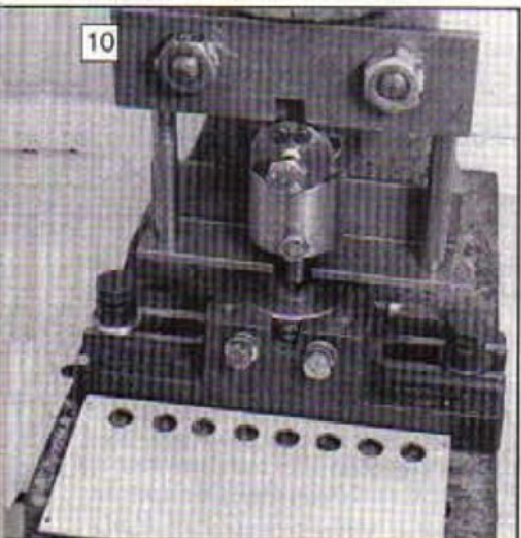
Hole punching

The simplest form of hole punching will be that of making round holes in relatively thin materials. Most readers will have experienced the difficulties of drilling holes in thin metals, in particular where the diameter is large compared with the thickness of the metal. Frequently this will result in holes being produced that tend to have a triangular shape. By comparison, holes produced by punching will be round and very easily made.

That is not to say there are not disadvantages in the method. Probably the largest disadvantage is one of cost, a punch and die probably costing £10 plus. In use, the hole size created is equal in diameter to that of the punch, whilst the die requires to have a hole slightly larger. The clearance between punch and die is dependent on the thickness of the material being punched. As a general rule the diameter of the die should be larger than the punch by 0.1mm per 1mm of material thickness. In practical terms some divergence from this rule can be permitted to minimize the range of dies required.

The effect of the two diameters can be seen by close examination of a punched hole. If a die with the correct clearance has been employed, the top half of the hole will have smooth parallel sides and will be equal in diameter to that of the punch. The

8 13mm holes very easily made in a 2.5mm thick aluminium plate.



11
Bolster set up with rear locating plate and small stripper plate.

lower half of the hole will be quite different, having a rougher finish and will be tapered, increasing from the punch diameter at the top to the die diameter at the bottom. A rather poor illustration of this situation can be seen in **photograph 9**. An interesting fact is that, whilst the hole produced is equal to punch diameter, the plug punched out is larger being equal to the die diameter.

The requirement for differing size dies for a given punch diameter, to suit differing material thicknesses, is unlikely to become necessary in the home workshop. For unless items are to be made from very thin materials (say less than 1mm) or much thicker materials (say more than 2mm) it is probable that a single die can be tolerated.

Larger holes

As well as quality of hole, another advantage of the method is that larger holes can be produced than can easily be made by drilling. **Photograph 10** shows eight holes 13mm diameter punched into 2.5mm aluminium. Even at this size the press had plenty in hand and even larger holes could be made. For maximum pressure the principle is to swing the handle quite vigorously and let the weight carry the punch through the work piece. To achieve maximum pressure in this way a very robust bench would be required – it is quite probable that the bench in many cases will be the limiting factor.

The size of the largest hole possible will usually depend on the pressure which can be developed by the available press. However the pressure required to punch a hole is obviously also dependent on the type and thickness of material being punched. In the case of very soft and or thin materials, it is possible that the limit will be that of the available tooling, such as hole size in the die holder, etc.

Required tonnage

The tonnage required to punch a hole can be calculated from the formula,

tonnage required = circumference x material thickness x constant. The constant is a factor of the material being punched, obviously greater for the harder materials such as steel and less for softer materials such as aluminium. It will also be even lower for materials such as hardboard, cardboard and leather, etc. This highlights yet another advantage of punching over drilling, in that materials can be worked that would be very difficult if holes were attempted by drilling. The constants for the common materials will be quoted in the final part of the article.

As an example, it can be seen from the formula that typically a 6mm diameter hole in 5mm thick material will require the same tonnage as a 30mm diameter hole in 1mm thick material. It should be obvious, however, that there is a limit to how small a diameter can be produced in the thicker materials, due to the fragile nature of the punch under these conditions. A minimum hole size of no less than the material thickness should be a good starting point; of course, softer materials will be less of a problem in this respect.

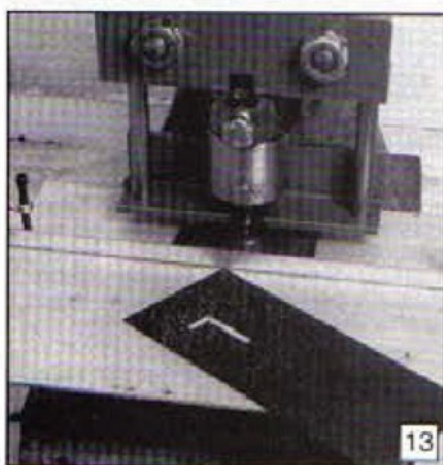
Strippers

Having punched the hole it will immediately become obvious that there is another marked difference between this method and that of drilling, in this case a disadvantage. With the hole punched, it will be found that punch is a tight fit in the hole and cannot be removed easily. With a one-off hole of large size it would be possible to gently tap the workpiece off the punch; this though is not really a practical solution for most cases.

The methods of overcoming this problem will frequently depend on the nature of the work being carried out. With flat components the situation is quite easy to overcome with general-purpose attachments made for the purpose. The problem comes when punching holes in components that have already been bent. An example of this would be making holes



A stripper assembly that places no additional restrictions on the size of the material than can be worked.



An auxiliary table added to the bolster using the two screws seen in photograph 12. In this case the table is being used to carry a guide bar to enable a rectangular cutout to be nibbled out. A half finished cutout can be seen in the plate in front.

in the fascias (lids) of ready made enclosures when making electronic equipment.

The simplest form of stripper, as they are called, is a ring of very hard rubber which is placed around the punch: this may have a metal plate on the end to help spread the load. A more elegant solution, but using the same principle, is to substitute the rubber with very heavy duty springs, maybe even disc springs. In this case the springs would require to be built into some assembly to make it a practical proposition.

The use of these forms of strippers has the disadvantage that the spring/rubber has to be compressed during the punching operation, thereby adding to the punching load. It is therefore only acceptable for conditions where the stripping load is low, such as soft materials and thin metal components.

A much more practical solution is for the punch to pass through a fixed plate, such that when the punch is raised the item having been punched comes up against the plate and the punch is withdrawn. There are two basic approaches to this method; the simplest (but only applicable when small items are being worked on) is to add a small overhanging plate to the bolster. This however would not be suitable where larger workpieces are concerned, due to



Set up for punching a 4mm hole in 3mm thick B.M.S. strip.

the problems of making it strong enough. A simple set up using this method can be seen in **photograph 11**. In this, a rear stop is also included to determine the distance of the hole from the edge of the plate; the overhanging plate with slot acts as the stripper. These parts which have been made by the author can be seen in **photograph 8**.

The most adaptable method is to mount a stripper from the upper part of the press structure. This will create no restrictions on the size of the item being worked, other than those imposed by the press itself. A method of doing this is illustrated in **photograph 12** and can also be seen in others. Ideally, for ease of use, the distance between the plate being punched and the underside of the stripper should be a matter of a millimeter or two. The arrangement shown would therefore benefit by some adjustment being built into it – again, this is a home-made attachment.

Hole positioning

One aspect of punching holes in sheet metal is the problem of positioning them. The method above, shown in **photograph 11**, is quite easy and is therefore acceptable even for one off holes, its disadvantage being that it locates the plate in one axis only. With an extension table as seen in **photograph 13**, a second stop could easily be fitted.

Some punches are made with a small point on the centre of their face, this intended to be located in a centre punch mark as one would when drilling. With the punch located, it is withdrawn slightly before bringing it down firmly to make the hole. This system works well, but it is next to impossible to sharpen the punch without losing the point!

For small holes, say 4mm dia., the part can be scribed with the two lines as would be done for drilling. The punch is then brought down and the lines placed centrally under this. The punch can then be withdrawn slightly and brought down firmly to complete the hole. For larger holes, this would not be an acceptable method due to the difficulty of accurately judging the centre of the punch. In this case the plate can be marked with two lines that represent two edges of the hole. The punch is then brought down to almost touch the plate which is then positioned. With the punch having sharp edges, lining up can be done quite accurately providing the slot in the stripper plate is large enough to permit full vision of the markings.

Nibbling

One very distinct advantage of a bench press is the ability to produce rectangular and other shaped holes by a process of nibbling. For those not familiar with this, it is to produce a hole by the repeated use of a small punch to produce overlapping holes. **Photograph 13** shows a rectangular hole half way through the process. To achieve this, an extended table is fitted to the bolster using the two screws seen in **photograph 12**. On this is clamped a bar to guide the plate whilst the nibbling process is taking place. The guide will of course require to be repositioned for each side. For irregular shaped holes a guide can be made, inside which the punch will trace around. Making the guide could be a time-consuming operation, but would definitely be worthwhile should a number of identical holes be required. This highlights another of the benefits of using a bench press – its ability to be easily set up for batch production.

Batch production

Without doubt, one of the outstanding advantages of a bench press is its ability to be set up for batch production. This can be done quickly and with a minimum of accessories. The extension table, seen in **photograph 13**, can easily have guides added using small clamps; these will allow holes to be punched in a number of plates all in the same location. **Photograph 14** shows how guides can be set for punching holes along the centre of a strip. Whilst not included in the set up, an end stop could also be incorporated to position holes a given distance from the end of the strip.

In the next part we will deal predominantly with the use of the bench press for bending.

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Machine Mart., 211 Lower Parliament Street, Nottingham NG1 1GN. Tel. 0602 241004.

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Tilgear, Bridge House, Station Road, Cuffley, Herts. EN6 4TG. Tel. 0707 873434.

Important Announcement

Publication dates are changing for

MODEL ENGINEERS' WORKSHOP

We are moving these dates forward. The first edition affected by the change is the December/January edition (published 12th November).

This issue will now be available on **22nd October** and the cover date will change to **November/December**.

Thereafter, **Model Engineers' Workshop** will be available on the 4th Friday of alternate months, i.e. January/February cover date – 24th December – March/April – 25th February etc.

The Editor gives a few observations on an excellent idea for exhibiting at the forthcoming M.E. Exhibition, and fills readers in on a few of the special innovations which will make this an even more attractive event in the modelling calendar. The Exhibition will be held at Olympia, London from 31 December 1993 – 8 January 1994.

THE MODEL ENGINEER EXHIBITION

My comments in the April/May '93 issue of *M.E.W.* regarding readers exhibiting their work at the Model Engineer Exhibition, on a non competitive basis, and requesting your views on the subject, brought in a number of replies. All were basically enthusiastic about the idea. I was aware that there is already in existence the facility to display items in this manner within the Loan Section; a number of replies made mention of this fact.

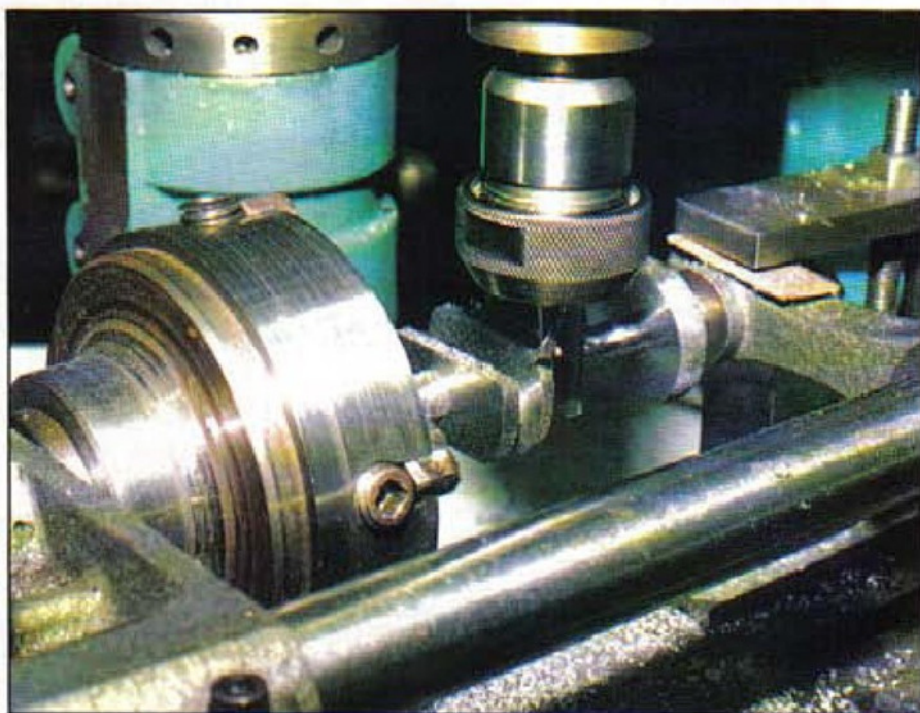
The suggestion of a section called "Made to be Used" was thought by a number a good idea, but no one came up with a better title, and I for one was not happy with it, quoting it really as a starting point. It has been decided therefore to encourage readers of *M.E.W.* to exhibit in the Loan Section, but in a special area of that section, designated as being supplied by *M.E.W.* readers.

This section will in no way be confined to workshop equipment, though it is anticipated that this will be the major content of the display. It would be nice if authors of articles published could make it possible for their original piece to be displayed, and likewise readers efforts in making these, with or without their own modifications to the design. The section would not be confined to items published, any other item of home made workshop equipment would be equally welcome.

Please do not be put off exhibiting by your distance from Olympia. Last year a very much improved model collection and delivery service was set up, with teams of modellers in vans covering the country, only a couple of days prior to the exhibition opening day, returns by and large took place the day after the Exhibition closed. We know already that collection points are being arranged in the following areas:-

Sunderland, Leeds, Peterborough, Cambridge, Norwich, Ipswich, Manchester, Leyland, Sutton Coldfield, Derby, Nottingham, Bristol, Exeter, Southampton, Fareham and Andover.

This is a free service. All that is asked is that the exhibit is securely packed in a stout box and clearly labelled and identified with the owners details, and giving clear instructions as to packing and unpacking the exhibits. It is anticipated that collections this year will be on 28 December, returns will be on 9 January 1994. If you would like to know more about the service or how to enter your model or equipment please contact our Argus Specialist Exhibitions Office, Argus House, Boundary Way, Hemel Hempstead, Herts HP2 7ST, tel. 0442 66551 or fax 0442 66998.



A demonstration on the S.M.E.E. stand last year – a crankshaft being milled from the solid by Ivan Law.

Model Auction

Christies of South Kensington will be conducting a model auction at the Exhibition on Wednesday 5 January. The models for the auction will be on view on the gallery from the opening of the Exhibition up to the auction. The auction will be limited to 200 lots on this first occasion.

If you, or someone you know has a model which they may wish to enter please contact Tom Rose at Christies, tel 071 321 3283 if you require full information. We are unable to deal with any enquiries about the auction at Argus House.

Other attractions

This year the largest indoor flying event yet staged will take place during the show. The National Hall, which adjoins the main Exhibition Hall, will be used for flying events each day throughout the show.

The gallery will be the location for the longest 7½ in. gauge portable railway, this will operate each day providing a passenger service. Other attractions upstairs on the gallery will include The Arnhem Memorial Flight, a model recreation of the famous aircraft which took part in this historic campaign 50 years ago, there will be several smaller gauge layouts in operation.

On Monday 3rd January it is hoped that the area normally given over to model car racing will be devoted to displays by miniature traction engines, hopefully coupled to various implements to demonstrate the stationary, or belt working of these engines.

Thursday and Friday 6-7 January the car arena will again devoted to live steam, as we endeavour to discover the *Clayton Driver of the Year*. An obstacle course has been laid out to see if those who build these marvellous wagons can drive them with the same degree of precision used in their building.

There will be a display of models from the collection of the Maritime Museum, including many which have not seen the light of day for many years.

An advertisement elsewhere in this issue will give full details of the show, but I felt that I could not let the issue pass without detailing some of the attractions lined up for your interest.

However, without your help we cannot hope to succeed, we need your input your tooling, models etc. for display, and you as a visitor, we hope to see you during the show, and your models etc. on the displays. If you wish to show in the *M.E.W.* section of the loan area please mark your entry *M.E.W.* to enable us to identify this fact.

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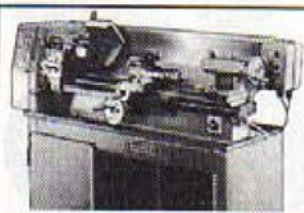
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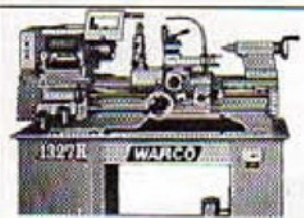
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HOLDING COUNTERSUNK SCREWS

Holding countersunk head screws for shortening is always a bit of a problem.

I adopt two methods, one a simple quick solution used on occasions when the cut end is concealed and does not need to be properly radiused and the other when the end needs to have a neat radius.

For the first method all that is required is an odd bit of strip, any material, of thickness approximately equal to the length of screw required. Drill a clearing hole through and countersink one side so that the screw, when pushed through the hole protrudes the amount to be cut off. Grip the strip in the vice and hold the screw in place with a screwdriver. Whilst partially rotating the screw saw off the thread with a junior hacksaw held close up to the strip, **Figs. 1 and 2.**

The end can be tidied up if required by holding the screw in a thinner piece or strip, or a more deeply countersunk hole, filing the end whilst rotating the screw with the screwdriver, **Fig. 3.**

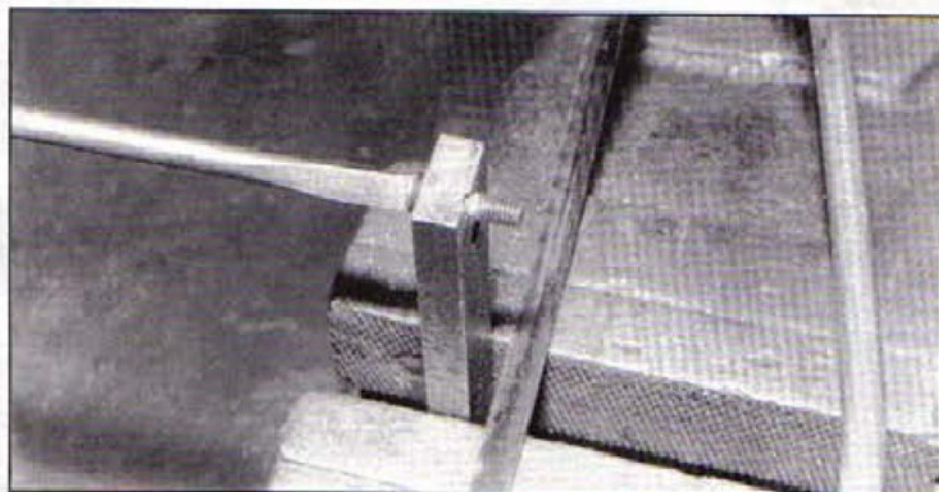
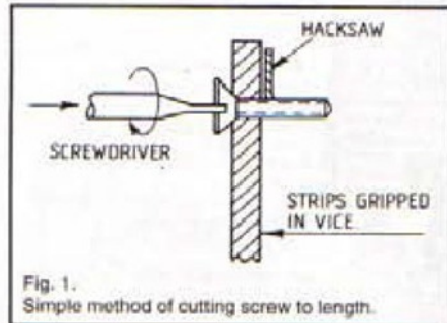


Fig. 2. The operation taking place.

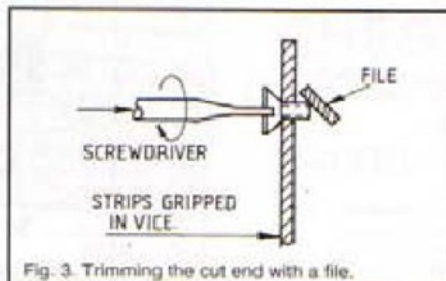


Fig. 7. A screw held in the chuck in the lathe.

The second method which enables the end to be neatly finished in the lathe uses a stud chuck. This tool shown in **Fig. 4** and dimensioned in **Fig. 5** is also used for holding short studs when screwing the second end. Only one arbor is needed but whilst set up make a number of caps tapped with normally used threads, others with clearing holes and a few undrilled blanks for spares.

The countersunk (or cheese head) screw can be cut down slightly over length by any convenient means, even wire cutters, put in a cap and screwed onto the arbor held in the lathe, **Fig. 6.** The end can now be given a neat radius with a file or a radius form tool, **Fig. 7.**

When using the chuck to make studs, screw and radius the long end, then cut the stud to length. Hold the arbor in the lathe and screw on the appropriate size cap tightly. Thread in the half threaded stud,

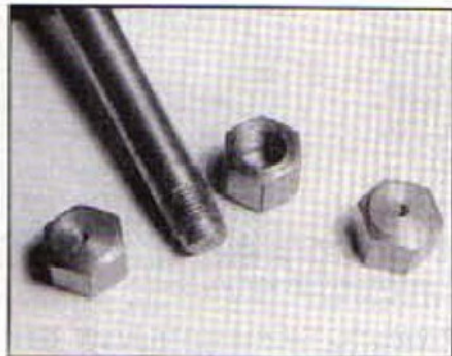
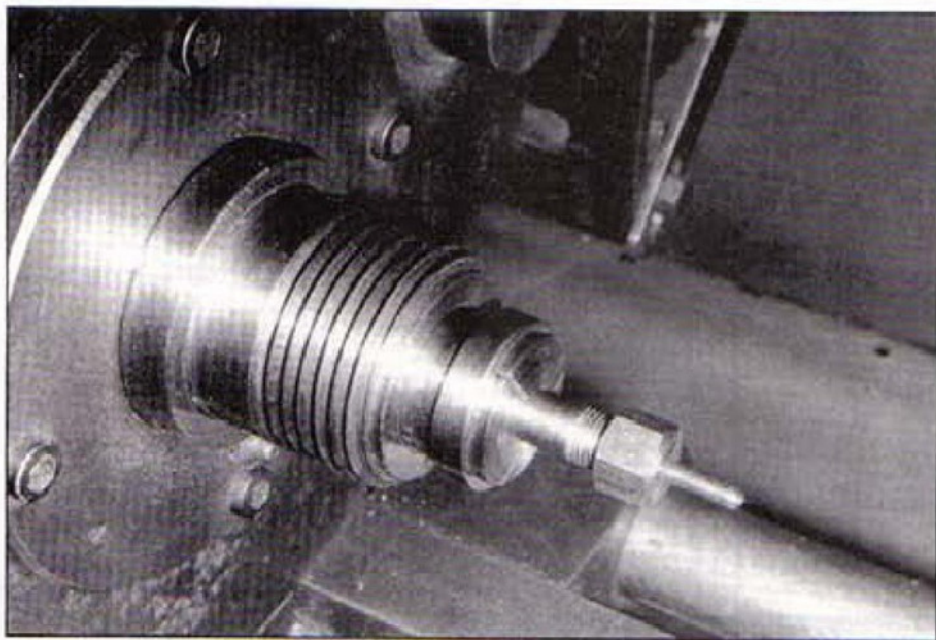


Fig. 4. The Stud Chuck showing arbor and three caps.

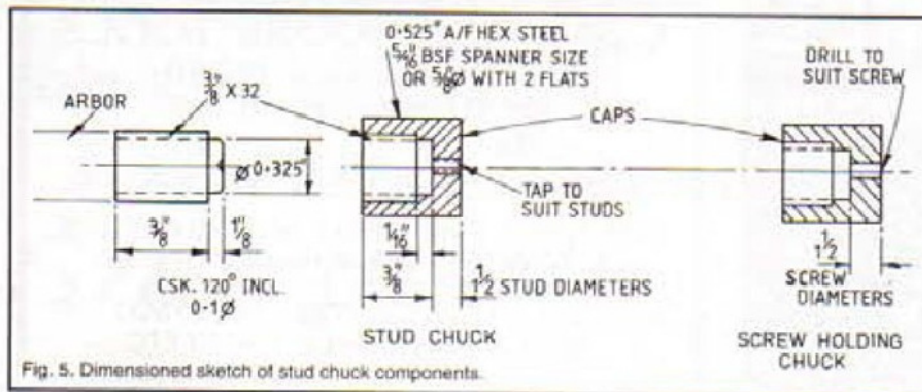


Fig. 5. Dimensioned sketch of stud chuck components.

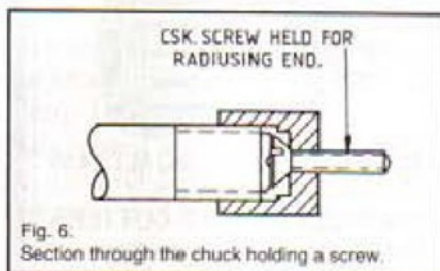


Fig. 6. Section through the chuck holding a screw.

thread the outer end with a die held in the tailstock holder and radius if you wish. Unscrew the cap slightly with a spanner and the stud can now be unscrewed by hand, **Fig. 8**. The short end should be screwed about one diameter and commercial studs are often not given a radius on this end. These stud chucks are particularly useful when making small diameter very short studs although the one shown is used for making studs up to 1/2 in. or 6 mm diameter, **Fig. 9**.

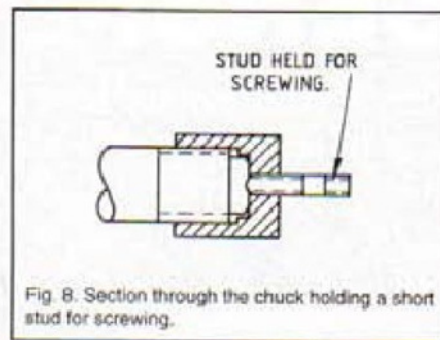
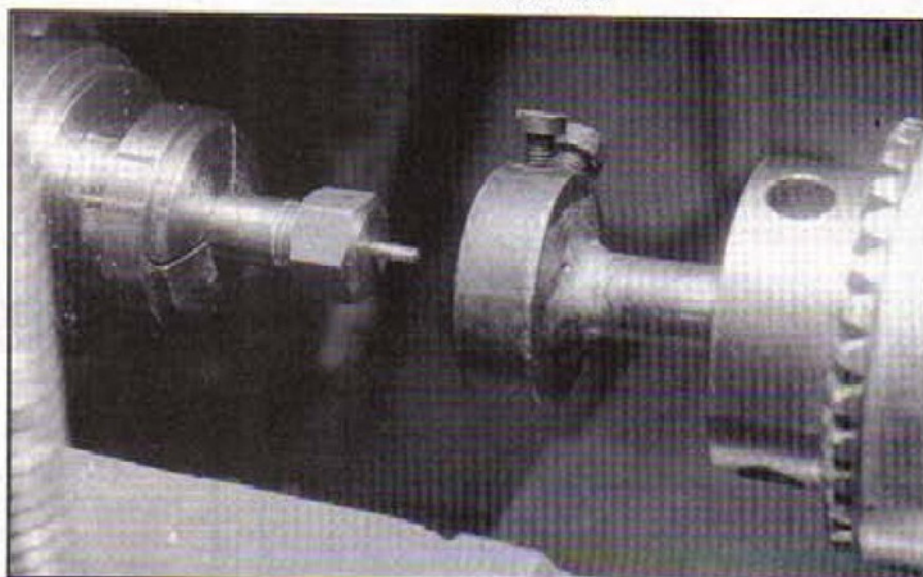


Fig. 8. Section through the chuck holding a short stud for screwing.

Fig. 9. Screwing a stud held by the chuck in the lathe.



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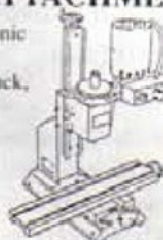
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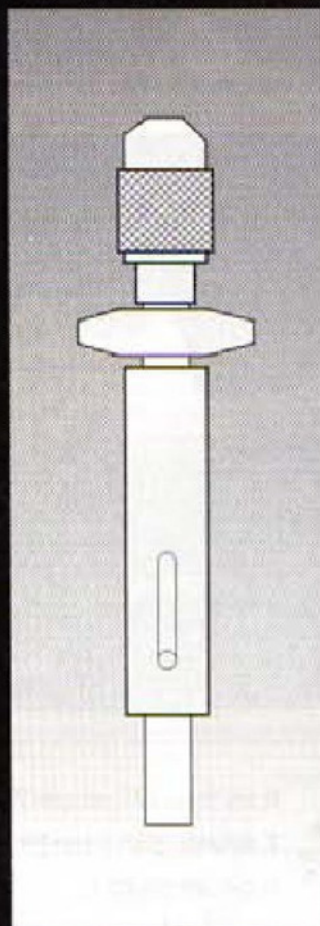
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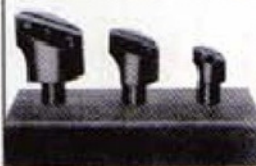
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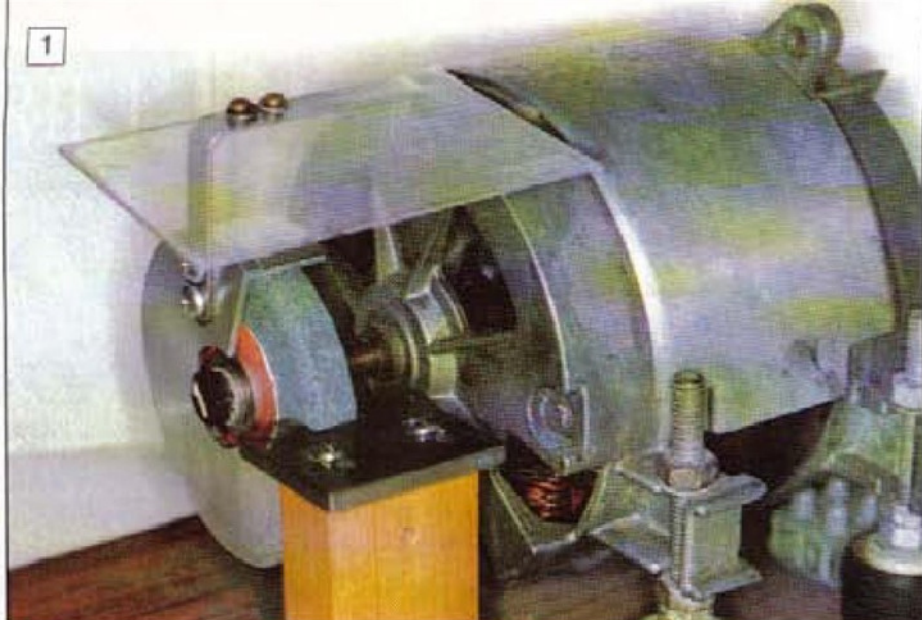
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We know from the article in the Dec 91/Jan 92 issue of *MEW* regarding the workshop of R.J. Loader, that lack of space is a situation that he is continually having to overcome. He explains how he saved space by mounting an off-hand grinder onto the outer end of the mandrel of his Unimat 3 lathe, also saving a lot on cost. Also included in the article is some very useful information on grades of wheels and safety



1: The original home-made grinder.

OFF HAND GRINDING ATT FOR UNIMAT 3

For a long time I have been using a home-made grinder for tools and cutters. **Photograph 1** shows it in all its glory. The motor is from an old washing machine, the wheel guard was going to be the casing of a fly fishing reel and the eye shield is the lid off a cassette case. The wheel is a 5in. Black and Decker type and has done a good job. It isn't perfect though, and when I bought a 5in. wheel, there was no way it would fit, so I made an attachment to fit my Unimat 3 which didn't cost much or take too long to make.

The best thing to have, of course, is a commercial double-ended one but they are expensive. I have looked at the maker's attachment for the Unimat and like most of them, it fits in front of the headstock. There are two snags in this; the machine cannot be used for anything else while it is fitted and I don't care how good the guards are, some abrasive and grinding dust will get where it shouldn't.

I decided to put it at the back end of the machine out of the way. It can be left in position (I wonder if the flywheel effect improves the performance of the lathe. See *Backlash elsewhere in this issue, Ed.*) except when long thin work needs pushing up the spindle, or I have to set up my primitive screw cutting tackle. **Fig.1** shows the assembly with most of the features.

The Mandrel

The attachment is built round an expanding mandrel shown in **Fig.3**. It locks by tightening a socket screw at the headstock end. All the diameters are turned between centres to keep them concentric. The 0.400in. diameter may need a bit rubbed off with emery cloth but it is the size to aim for, the spigot at the other end fits the grinding wheel bore. I made mine smaller than the 1/2in. on the drawing so that I could put a bush between spigot and wheel bore; it allows for the wear and tear of taking the wheel on and off.

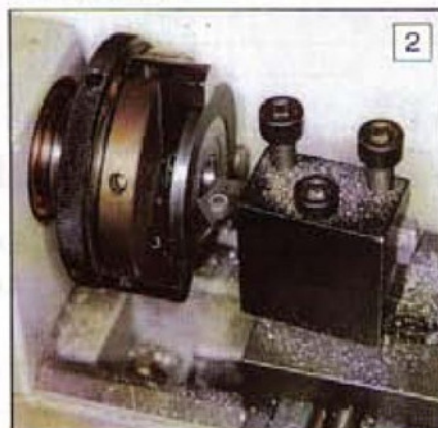
The wheel is locked by a 1/2in. B.S.F. bolt

with a thick plain washer and a spring washer. I know that the thread should be left-handed to be self-locking, but the grinding action shouldn't exert enough force to be a problem – if it does, you are bearing on too hard!

The flat on the 1in. diameter is for a spanner, to make the locking easier. It could be a hole for a tommy bar; something is needed or things will slip when tightening. The thread in the 0.400in. end is tapped *before* the slots are cut and it is tapped *taper tap only*, so that the socket screw will expand it. The slots are cut with a hacksaw.

Flanges

Discs are cut from 1/4in. sheet, trimmed round on a mandrel and held in the reverse jaws of the three jawed chuck to turn the recess. **Photograph 2** shows the recess being machined, 1/2in. is deep enough, a broad area should be left for clamping. Follow the dimensions on **Fig.4** unless the wheel is a different size from 5in. If it is, make sure that the flange is at least 1/3rd. of the size of the wheel diameter. It is a requirement of the Abrasive Wheel Regulations. **Fig.4** also shows the non-standard washer.



2: Cutting the recess in the flange.

Frame Sides

These are square because it is an easier shape and I had some mild steel that size. They are to fit a 5in. wheel. They are 1/2in. or thicker to allow for tapped holes. 5in. wheels are a convenient size for the Unimat and they are available from most suppliers and some of the better hardware shops.

Fig.2 shows the dimensions. I've only suggested the positions for the holes marked 'A' because that's where my fixing brackets fitted. The positions could be different for other lathes. The central hole was enlarged from a drilled hole using a coping saw, ignoring one of the first principles of sawing, because only two teeth are in contact while cutting. However, if you'll forgive the atrocious pun, it coped



3: The frame centre being cut out with a coping saw.

nicely, as long as I sawed slowly and steadily. **Photograph 3** shows one of the cut outs almost finished; it needed a clean up with a half-round file after the sawing.

Holes for the bracket and cover plate screws were left to be spotted through later. The 2in. centre hole meets the 90 deg.

cut out to make it easier to assemble the completed frame round the wheel.

The frames are assembled by $\frac{1}{4}$ in. B.S.F. bolts with spacers in the back corners and a bolt through the tool rest in the front bottom corner.

A small modification

To be able to bolt the guard assembly to the lathe, I used two holes I had drilled and tapped in the bed casting. The scrap view in **Fig.1** shows the dimensions and the holes can be tapped M6. or $\frac{1}{4}$ in. B.S.F. Different lathes may have existing holes or other features to clamp to; remember, my design is for the Unimat 3 and I hope the makers will forgive me for taking liberties.

Brackets

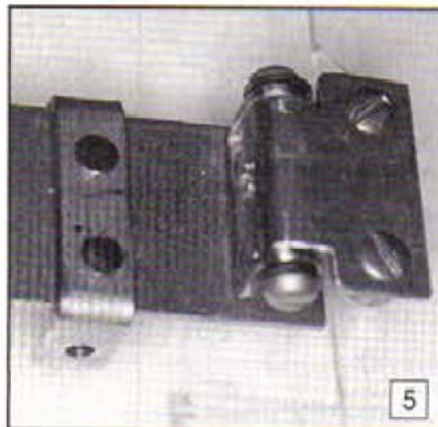
There are three brackets, see **Fig.5**. The bottom two do most of the work and are splayed a little. It may be possible to use one at the top and one at the bottom, but I'm happier with the three support system for rigidity. To position them, I assembled the wheel on the arbor, propped the right-hand frame side in position and checked all the measurements before I made the brackets.

I used $\frac{1}{2}$ in. x $\frac{1}{4}$ in. mild steel to make the brackets, a choice influenced by my bending tackle, a $2\frac{1}{2}$ in. vice bolted to one end of my Workmate and a $\frac{1}{2}$ lb hammer. I used a block with rounded corners to get a reasonable radius.

Where the bottom ones bolt to the lathe, the holes are slotted out for ease of fitting. For the same reason the top one is slotted. **Photo 4** shows the position of the brackets. For fastening to the frames I used 2BA bolts, the largest size which would give a thread in $\frac{1}{8}$ inch.



4: The positions of the three brackets.



5: The short cover plate fitted with the eye shield.

The $\frac{1}{4}$ in. long spacers give plenty of clearance for the wheel between the frames. Any slight variations can be corrected by packing a washer between frame and bracket, or by filing a bit off the bracket.

When the brackets are finished and have been checked, the holes marked 'A' in **Fig.2** can be marked through to the frames, drilled and tapped.

Long cover plate. Fig.6.

Using thinner material, the cover plates were easy to bend round a piece of bar to give the right radius. Because the positions

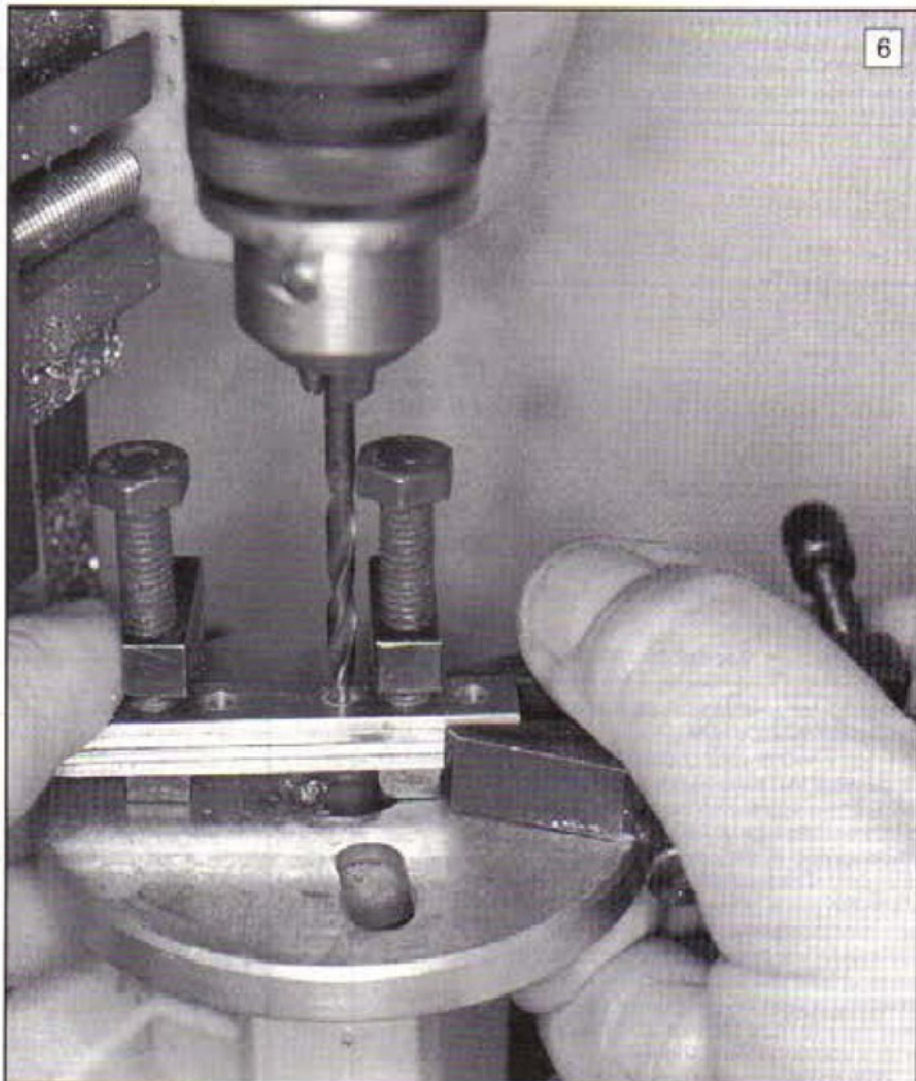
of the $\frac{1}{8}$ in. holes for the clips aren't critical, they can be drilled before bending.

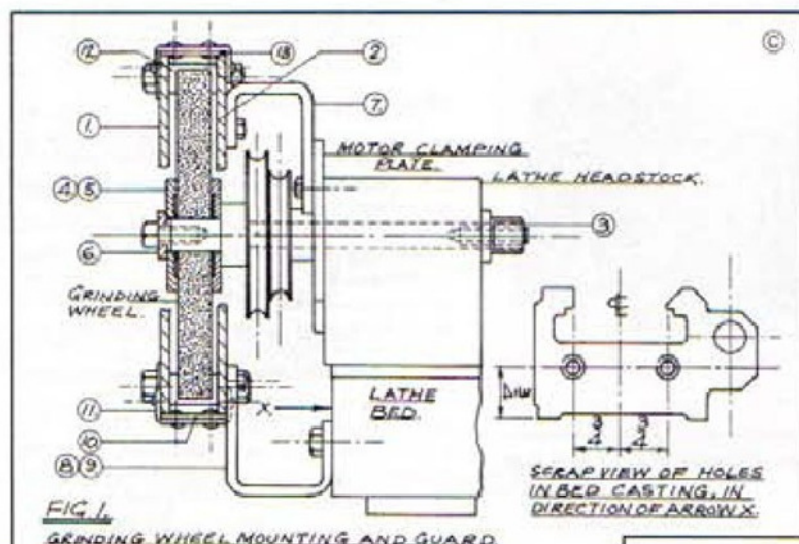
Short cover plate. Fig.7.

The cover plate is made in two pieces so that the guard assembly can be slipped over the wheel. The short cover plate completes the assembly and is drilled to take the bracket which fastens the eye shield. I haven't specified any parts for this, but **Photo 4** shows what I've used, half an old hinge, a piece of 16 s.w.g. mild steel bent into a long 'U' shape, some screws, thin nuts for fastening the bracket to the cover plate and shakeproof washers so that the hinge could have a drag on it but still pivot. The eye shield is an old C.D. case lid, it just needs a couple of holes for screws to fasten it and a cut-out for the hinge. A strip of fibre, soft plastic or even card between hinge and the C.D. lid will stop it cracking as mine has done, something else shown in **Photograph 5**.

A C.D. case lid is only one of several things which could be used for an eye shield. I used it because it was there and they only cost about £2 each to buy; one case makes four shields and when they get too marked, it isn't a catastrophe to throw them away. If you can manage with a smaller one, cassette tapes are only 50p for two. I like the C.D. case because it covers well. A frame round it could improve it, a refinement I may make when I have time.

6: The cover plate clips being drilled.



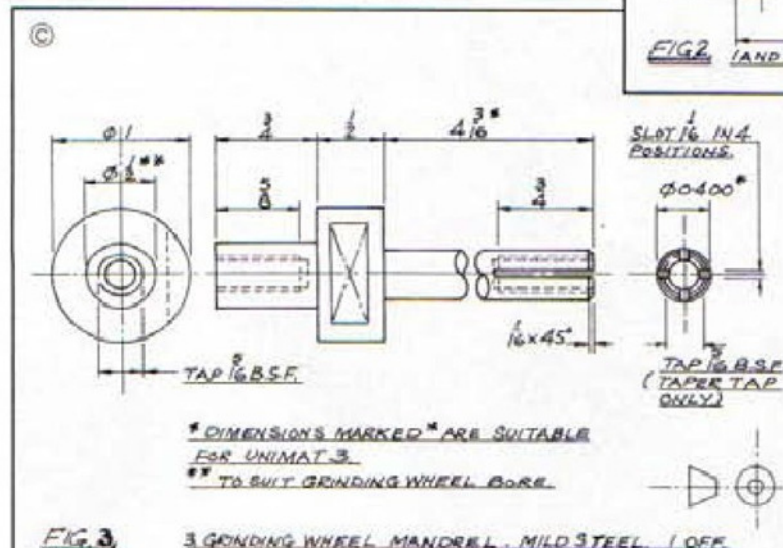
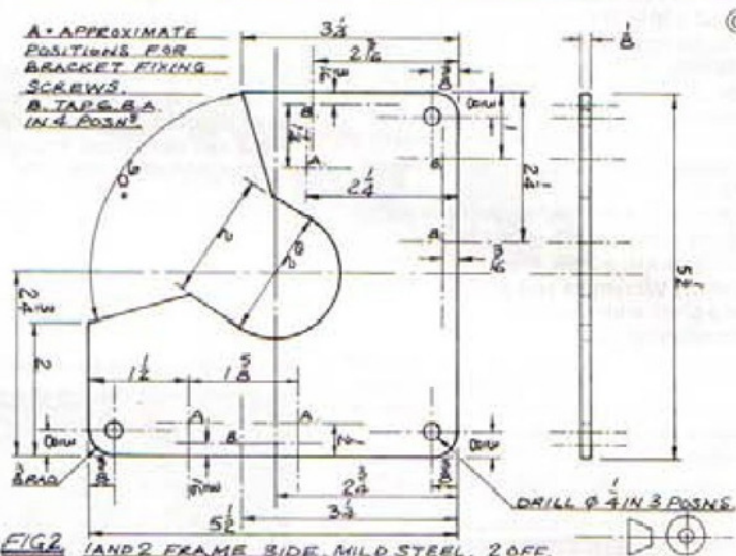


Cover plate clips

Each cover plate has two clips, see **Fig. 7** for the details. Bending them is simple, done round a block of tin, with the corners just rounded off. They are drilled before bending by marking out one, clamping the four together and drilling through. **Photo 6** shows this being done. To use this method you need three hands or an accomplice, so ask your wife or whoever is available to wind the handle. If you are on your own, clamp it.

Riveting the clips

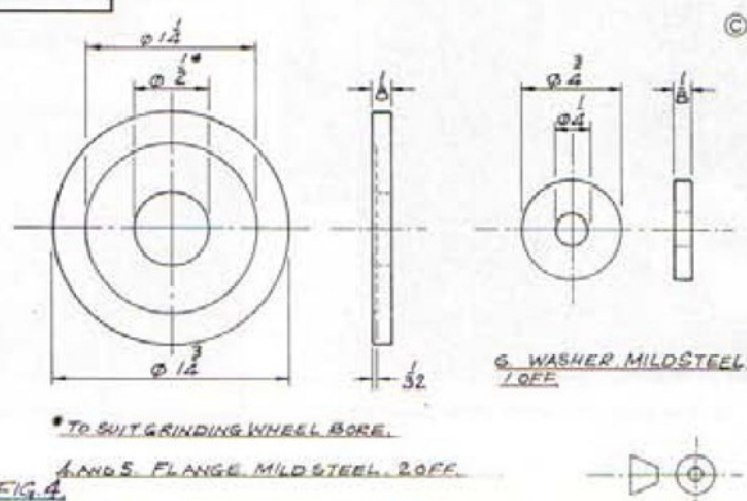
Riveting was a natural choice for fixing the clips. It is quick and easy and I have plenty of $\frac{1}{16}$ in. mild steel rivets. I could also make three rivets of the length I needed out



of one lin. one – that took care of my reputation for parsimony.

I didn't bother with countersinking or fancy work like snap heads, just knocked them down equally on each side till they mushroomed nicely. As you can see in **Photograph 4**, they don't look too unsightly. The knocking down was done on a smooth piece of steel using the normal hammer face and angling it *slightly* to get the mushroom shape. *Do not use the ball pane*, unless you are a whizz kid with a hammer. It won't do as good a job and it is very easy to miss the rivet and make marks where you don't want them.

With the clips riveted on, the covers



were clamped in position and the holes spotted through. Take the frames apart to drill them and don't be tempted to use a pistol drill. I did try and the drill wandered off centre very badly and I broke a 6 B.A. tapping drill. All the fastening holes for the clips were tapped 6 B.A.

Toolrest

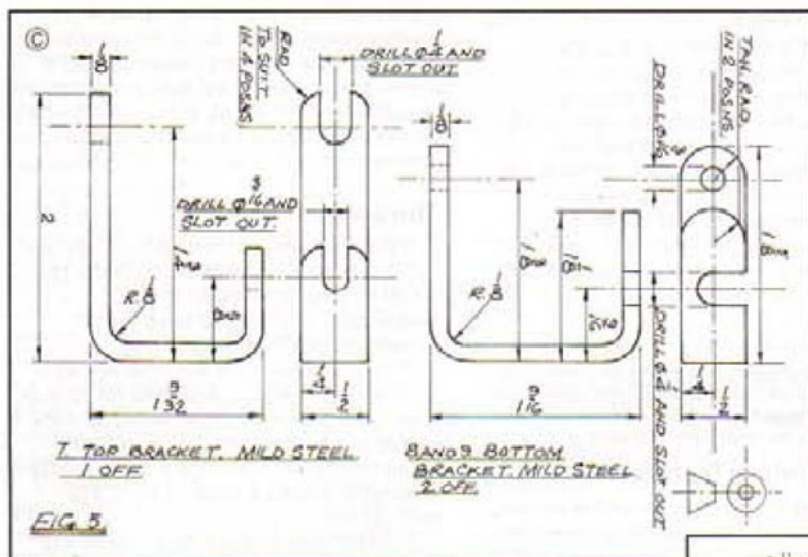
I made this in two pieces. If you have the equipment to silver solder, braze or weld a boss to a piece of steel angle, it could be made simpler. I have no such facilities, so I used a piece of 1½ in. x 1½ in. steel angle 1½ in. long with a cut-out for the wheel. The cut-out must allow reasonable clearance for the wheel, **Fig. 8** shows the details.

The other piece is made from $\frac{1}{2}$ in. x $\frac{1}{2}$ in. mild steel cut to an angle to clear from the wheel. It acts as the third spacer mentioned

earlier and is fastened to the angle with two 2 B.A. cheese head screws. **Photograph 7** shows the complete tool rest.

Assembling

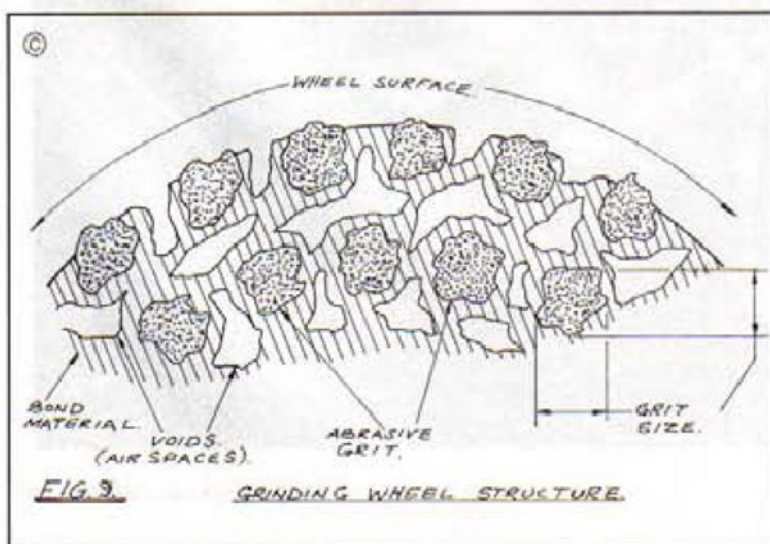
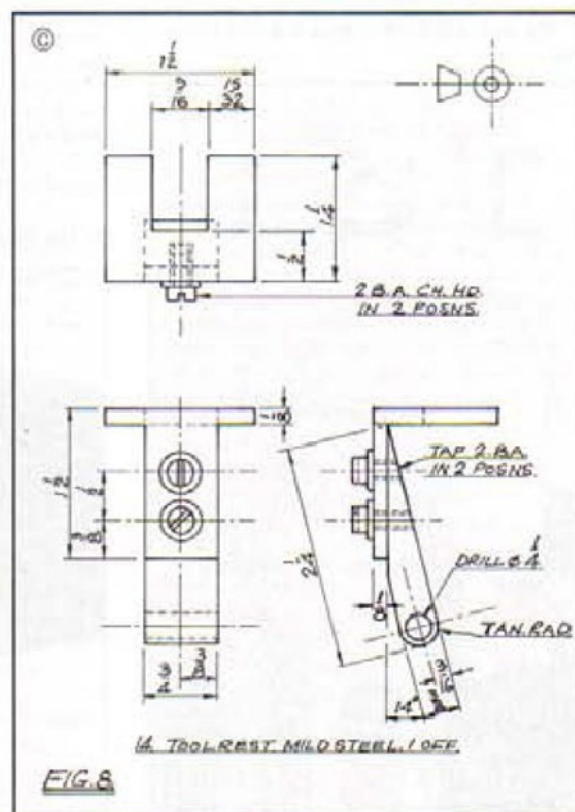
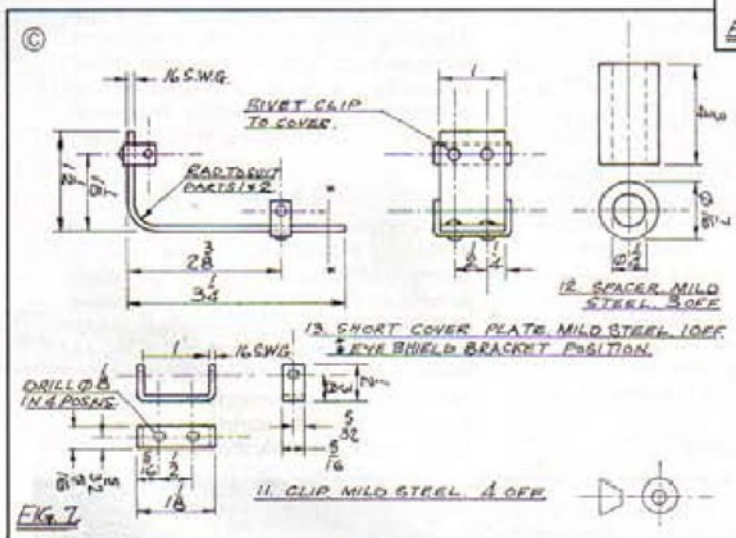
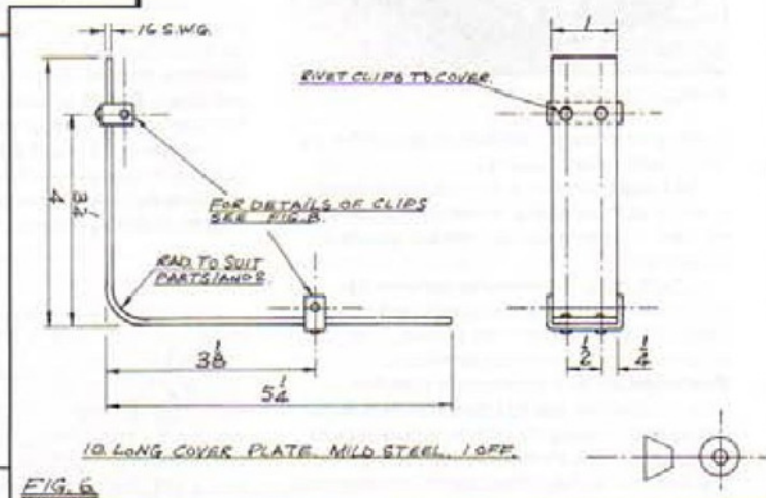
With everything put together except the short cover plate and the tool rest, the guard can be threaded over the wheel which should be already on its arbor and in position. The bottom brackets are left loose in the frames and with a bit of fiddling they can be positioned and the bolts screwed into the lathe bed finger tight. At this stage, you will appreciate the slots in the brackets and the reason for using hexagon headed bolts. The tool rest is put in now but left swung back from the wheel till everything



else is fixed.

Slip the top bracket over the bolts in the frame and the motor plate and do them up finger tight. When things are nicely lined up, the wheel will revolve by hand and the flanges look true with the centre holes in the frames, tighten down, checking as you go. Swing the tool rest into position until the gap between the wheel and rest is as small as possible, while allowing the wheel to rotate. Check this by rotating the wheel by hand.

Put the short cover plate on and adjust the eye shield. If you are using a C.D. cover or similar brittle material, move it by



BRUSH UP

Scratch brushes, which are a form of cutting tool, soon lose their effectiveness with use and start to polish the work instead of cutting the surface. This failing is soon corrected by applying the ends of the tufts in the brush against the wheel face of the bench grindstone with a gentle sweeping action till all ends are treated. The resulting brush is far better than when shop new.

Alec F. Farmer



7: The toolrest.

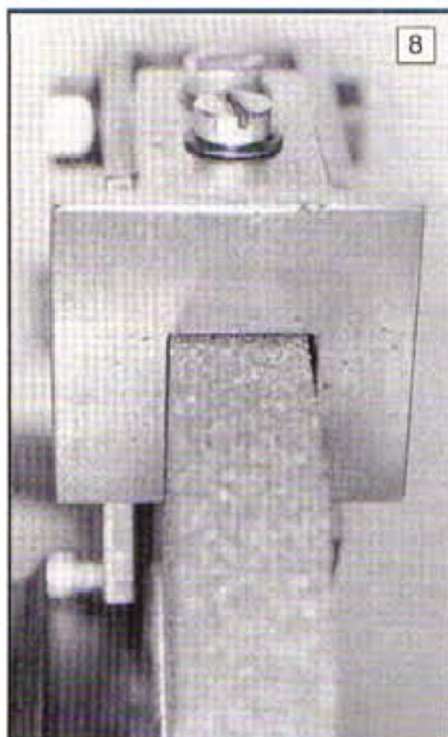
holding the hinge. Holding mine by the cover was what cracked it!

The machine can now be turned on to check that everything works. Let it run for about half to one minute before grinding anything.

It took me just over nine minutes to assemble the wheel and guard and have it ready to go, starting from scratch. The finished attachment is shown in **Photograph 9**. It also shows that the original Unimat guard has to be swung out of the way, luckily the wheel guard is quite substantial. The three holes in the side of the frame are there because it was intended for another job; they have no purpose.

So much for the nuts and bolts, it is time to think a bit about the abrasives and how the wheel works, so those of you who are only interested in the attachment can skip the next bit and go on to the section headed, 'Grinding technique and safety'.

8: The rest adjusted to give the minimum gap.



Abrasive types

Diamond is the hardest and is used crushed for embedding in wheels and hones and making diamond lapping compounds. Whole diamonds are used for wheel dressing, more about that later.

Silicone Carbide is next in the hardness scale and is used for lapping paste, sharpening stones and the green grit wheels for grinding tipped tools. It will grind cast iron, non-ferrous metals, stone and marble. Like diamond it will dress some wheels.

Aluminium oxide is the most useful abrasive because it will grind all the steels we normally use, especially high speed and carbon tool steel.

Grinding wheel features

A wheel is not a solid mass of abrasive and **Fig. 9** is a slightly distorted view of a small section magnified. I shall leave out diamond wheels because they are a bit different and we don't come across them too often, **Fig. 9** is what the ones we use for everyday grinding look like.

The grit is the stuff which does the cutting, it is held together by a bonding material in which there are voids or air spaces, making the wheel porous.

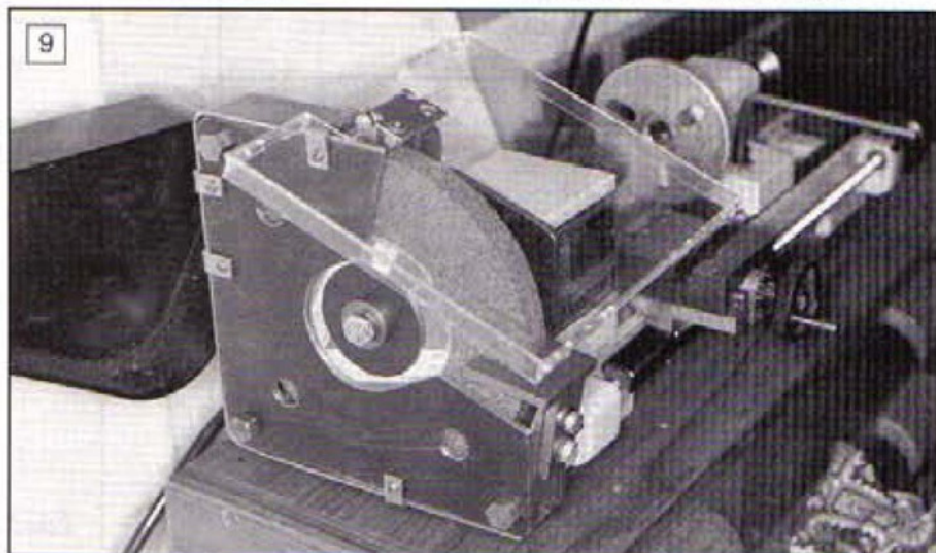
The grit

Grit is sorted into sizes when it is made. Sizes will be from 8 to 600 and the number means the mesh size in holes per inch. Coarse sizes are screened out, fine ones sorted by different methods. For the wheels we use for sharpening the best range is from 40 to 80. don't be tempted to buy too fine a grit, they cut slower than a coarser one, encouraging you to press too hard, which will burn the work and make the wheel need more attention. This is especially true if you have only the one wheel. If you have a double-ended machine, then a coarse and fine is a good combination. Given the same chance I'd opt for a silicon carbide on one end and an aluminium oxide on the other, 60 grit for each, but I use tipped tools a lot.

Another reason for choosing a coarsish grit is because the finish can be smoothed with a sharpening stone or hone.

Don't be surprised to find the abrasive called something slightly different. The

9: The finished attachment.



makers all have their own names and aluminium oxide can be called alundum, aloxite or oxaluma; the fancy names for silicon carbide are, crystalon, carborundum or carbolite. If in doubt, look for an A or a C on the wheel label. I won't insult your intelligence by telling which is which!

The bond

75% of all wheels made have a vitrified bond. It is hard and brittle and limits the wheel to a surface speed of 6500 feet/minute, it is the one used for the wheels we use for tool grinding.

The other one we may come across is resinoid. It is tougher and used for jobs like angle grinding and similar arduous work. It smells like burning insulation or tufnol being machined when it is used. Because it is tougher it can be used up to 12,000 feet/minute.

Two other bonds are very specialised: rubber for cutting off and slitting wheels and shellac for grinding very highly finished rolls.

Grade and structure

These terms refer to the strength with which the bond holds the abrasive in place and the ratio of bond to abrasive. A wheel with a lot of bond and a strong hold will be a hard wheel and vice versa for a soft one. The words 'hard' and 'soft' do not refer to the abrasive.

Grades are from A to Z, soft to hard. For off-hand grinding, which is how we grind tools, between K and N is correct.

Structure is a number, the lower the number the denser the wheel and the fewer voids or air spaces, see **Fig. 9** again. The voids in the wheel help to move the chips away quickly and make the wheel free-cutting. A structure of between 4 and 8 is right for off-hand grinding. The usual maximum is 14, which is the most open.

The marking system

In case the technology confuses us and makes our brains hurt, the makers of abrasive wheels have a marking system printed on the blotter which fits between the wheel sides and the flanges to cushion out small lumps and bumps. The 3in. one on my washing machine motor is perfectly described on the blotter. It reads, A-60-N6-V and tells us that the abrasive is aluminium oxide, the grit size 60, the hardness

medium, the structure fairly open and the bond vitrified. The maximum speed is given as 8680 rpm. It makes it ideal for off-hand grinding if the speed is between 6000 and 8000. My motor did nothing like this speed, which is why it glazed very quickly. I'll explain glazing later.

The labelling of my 5in. wheel is not quite so comprehensive but it has the essentials. It is a green grit or to be exact more of a greeny-blue grit and is labelled, GC-60-K-V with a maximum speed of 5350 rpm. The G is a maker's reference which is sometimes in front of the sequence and sometimes at the other end and refers to the abrasive or the bond. The only thing left out on my 5in. wheel is the structure number but a look through a magnifying glass will show if it is dense or open.

If a wheel has no marking system, *don't buy it*. If it has lost its label or you cannot read it for dirt or rust, *don't use it*. NEVER run a wheel at more than the maximum speed shown on the blotter.

Grinding technique and safety

Remember that any spinning mass is potentially dangerous. The surface speed of a grinding wheel will be between 50 and 80 miles/hour, that is why they have to be carefully guarded. The wheel cuts, it will go through flesh, bone and anything else that



10: A Huntingdon type dresser.

is in the way. It burns as well, neatly cauterising the cut it has made. So you won't feel much till the first time you wash, then the nerve endings will let you know.

Remember that the sparks are mainly white-hot pieces of metal and if they hit an unprotected eye they will stick. The eye, being a clever object, will try to grow a skin over the foreign body to protect itself. Eventually it will have to be scraped off, under anaesthetic of course, but not a happening I recommend. So **PROTECT YOUR EYES**, by using an eye shield and safety specs or goggles.

Adjust the gap between the wheel and the tool rest so that it is as small as possible. Take no notice of anything which gives a figure, if the wheel rotates freely and a piece of thick paper will jam it, that is right.

Use the face of the wheel and keep the tool moving so that the whole of it is covered, the cutting action is better, cooler and the wear is even.

Some jobs are very difficult to grind on the face of the wheel. Use the side as a last

resort and then with minimum force.

Try to grind dry, like the makers of high speed and carbon tool steel ask you to in their literature. When this is impossible, use cold clean water for cooling and cool the tool before it gets too hot. You have very sensitive heat sensors built into you; they are called fingers!

Don't stab at the wheel or use too much pressure; if the motor slows or changes sound, ease off.

Check the wheel frequently, it won't keep cutting for ever without attention.

Grinding wheel problems

Given ideal conditions, a wheel needs very little attention because as soon as an individual grain gets blunt, the pressure on it shears it off and exposes the new one underneath. Yes, you've guessed it, ideal conditions are a myth and there are three things which will stop a wheel cutting properly.

Out of round

The worst fault, because it is difficult to see the tool clearly. The vibration will make it hard to hold too. The cause is general misuse or a very hard bang or bump. Too much heavy grinding will also wear a wheel eccentric. The remedy is to true the wheel with a dresser or a diamond. Whichever is used, the toolrest is used as a fulcrum for the lug on the diamond holder or the dresser. **Photograph 10** shows a dresser in position, the wheel is stopped for clarity. The abrasive is sheared off by the spiked and plain discs which revolve with the wheel like a gear. The dresser is passed to and fro slowly over the wheel face. Because of the design of the toolrests they are usually swung back and a length of flat bar clamped to them. With the dresser lug hooked over this bar it must dress true. The dresser shown, called a 'Huntingdon' dresser, can also be used for the dressing which keeps the wheel sharp.

Glazing

This is the most usual problem and a glazed wheel cannot cut. It is easy to see because the wheel surface will be very shiny, especially when going. It can be caused by the wheel having too hard a grade or too dense a structure, so that the dull grains aren't released. What is more likely in our case, is that the wheel speed is too slow, this can be due to the motor speed being too slow or the wheel having been used so much that it is considerably smaller than when it was new.

Glazed wheels can be dressed with a diamond, the 'Huntingdon' dresser, an old carbide tip or a dressing stick. A dressing stick is a piece of silicon carbide abrasive 1in. square and about 6in. long. A piece of dressing stick and a dressing diamond are shown in **Photograph 11**, both have seen better days but still do the job. A silicon carbide wheel needs a diamond to dress it.

Where you have no means of increasing the motor speed, keep an eye on the wheel surface for glazing and be prepared to dress frequently. The other way you'll know is when the tool gets hot and it takes a long time to sharpen. The other way of reducing the chance of glazing is to use as large a wheel as possible, this will keep the surface speed up.



11: A dressing diamond and dressing stick.

Loading

A loaded wheel has bits of material stuck in the voids, those spaces in between the grains. It clogs the surface and stops the wheel cutting. I've used the word 'material' deliberately, because I've seen wheels loaded with wood, tufnol, brass, aluminium, most other metals and even a mixture of wood and graphite, where some idiot has sharpened a pencil. Dressing the wheel puts it right and, as with glazing, you will know when the wheel isn't cutting well and needs attention, by how it gets hot or needs too much pressure to do the job.

Since finishing the attachment it has sharpened small chisels, ground several drills of various sizes, re-pointed three centre punches and sharpened several lathe tools. It works fine, the only fault is that belt-changing is a bit difficult. The bolt in the bottom back corner of the frame tends to interfere with the belt when it needs changing. Replacing it with a countersunk one on the side against the headstock would solve the problem.

To summarise, choose a wheel 60 grit or coarser, of between J and N grade, open structure of 5 or close if it is marked, and as big a diameter as will fit. Run it as close to the maximum permitted speed as you can and keep the wheel dressed and clean.

Photograph 12 is of some sharpening stones for finishing high speed steel cutters and a diamond hone for doing the same to carbide tipped ones.

Sharp tools means accurate and well finished work. The information I've given concentrates on what I think a home workshop engineer should know about the process and safety of off-hand grinding.

Regarding safety, I remember how, years ago when I worked for a company where the grinder had no eye shield or goggles, I got a piece of grinding swarf in my eye. It happened on a Friday and by the time I could feel it, it was Saturday. Instead of waiting till Monday and going to the eye hospital, I went to the casualty department of a teaching hospital. They made a hash of it and I fainted on a hard floor, breaking a front tooth. I left the place with a front tooth missing. It was a week or so before I got married and our wedding photograph isn't all it could be.

Perhaps there is a moral; work safely when grinding – it could damage your teeth if you don't!

12: A selection of sharpening stones and a diamond hone.



PART 2

GRINDER TOOL POST

We conclude this two-part article with the details for making the excellent tool post grinder design by Gordon Cornell. It provides a demanding project with a very useful end product ...

Machining procedures

1. Spindle Bearing Clamp Ring (5) – bar stock

This part should be made first as it is used as a thread gauge and mounting mandrel in the process of machining the bearing/spindle housing. Place a suitable bar in a three jaw chuck, turn outside diameter to correct size with plenty of excess length, then bore to required .84in. diameter making a long tube and finally screw cut using appropriate thread chaser. At this point part off approximately 1.5in. long and set aside as thread gauge, ensure this has sufficient thread length to produce more than one item should you scrap one on further finishing operations such as the drilled spanner holes.

2. Bearing Housing (1) – casting

Mount the casting in a three jaw chuck using the special extended boss at the pulley guard end. Before commencing boring operations verify that the pulley guard mounting flange will not foul the saddle during machining. Being a casting it cannot easily be reset if a foul occurs. A very large boring bar is necessary to obtain sufficient accuracy and finish. Avoid a very high finish, use a minimum radius on the tool as castings do not machine like bar stock. Bore all the way through to suit internal ballrace using this item as a gauge. Machine wheel guard face to length then counterbore to suit outer ballrace. Screw cut using internal chaser to suit Spindle Bearing clamp ring gauge already produced.

Remove from chuck, screw in Locking ring tube and remount in the 3 jaw chuck using this item taking care not to damage the thread. Machine the pulley guard face to length, unscrew the housing from the locking ring tube before removal from the chuck.

Mount the housing on a face plate using an angle plate, drill the mounting hole, machine the recess and face to .625in. dimension or to suit your lathe. This recess is to accommodate the Myford 4 way toolpost ratchet, a ratchet pin can be fitted if desired. Remove from the face plate and place to one side for drilling and tapping operations.

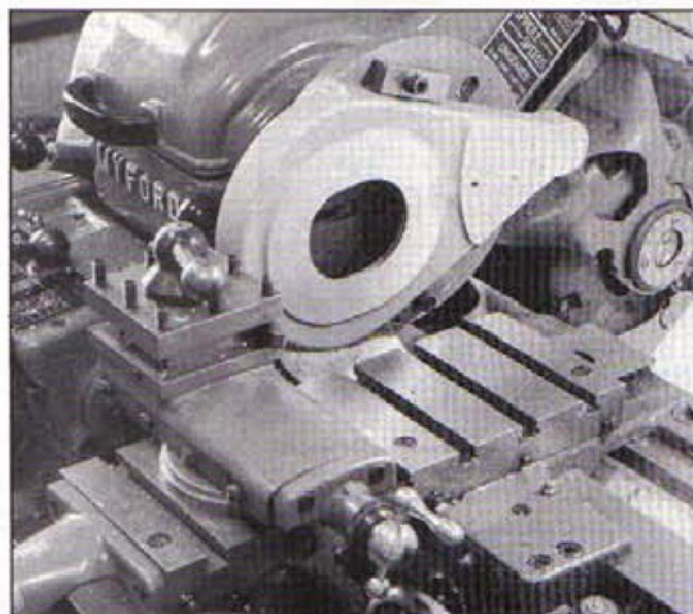
3. Motor Pulley Inner/Outer Guards (12 and 13) – castings

For jig purposes mark and drill the outer cover fixing screw hole 4mm diameter. Align Outer with Inner cover and drill through inner cover, tap both items with 5mm or preferred thread. Mount the Outer cover on a face plate using the 5mm fixing. In addition stop bolts should be fitted to

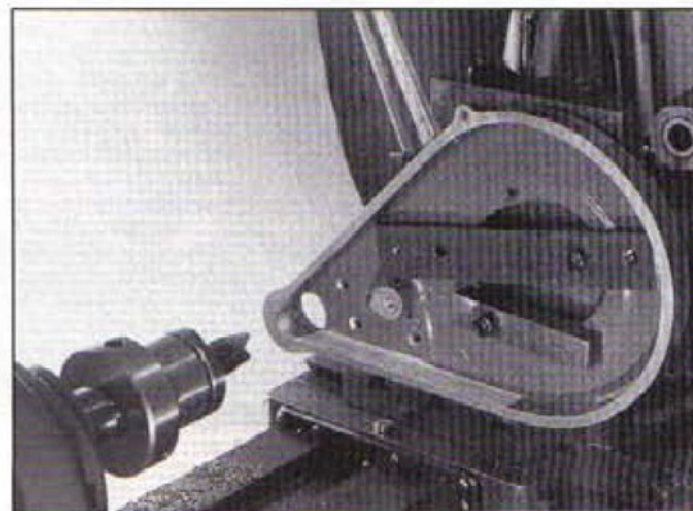
Machining the motor mount and inner belt guard. This is secured to the faceplate by a single fixing – note the stops to prevent rotation.



Machining the motor mounting face and exposing the cast aperture.



Drilling/Milling the spindle aperture hole. The latest castings have been modified to avoid the internal machining which can be seen. The cast aperture is also smaller to allow a wider range of motors to be fitted.



prevent rotation. Face machine to .625in. dimension remove from faceplate and fit Inner cover with mounting face to be machined first, exposing the motor mounting cast aperture in this operation. Remove and refit to machine the opposite face. Mark and drill hole for cover alignment pin in Inner cover right through, enlarge fixing hole in Outer cover to .218in. diameter, bolt inner to outer cover and drill hole in outer item. Dismantle, mark and drill .5in. diameter hole in Outer cover.

The simplest method for drilling the inner cover fixing holes is to mark them out on the mounting face, drill through then countersink the inner face. This item is then clamped to the Bearing housing and marked out by rotating a drill in each of the holes. Whilst the motor mounting hole and adjustment slot could be machined by a milling operation, marking, drilling and filing is an adequate method. Finally counterbore the .875in. diameter hole in the Inner cover to clear the spindle alley.

4. Guard Set 3 inch diameter Plain Wheel - casting

There is sufficient material in the castings to accommodate wheels up to 3.25 inch diameter x 0.875 inch width with the outer cover fitted. This guard type is also used for recessed wheels with or without the outer guard fitted. Extra castings are available if you plan to use a different guard set for recessed wheels. This uses a common casting for both inner and outer components. Mount in a three jaw chuck using the outer jaw set the outer item should only require facing to length but can be lightly skimmed inside if required. The Inner item is machined in the same manner except the raised boss is machined away to produce the mounting face. The appropriate drilling and tapping can be applied similar to the pulley guards however a better system can be employed if a rotary table is available, in which case the Inner guard cover bore should be machined as a register. Finally cut away portions of guard not required.

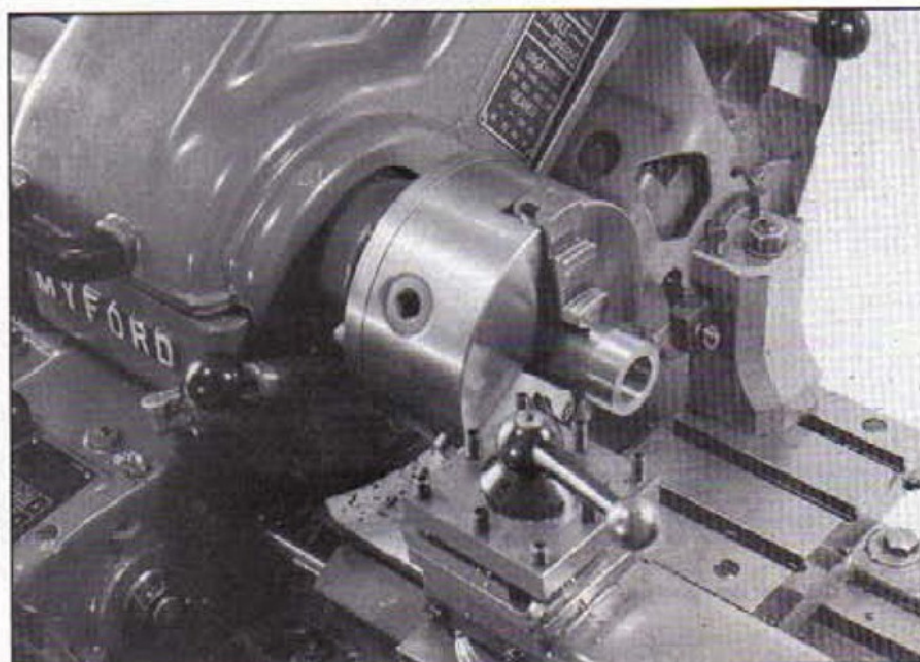
5. Guard Set - Cup Wheel and Low/Intermediate Pulley - casting

This guard has been designed to use an outer sliding ring to obtain a maximum life from a variety of cup wheels, the cut away is optional but permits grinding in restricted locations. A single casting is used to produce three components, start by mounting the casting in a 3 jaw chuck using the outer jaw set. Take a light skimming cut on the 2.125in. diameter to remove the casting draft, alternatively if your chuck cannot clamp onto the 4.187in. diameter temporarily mount on the 2.125in. diameter marking three clamping points. Remove from chuck and file three parallel clamping points, ensuring the casting runs true and will not move in subsequent machining processes. Sufficient clearance should be allowed for machining/parting off the Guard Inner Support. Alternatively this can be sawn off and the mounting face machined as an extra operation.

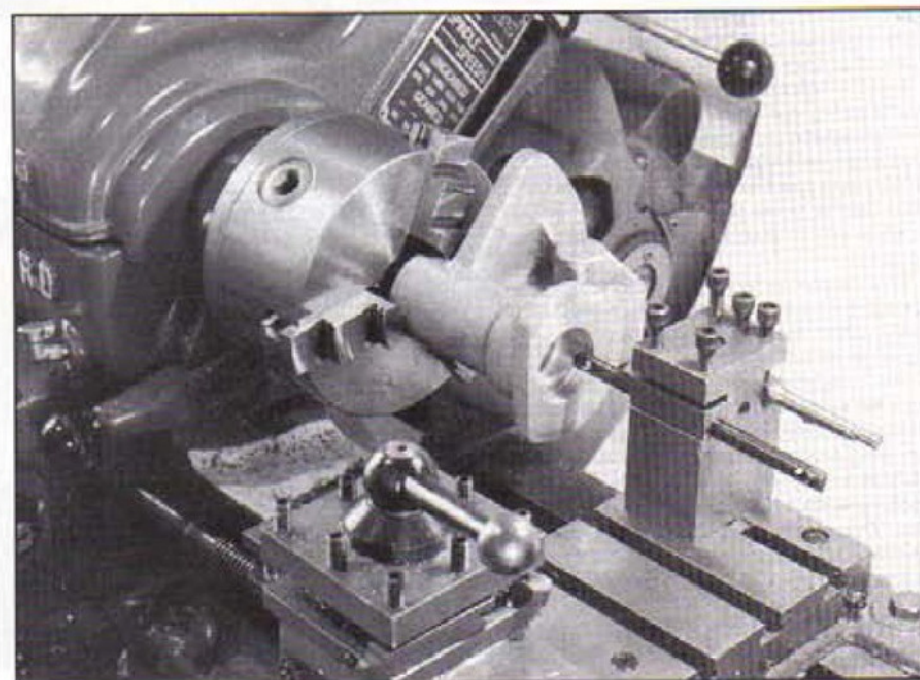
With the casting mounted on the 2.125in. diameter and running true commence by



Machining the first prototype outer pulley guard. Latest castings feature support bosses to aid mounting; they are also curved to increase cover stiffness.



Above, screwcutting the ballrace clamp ring at the same time producing a mounting spigot for the spindle housing. Below, boring and screw cutting the spindle housing 26 T.P.I.



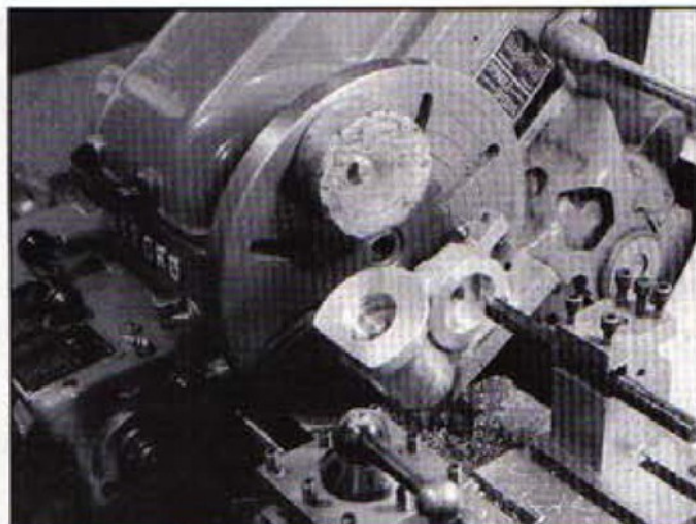
STAY SHARP

It is usual to remove burrs with a file; if it is desired to keep the edges sharp, use a small slipstone square to each surface.

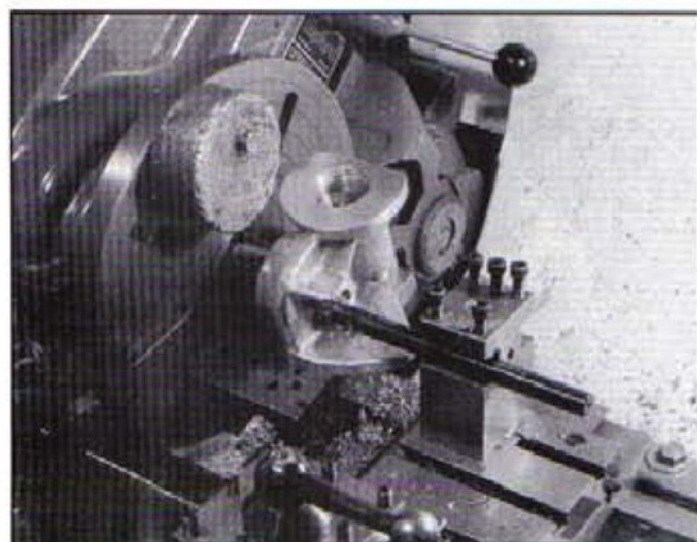
Richard Atkins



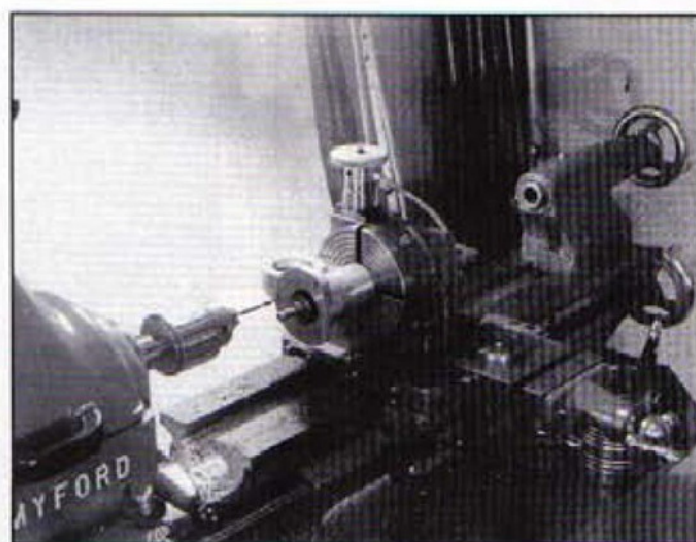
Machining the spindle housing motor guard mounting face with the casting mounted on the 26 T.P.I. spigot.



Machining the toolpost mounting counterbore to clear the Myford 4 way toolpost ratchet.



Cleaning up the upper face to ensure vibration free clamping with standard toolpost stud and nut.



Drilling the wheel guard fixing holes in the spindle housing.

boring the Guard Outer Sleeve to 3.687in. diameter, face and part off to desired length. Continue by machining the Guard Inner Support outside diameter so that the Outer Sleeve is a close sliding fit. Skim the 1.5in. diameter cast bore if this is not concentric, face and part off to length.

The 3in. Wheel Inner Guard can be used as a Marking out template for the Inner Sleeve radial mounting holes. The outer sleeve can be marked out for Slotting/Drilling and used as a template to drill the Inner Sleeve holes prior to tapping. Finally portions of the Guard not required are cut away.

This system is by far the quickest and easiest method of producing this particular guard, other methods have been tried many hours being wasted in the process.

The Low/Intermediate Pulley is produced from the remaining stub or bar stock using normal turning practice. The keyway can be cut using a method of your choice. Plugging the hole and drilling a guide hole prior to finishing with a Swiss file was used in my case. This was not satisfactory as the drill wandered due to differences in material. End milling would be more precise. This pulley must slide on/off the motor shaft with the key fitted from either direction to provide the Low/Intermediate Speeds.

6. High Speed Pulley - casting or bar stock

The casting has sufficient material to produce pulleys from 4 to 5 inch diameter, the standard for 28000 RPM is 5in.. The balance of this item is important thus it must be machined all over. Due to its size it must be crowned and run absolutely true.

Mount the casting in a three jaw chuck using the 1.06in. diameter extended rear boss. Turn the outside diameter and face. Drill and ream the shaft mounting hole. Reverse and mount in a three jaw chuck using the outer jaw set and complete the rear face machining. If you cannot mount this in your three jaw chuck, mark out and drill the motor adjustment access holes then use these to temporarily clamp to a face plate and face off the mounting boss to length. It does not have to be absolutely concentric but must be square to avoid run out. Remove and refit to a three jaw chuck using a mounting spindle through the 11mm diameter bore.

Mark out and drill the motor adjustment access holes. Cut the keyway as previously suggested for the intermediate pulley.

7. Chip Tray - Saddle Extension - casting

This is really an extra not being part of

the grinder itself. There is nothing very involved in finishing this item the drawing speaks for itself. Each individual machining it to suit his preferred installation. Bosses are provided for user guards and attachments.

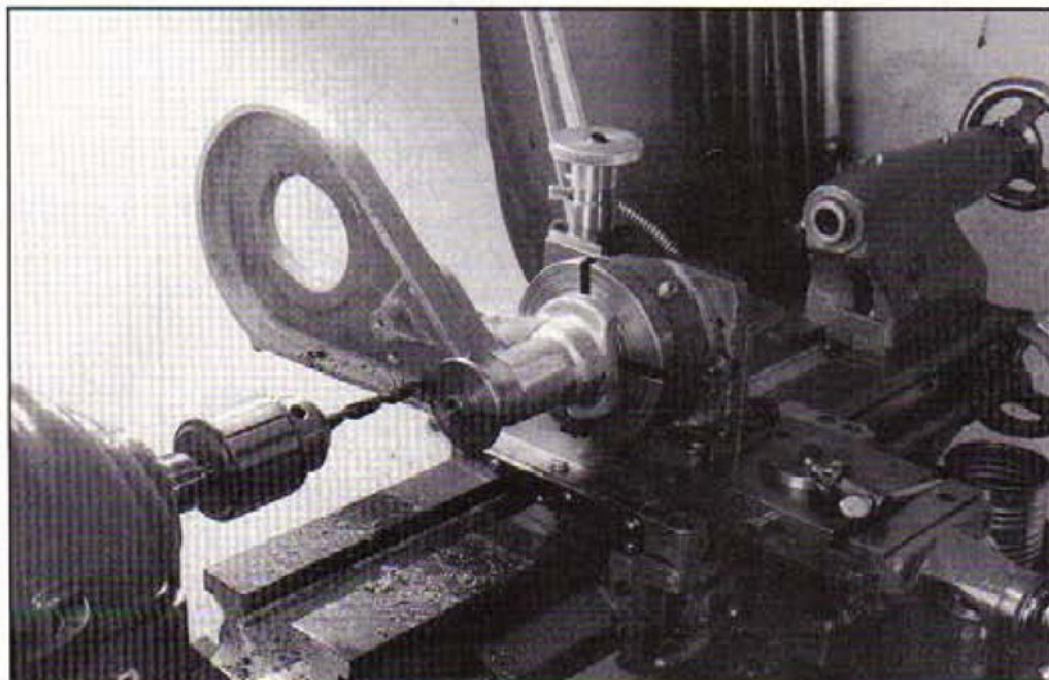
8. Spindle Assembly and other parts

Special attention must be given to the spindle to ensure alignment and concentricity. If possible the screw threads should be screw cut to ensure squareness finally sizing using a die. The spindle extensions can only be made sufficiently

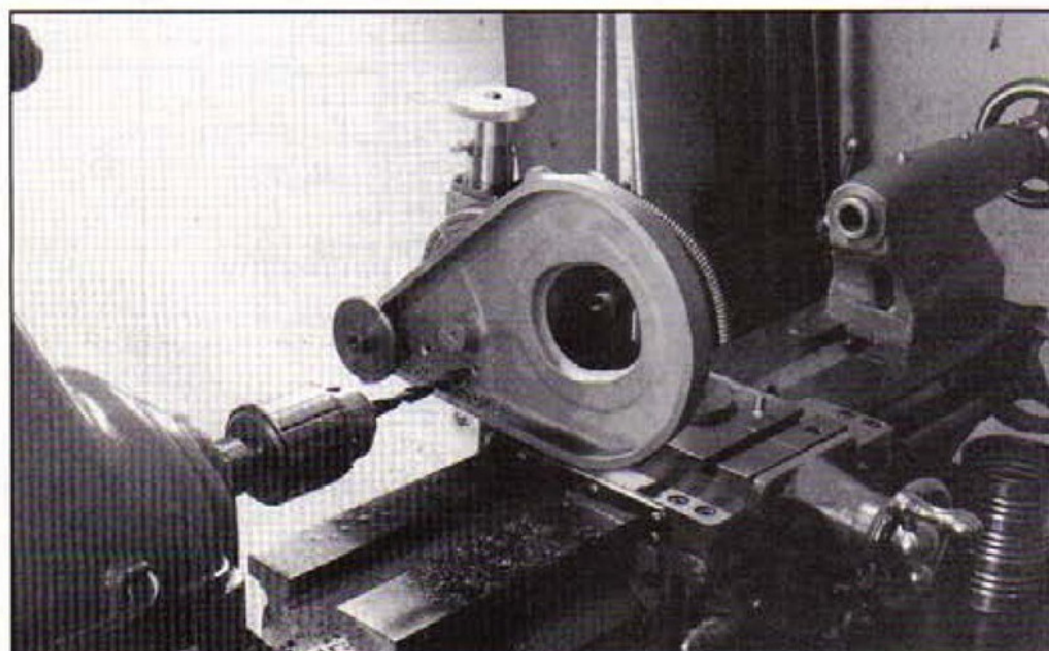
DENTAL DODGES

Storage of rod, say 300mm lengths, can be made very tidily by cutting a cylinder from a two litre plastic drinks bottle and filling the space with discarded denture tablet tubes! Mine accepts 12 tubes. The whole lot can be stood on the bench top taking up very little room, and is remarkably stable. The largest size in mine is 20mm diameter.

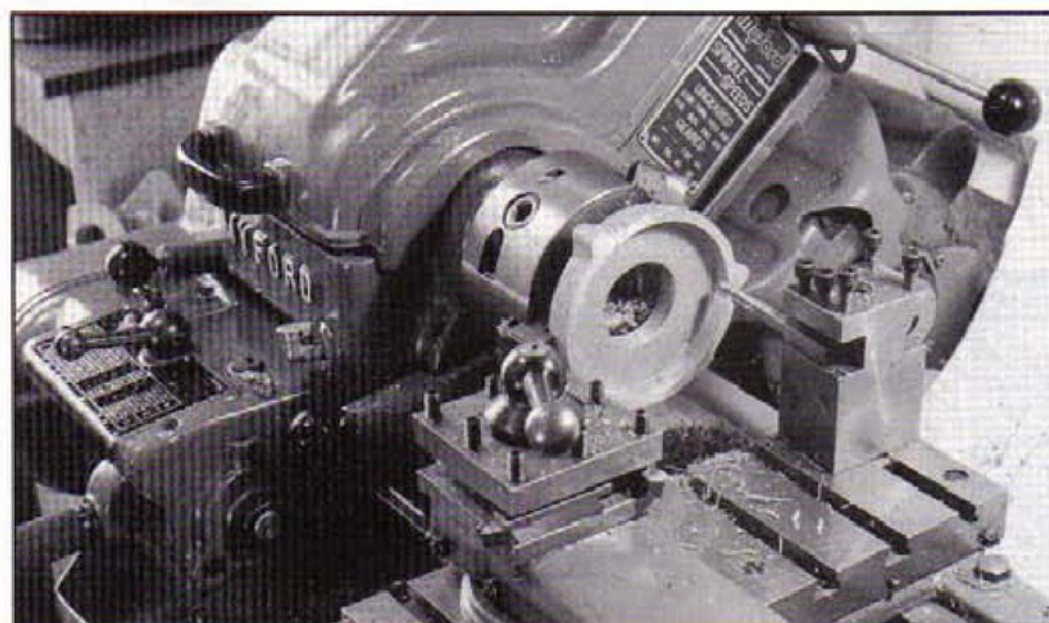
These same denture tubes, with the bottoms cut off and slit lengthways, will spring over lead screws to protect them from swarf. Just one point to note - it may foul the clasp nut if too long. **G.B.**



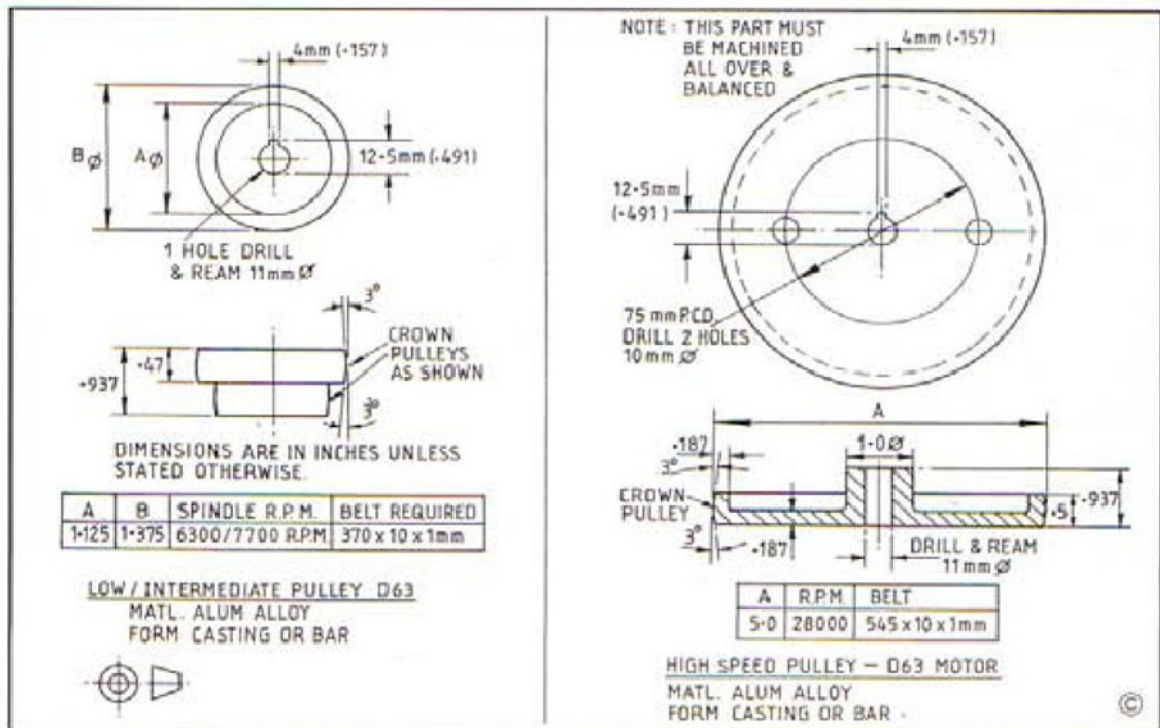
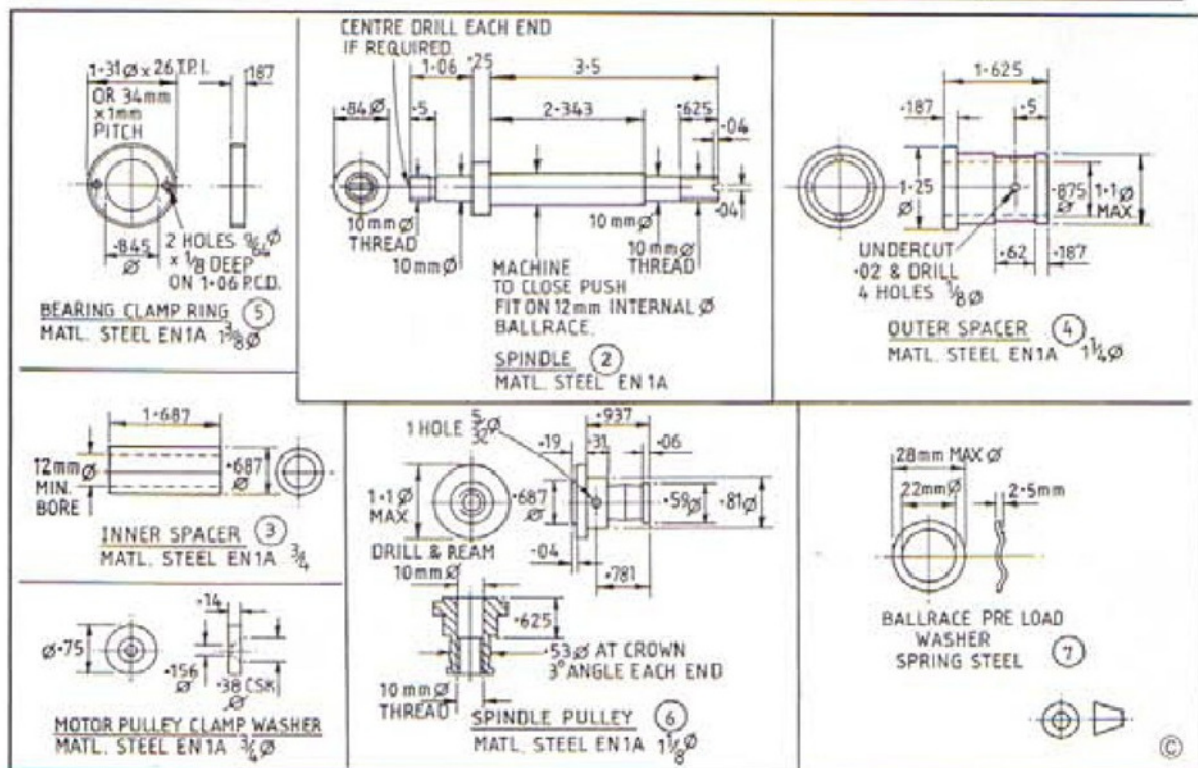
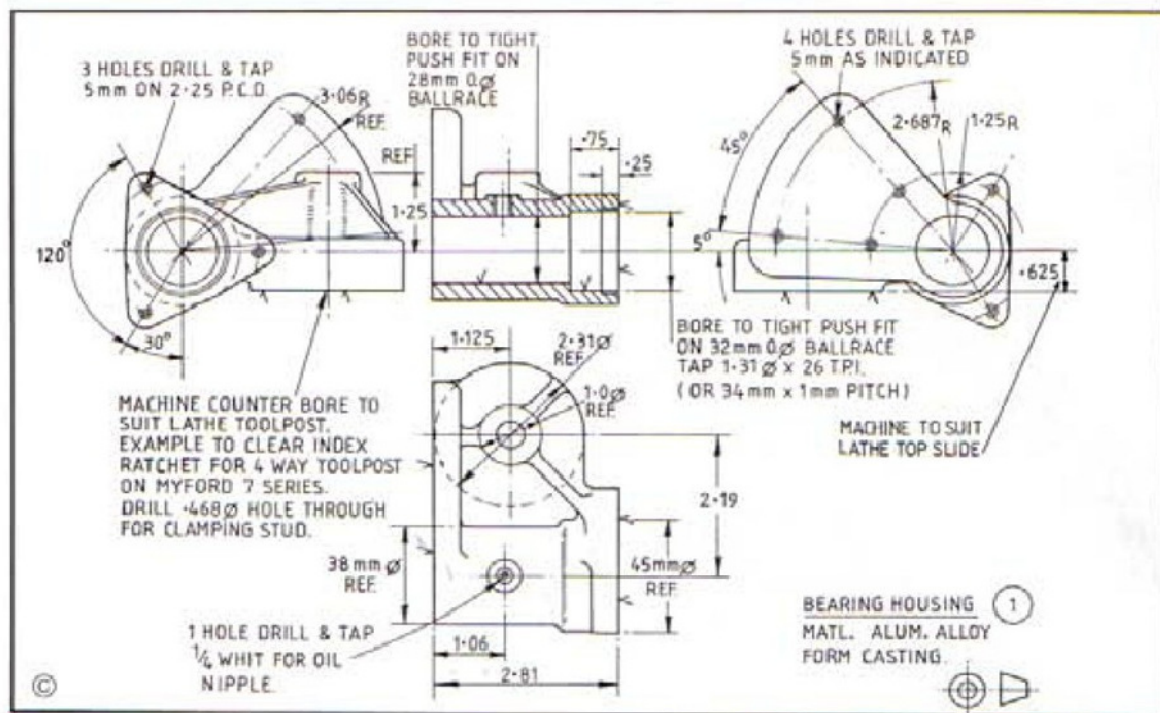
Drilling the pulley guard fixing holes in line using a series of alignment bushes.

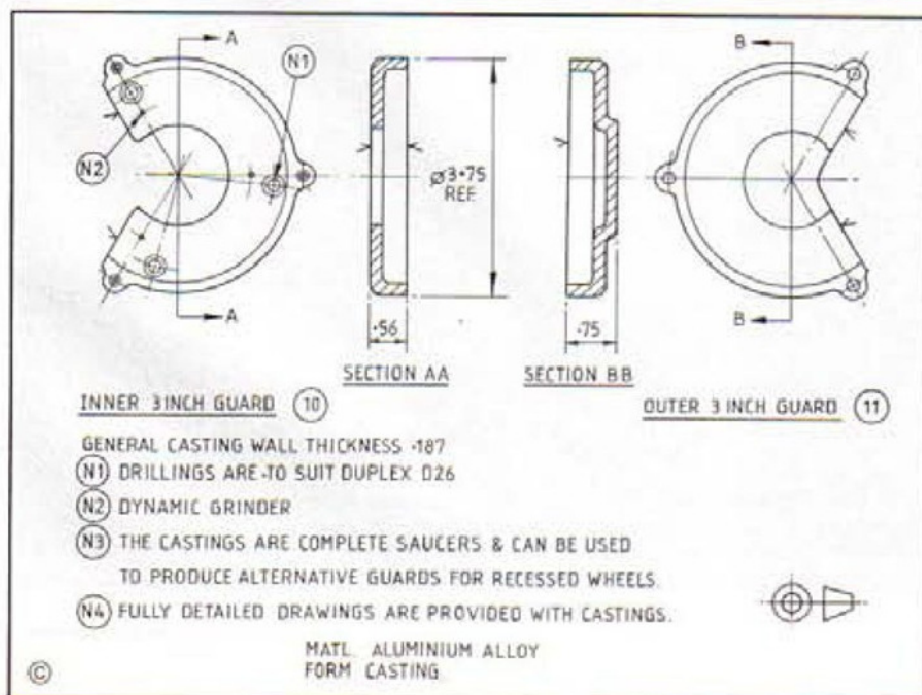
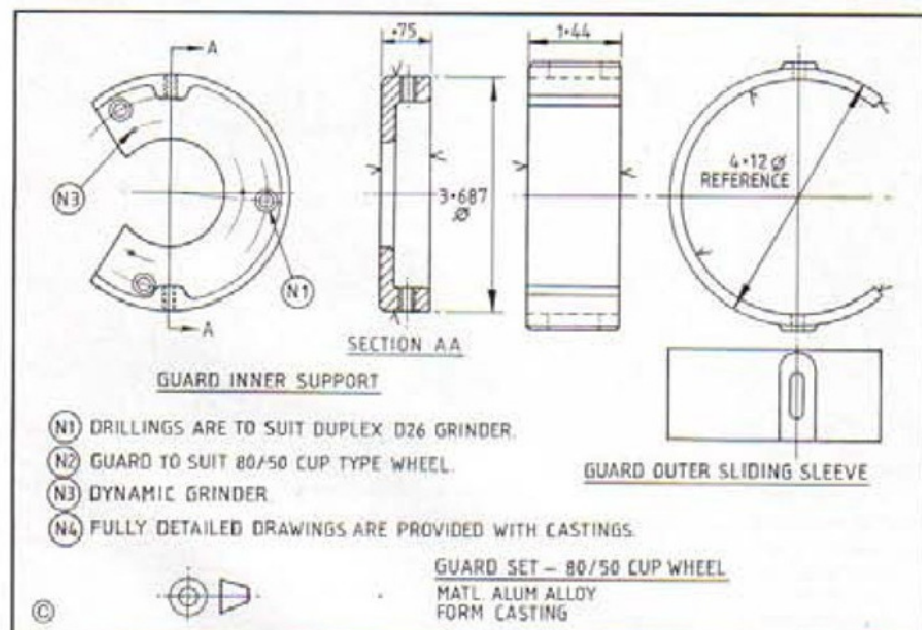
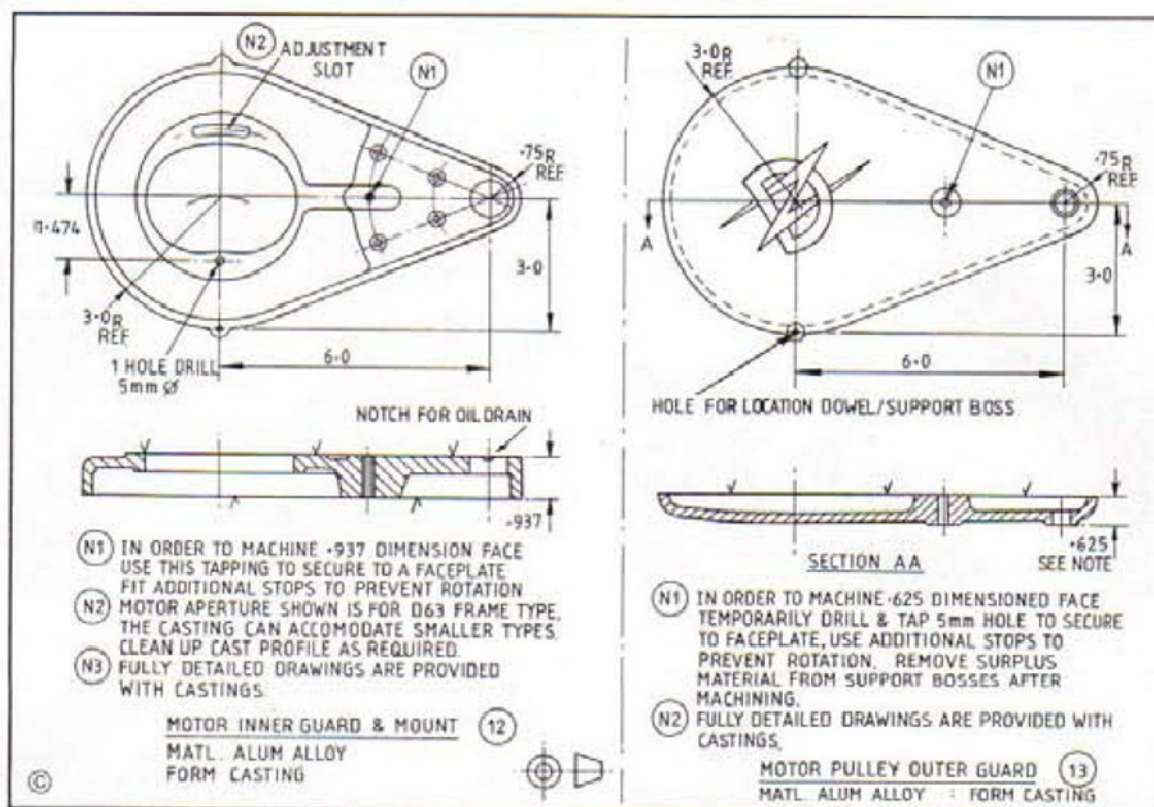


Re-aligned to drill the second pair of holes. This item is too large to simply rotate.



Machining the 3" external wheel inner guard.





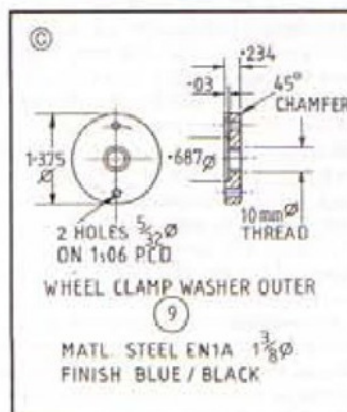
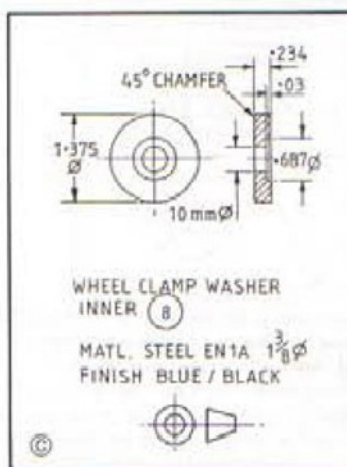
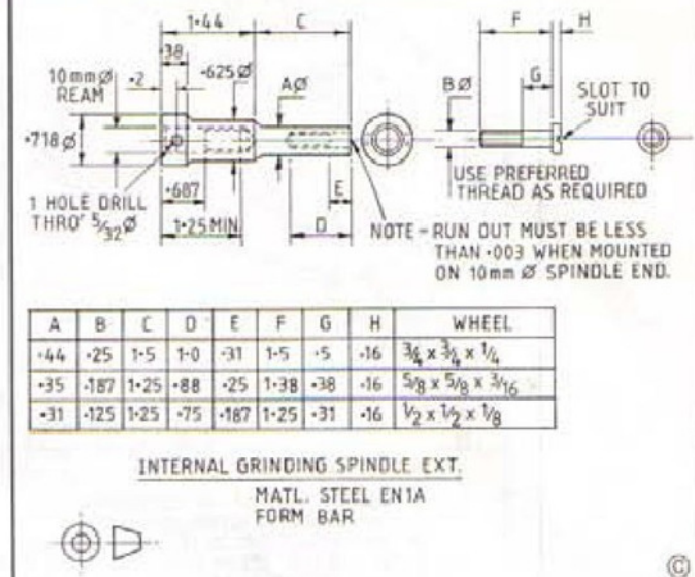
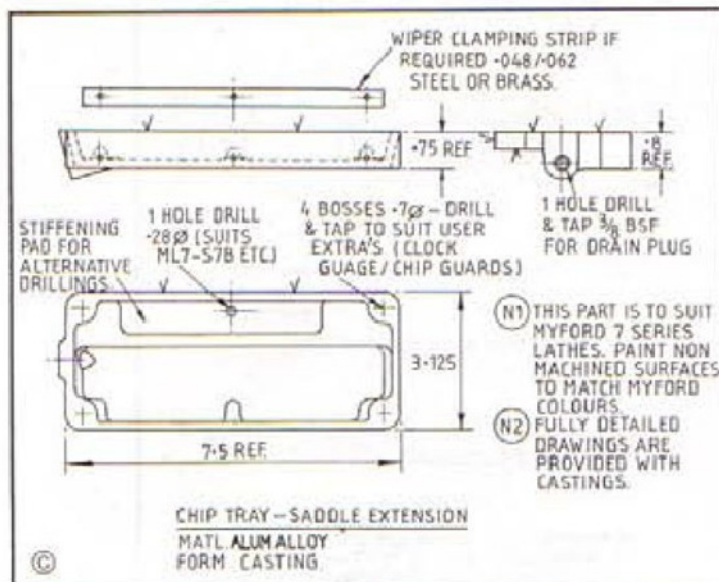
accurate using the following method. First produce a number of shafts with the drilled, reamed and tapped 10mm mounting hole. Then drill the cross holes used to tighten these on the main spindle. Continue by mounting the spindle in the three jaw chuck checking this is absolutely true, or turn a dummy spindle end on which to mount the spindle extensions. With the extension mounted centre drill the end and then support the end using a tipped half centre. Take a light external cut, retract the centre and observe that the spindle extension runs true. If run out is observed correct centre alignment. When accurate, finish external diameters. Finally drill and tap end to suit required fixing bolt. In my case I made special fixing screws with large heads as only a limited number were required.

All the remaining components are machined from bar stock I do not propose to describe the making of these items as the drawings should suffice. Note, more detailed drawings are provided with the castings than are published with this article.

CENTRE HEIGHT CHECKER

To check that a tool is at lathe centre height, gently trap a strip of 3mm Perspex (or a 150mm steel rule) between the tool and the stationary workpiece. So nipped, it adopts a position lying tangentially to the workpiece so that when (and only when) the tool is at centre height, the strip is held vertically relative to the bed.

W. Brian Taylor/N. Smith



Suppliers

Castings and drawings

A & D Barrowclough Ltd
Elm Street Mill
Elm Street
Burnley, Lancs. BB10 1NY
Phone 0282 427048

Continuous flat belts

F.U. (London) Ltd
Martin House
Gloucester Crescent
Wigston, Leicester. LE8 2YL
Phone 0533 773399

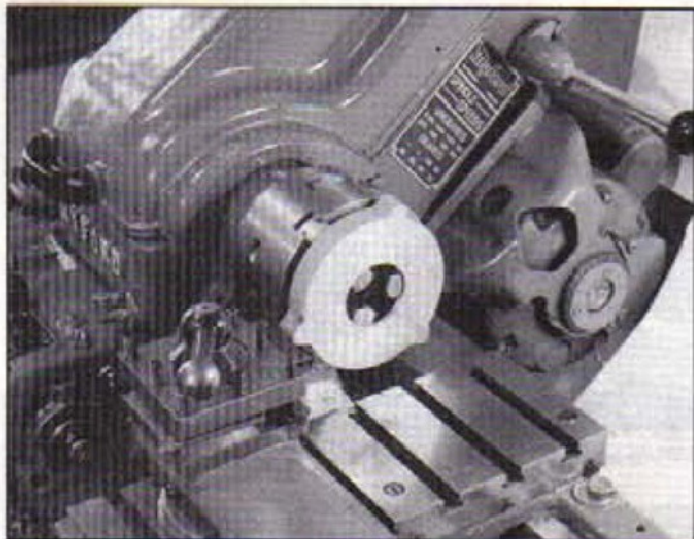
Diamond pressing stick

Blackgates Engineering
209 Wakefield Rd
Drighlington, Bradford
West Yorks. BD11 1EB
Phone 0532 853652

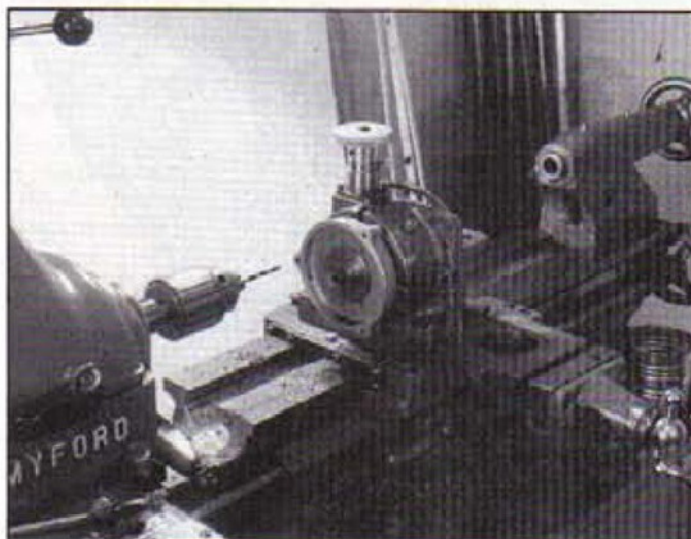


Parts List Toolpost Grinder

Description	No. Off	Remarks
Motor	1	180/250 Watt, 2800 rpm, single or three phase, D63 Frame/C Mount/T.E.F.C. Permanent Capacitor Type
Cable with 13 amp plug	1	RS 489-352
Switch & box	1	RS 330-200
Screw - motor fixing	2	5mm x 19mm Cheese Head
Washer	2	5mm Plain
Pulley - High Speed	1	Casting
Belt - High Speed	1	545 x 10 x 1mm Pirelli
Pulley - Low/Intermediate	1	Bar Stock
Belt - Low/Intermediate	1	370 x 10 x 1mm Pirelli
Key - Pulley	1	4mm x 4mm x 13mm
Screw - Pulley/Shaft	1	4mm x 13mm Csk.
Pulley Washer	1	See drawing
Inner Pulley Guard	1	Casting
Screw-Guard/Bearing Housing	4	5mm x 16mm Countersunk
Outer Pulley Guard	1	Casting
Screw	1	5mm x 22mm Cheese Head
Spindle Housing	1	Casting
Oil Nipple	1	1/4 BSW
Spindle	1	Bar Stock
Ballrace - Outer	1	6201Z
Ballrace - Inner	1	6001Z
Pre-Load Washer	1	Terry W61490
Bearing Clamp Nut	1	Bar Stock
Distance Tube	1	Bar Stock or Tube
Pre-Load Tube	1	Bar Stock
Spindle Pulley/Nut	1	Bar Stock
Spindle Extension - Internal	1	Bar Stock
Screw - Spindle Extension	1	To suit wheel type
Inner Guard - External Wheel	1	Casting
Outer Guard	1	Casting
Screw - Guard/Spindle Housing	3	5mm x 16mm Countersunk
Screw - Outer Guard	3	5mm x 22mm Cheese Head
Inner Guard - Cup Wheel	1	Casting
Outer Guard Sleeve	1	Part of above Casting
Screw - Guard/Spindle Hsg	-	use external fixings
Screw - Sleeve	2	5mm x 13mm Cheese Head
Clamp Washer - Wheel	1	Bar Stock
Clamp Washer Nut	1	Bar Stock
Spanner	1	Special 2 pin
External Wheel	1	3in. x .5in. x .75in. or .5in. BA60L5VFBLU
Cup Wheel	1	3in. x 1.5in. x .75in. or .5in. 3PA60K5V100
Internal Wheel	1	.5in. x .5in. x .187in. or .125in. BA60L5VFBLU
Wheel Inner Sleeve	-	Plastic as required
		Note - Other wheel types are optional
Extras		
Diamond Wheel dresser	1	Blackgates
Chip Tray - Saddle Extension	1	Casting
Warning Plate	1	For finished machines



Finishing the guard mounting face. The casting is held on the larger internal diameter, so that the face can be traversed.



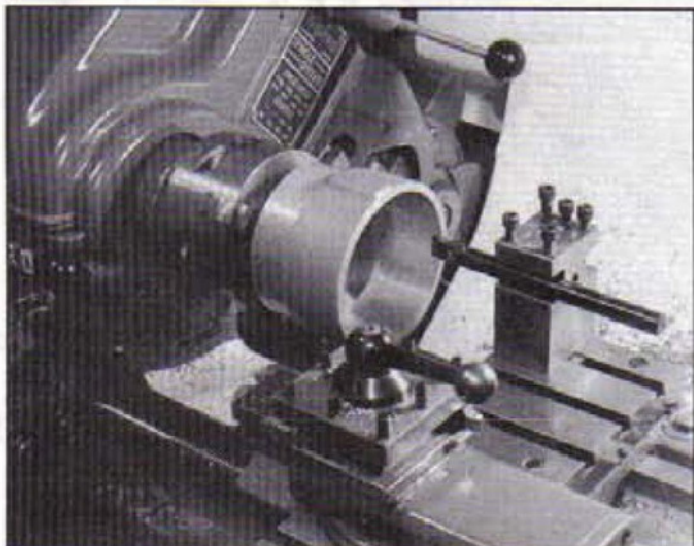
Precision drilling the inner guard fixing holes mounted on a register.



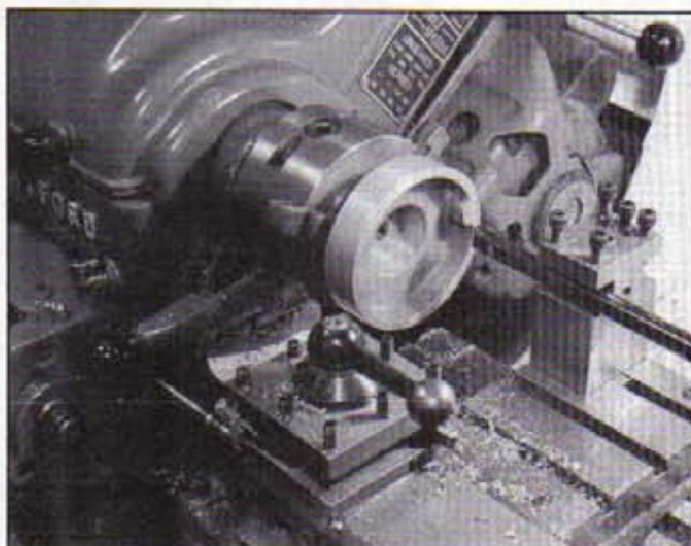
Drilling the outer guard fixing holes using the inner guard as a jig.



Machining the low/intermediate pulley from the casting stub and rough machining the inner component of the cup wheel guard.



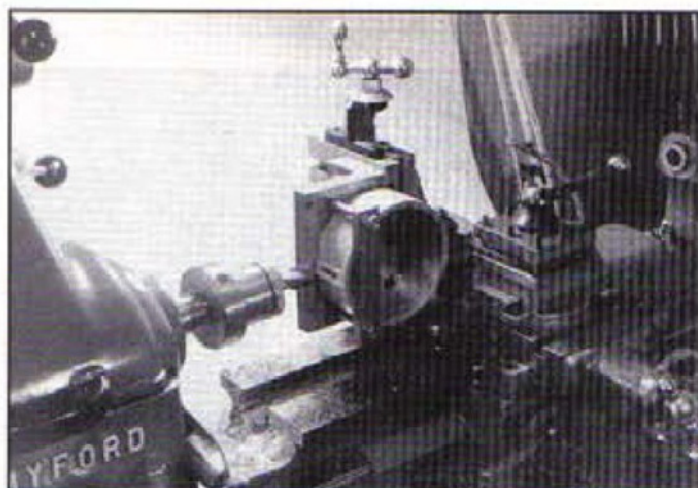
Boring the sliding ring of the cup/recessed wheel guard.



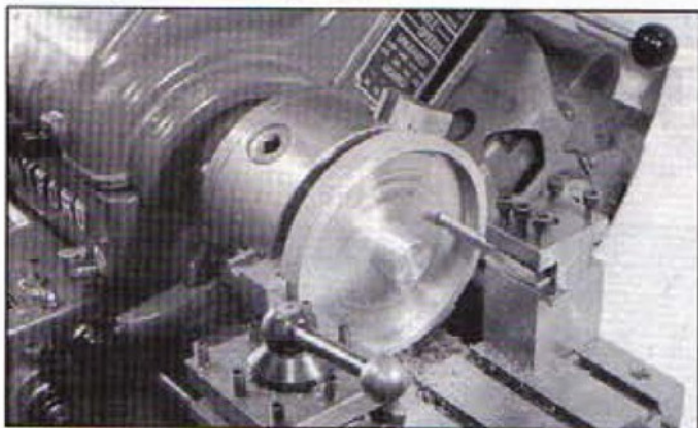
Finish turning the cup wheel guard mounting.



Facing off the sliding ring to length. This was sawn off in the previous operation for safety reasons.



Milling and facing the slots in the sliding outer ring.



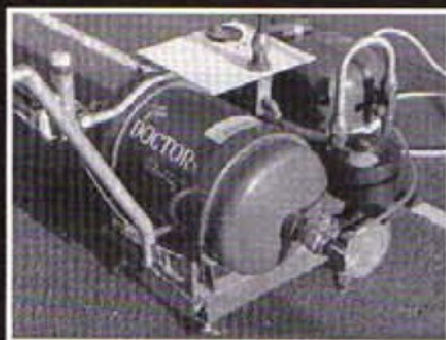
Counterboring the high speed pulley. Check that the chuck jaws do not foul the saddle with this operation.



Precision turning an internal spindle extension. Read notes carefully as finished spindle run out is very important. Avoid heavy cuts.

IN OUR NEXT ISSUE!

Coming up in the
DECEMBER/JANUARY
issue No. 20 will be:

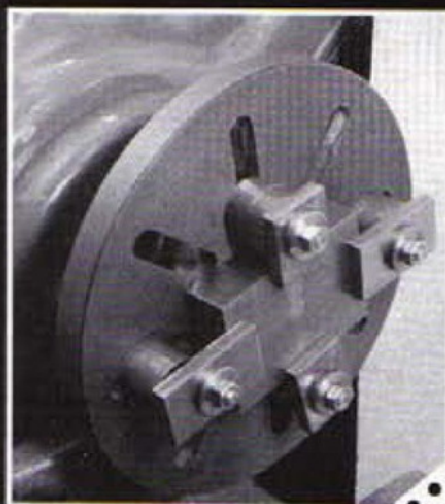


A small compressor, made
from surplus items.

A compact angle and face
plate clamp system, making
the setting up of workpieces
on the angle plate, or face
plate, an easier operation.

A plain mans guide to
materials, the first of a series
and relating to ferrous metals.

Computer aided design basics,
considering its possible use in
the home workshop.



AND MUCH MORE

Contents may be changed



Don't forget!

The next issue of
Model Engineers' Workshop
will be published on
22nd October 1993.