No. 18
AUGUST/SEPTEMBER 1993 £2.50

MODEL ENGINEERS' WORKSHOP

THE PRACTICAL HOBBY MAGAZINE

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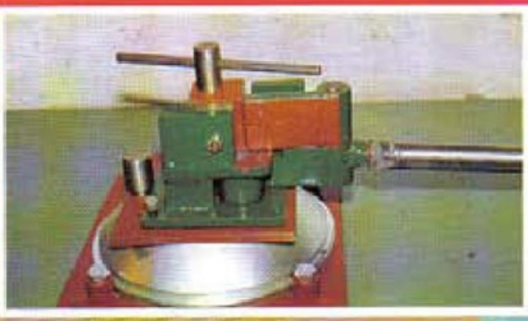

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ALSO IN THIS ISSUE:
Versatile toolpost grinder & lathe-mounted fretsaw

MODEL ENGINEERS' WORKSHOP AUGUST/SEPTEMBER '93 Issue No. 18

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Editor: Harold Hall

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Enough to make any woodworker drool, this is a section of the woodworking dept at Tilgear. The metal and machine side of the business is equally exciting, see page 57 for details.

Modeller on the cover is Harold Newman, seen here in his workshop – the result of some years of patient endeavour.

ADVERTISERS' INDEX

Harold Hall

ON THE EDITOR'S BENCH

In this issue we were to conclude our series on electric motors and their speed control with an item on controllers for DC motors. It has been found preferable to divide this final part between two issues. Contrary to the situation in the last issue, where it was explained that it is impractical to detail the making of an AC inverter; in these concluding issues more emphasis is to be placed on making ones own, especially in the next issue.

The article includes the application of smaller low voltage motors that have many uses for table feeds; powering smaller lathes and milling spindles etc. For these, making ones own controller is a much more of a possibility. The article will contain some new circuits as well as some updates on some which have been previously published.

In issue number 16, I raised the question of exhibiting workshop equipment at the Model Engineer exhibition, and asked for readers comments on some magazines of the past. I would like to thank all those who wrote regarding these subjects. More will be said about the exhibition in a future issue but a selection of the letters received regarding the older, now defunct, magazines are published under the heading *Backlash* in this issue. A few readers erroneously thought that I wished to obtain copies, many thanks for the offers; in fact I was questioning to see if readers had saved copies, so as to determine if they were considered collectable, as is *Model Engineer*, and hopefully *Model Engineers' Workshop* in the future.

Safety Equipment

Since becoming editor I have received many letters pointing out the responsibility, moral if not legal, for setting a high standard in the observance of safe working practices. These have often referred to the requirements of the Health and Safety Act.

I have no major disagreement with readers who write in this way, but do however, have first hand knowledge of the difficulties.

It was with this in mind that I added to my photographic kit a pair of safety spectacles. These could be used by any machine operator I photograph, should he or she not have a pair available.

Most readers will appreciate that, when arranging to visit a workshop, it is impractical to set out rigid requirements, particularly in advance. This would necessitate asking such questions as: Do you have all your electric sockets at the ideal height? Do you have to reach over a machine to start and stop it? Are any of your cables mounted to a surface where they may become damaged? Do you have safety guards on the milling machine? The list would be large and in many cases a visit never materialize.

Still, back to the spectacles. It seemed a good idea to go armed with a pair of safety spectacles, so a pair were duly purchased. As I have to wear spectacles there had never been any reason for me to actually handle a pair of safety spectacles. I do use goggles over my specs in severe conditions, but these mist up in a matter of a few minutes.

On receipt, I duly tried them on and immediately realized that the protection they gave was inferior to that given by my own more regular prescription glasses. These are fitted with vari-focal lenses, the lenses are of necessity large. I also like, so as to minimize the sight of the frame, for the lenses to be set close to the face. Also for maximum ease when reading, which uses the lower part of the lens, the lenses are tilted well in so that the lower edge almost touches the face. See photograph at top of this page.

The end result is that my specs give better protection than do the safety specs. However as my spectacles do not have shrouds mounted to the side arms I can just get a finger in from the side. However this is from well behind the eye, towards the hairline. In this respect the safety specs are a slight improvement, but in all other respects my own seem better, being unable to even get something as small as a pencil in at any other point. The safety spectacles permit all four finger ends together to have access to the eye from below and a single finger from above at each end of the lens.

I have not gone into all this detail to discredit BS2092-2 spectacles, which have of necessity to give a reasonable degree of protection without over complicating the situation for industry. The moral is, that when the individual considers safety in the light of his or her personal situation, some thing better than the laid down standard may be possible.

Even if spectacles are not bifocals there is no reason why larger lenses should not be obtained; with the larger frame a wider field of vision is available. I found this factor most unhelpful with the rather small lenses of the BS spectacles. If replacing your spectacles it is wise to get them fitted with safety lenses; that is plastic or toughened glass. I could say more on the subject but feel enough has been said for this issue, perhaps I will return to it at some other time.

Lady readers

Whilst looking through some older copies of the *Model Engineer* at the office, I came across a letter in an issue published around 1946-1950. The writer suggested that, as during the war years much machining in industry was undertaken by female labour, the result should be an increase in ladies involved in the hobby of model engineering. Sadly, with one or two notable exceptions, this does not appear to have occurred.

There have been one or two articles published in *M.E.W.* provided by a lady author, and also some correspondence in *Scribe a Line* from another. I wonder, do we have any more female readers?

Reader Survey

Have you returned the survey from the last issue, if not, it is not too late? Many of the questions were quite different from the earlier two, and will provide me with very useful information regarding your likes and dislikes. If you have not yet returned it, may I include a special plea that you make a few minutes available to complete it, for this I will be very grateful.

Articles, this months' request

We are looking for an article on a vibrating hand engraver, can any reader come up with one, if so, as always, please write first with some brief details.

A word of thanks

Finally a brief comment on a couple of subjects. First I would like to thank my wife, who has been helping me complete this issue. Unfortunately a recurrence of a back problem from many years past, left me flat on my back for 13 days. My filing systems etc. are very precise, some would say too much so, and as a result she was able to locate items from our office cum dining room and bring them too me, also taking photocopies as required.

Even when I was back on my feet, she had to extricate heavy files etc. from the lower shelves. Perhaps I should get her working the word processor, just in case.

Also, two readers have made comment on their being unhappy with my statements, in the last issue, regarding not answering some correspondence, that makes three of us! The above situation has made me realize even more how important it is that the production of the magazine must take priority, fortunately this issue was well advanced prior to my malaise.

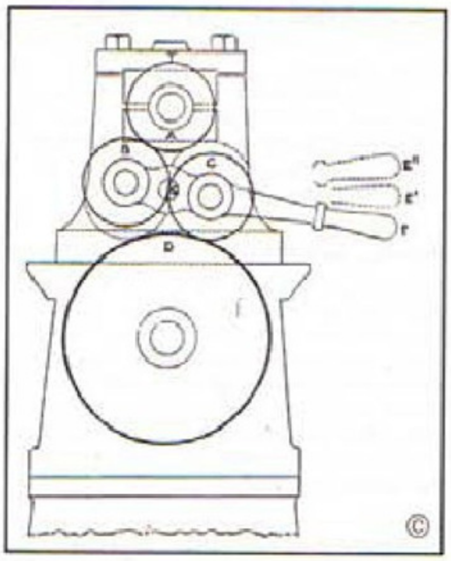
Please be assured that I will continue to review the situation, and do keep your letters coming.

QUICK TIP

When making the storage case for the parallels in *M.E.W.* No. 13, then if the strips of wood split when fixing them, simply blunt the pointed end of the panel pin. Do this by tapping with a hammer while holding it head down, then there is no need to drill the ½in. dia. hole.
N. Smith

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



Nasmyth's tumbler reverse - in error?

Martin Humphreys writes from Chorleywood to point out an error in the recent article, The evolution of the lathe

In the February/March edition of M.E.W. *I was most intrigued to read the article by Don Unwin on the evolution of the lathe. So much can be learned from historical studies but it can happen that misinterpretations can be made which are subsequently repeated without question. For example, a close examination of James Nasmyth's Tumbler Reverse for Leadscrews, (Fig. 13 p.62 of that issue repeated above - Ed), shows that it merely achieves a reversal of the tumbler wheels themselves since their pivot is apparently in line with their centres.*

Wheels A and D will continue to rotate in the same sense at either extreme of the positions of wheels B and C with a disengagement in the middle position.

It is not likely that such an eminent engineer as Nasmyth would have made such a mistake, so could it be that the diagram shown was for a quite different purpose?

To which Don Unwin replies:-

Thank you for your letter which was passed to me by the Editor of M.E.W.

You are absolutely correct, the device as drawn does not provide reverse to the lead screw. However I can assure you that the sketch came from my copy of James Nasmyth, Engineer. An Autobiography, *Edited by Samuel Smiles, Published 1883. Nasmyth has made a mistake in his sketch, not the only one in the book I'm afraid probably because he was writing so long after the events. Unfortunately it is rather too late to point it out to him now!*

The Drummond lathe saga

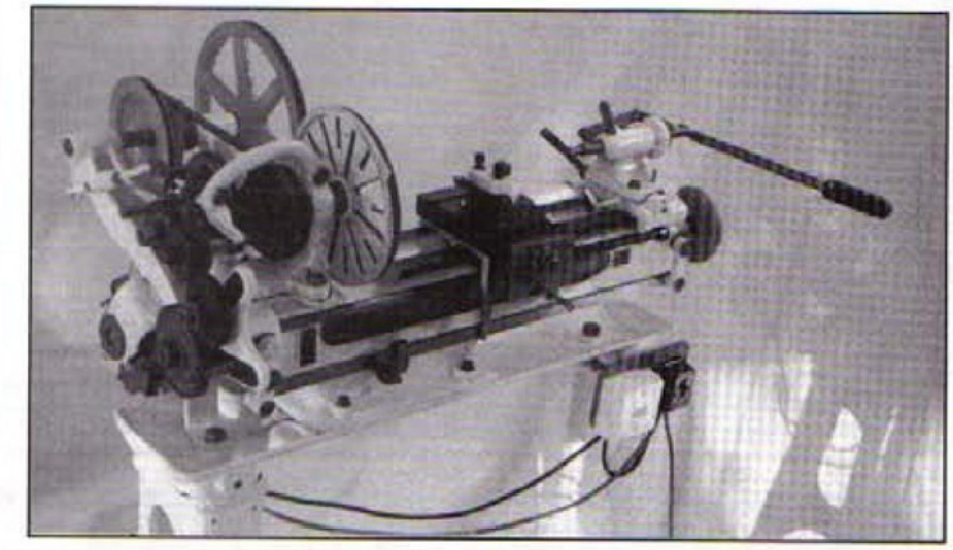
Arthur Whittaker of Southampton has acquired an unnamed lathe which he considers may be a Drummond. However, looking through some old adverts I consider that it may be a Milnes -can anyone solve this puzzle?

As a newcomer to the hobby and to M.E.W. *- a subscription was a very welcome Christmas present - may I join the Drummond Lathe correspondence?*

A few months ago I was given a very neglected 3½in. lathe which I stripped down, cleaned, painted and reassembled. I enclose a photograph of the result.

Despite the absence of a makers nameplate I have been assured that I have a potentially excellent Drummond.

Most components are in reasonable



condition with the exception of the mandrel: there are two, neither of which run true. One is clearly the original but has distorted during weld deposition on the bearing surfaces; the second is an unsatisfactory attempt at a replacement. I have made a drawing from these two to make a replacement but ideally I need machining tolerances and I would like to get the nose dimensions back to original. I also have two sets of plain bearings which have different oil ways: how do I choose which to use? Any helpful comments would be gratefully received.

I have eighteen change wheels in good condition ranging from 20 to 73 teeth all 14 DP.

If anyone has unearthed a copy of an appropriate Drummond manual may I also plead for the opportunity to make a copy of same.

Stainless machine tools - surely not?

Anthony Walton of Tulse Hill, London, whom I met by chance recently has set his heart on a rust free workshop, with tools and machines made from stainless steel. Whilst the trend is for more and more small tools to be made from stainless steel the stainless steel machine tool would seem to be a long way off.

Rust always causes problems in a workshop. There are various solutions, I have set my heart on one in particular. Stainless steel. Let no-one tell me there are other solutions - I know; and I do not want them.

I am hoping for a stainless steel lathe. The biggest problem will be the three jaw self centring scroll keyed chuck. Of large size; for what the amateur wants are small machines but of massive construction; few people want to turn ten foot poles; many want to turn an old car's brake drum. Can any reader come up with any info as to who in the world (Japan included) would supply ex stock, or even (though this is notoriously dearer) make such an article?

On another part of my overall problems could one of your experts (Don Unwin perhaps), write a definitive article on lathe beds? Should they be perfectly flat? unbroken or bifurcated? rounded? have integral vees ? gap beds? etc. Every lathe I look at seems to have a different bed and somebody must know what the absolute ideal is if you can afford to pay for it. Could anyone be induced to tell us, the end users?

Reaming - a matter arising

Hans Rudolf Brenner has written from Hagendorm, Switzerland pointing out an inconsistency in the article on reaming (*M.E.W.* No. 13). I no longer have the author's original text, so I am unable to verify whose error this was - it may well not have been the author's. I feel that the figure of 10% mentioned should have read 1%, but my preference would be to allow a little more than this in the smaller sizes

I hope you will forgive me for coming back to Mr. Loader's article about reaming. After reading that article, I expected that your mailbox would soon be flooded with *letters, but as this seems not to have been the case, I feel I have at least to fill that gap. First I have to admit that I don't see myself as an authority on that subject, insofar as my knowledge mostly comes secondhand from my library and a little only from my own workshop.*

The subject on which I would like to comment in this letter, is the amount of material to be removed by reaming or, in other words, the size of the drilled hole in relation to the reamer's diameter. In his article Mr. Loader states that this allowance should be 10% of the reamer diameter. As this contradicts all I have seen about that, I checked to see what the higher authorities have to say on the subject. This can be expressed in one sentence:

"A reamer is not a tool for bulk removal of but should take only the smallest possible cut!"

Mr. Loader's recommendation of 10% is, in my eyes, certainly bulk removal. I would even go so far as to say that it is almost impossible to enter a reamer in a 10% smaller hole. To stress my point, I cannot do better than to quote one of these authorities. Mr. Ian Bradley, in his book The Amateurs Workshop, *writes :*

"In order to avoid overloading a parallel reamer, and to ensure a smooth finish to the hole, it is important to ensure that only the correct amount of material is left for removal. Manufacturers recommend that this should be from 0.006 to 0.010 in. for reamers up to ½in. and from 0.010 to 0.015in. for reamers from ½ to 1in. diameter."

Expressed as percentages, these values lie between 1 and 2% and this corresponds well with my own experience. For my metric reamers in the same range as above, I drill 0.1 or 0.2mm undersize. Naturally it is necessary to ensure that the drill does not cut oversize! I felt that for the benefit of the so-called tyros I must mention what I consider a rather bad slip in your otherwise excellent journal, and if somebody feels I am completely wrong and Mr. Loader is right, I will be pleased to read his opinion in M.E.W.

An easy intercom unit

Pat Twist of Winchester is another reader reporting a useful buy at a Car Boot sale

With the idea of installing an intercom between my workshop in the garden and my bungalow, I acquired at a car boot sale, two ex-GPO telephones of the dial type.

The two phones turned out to be slightly different but were compatible, they were models 706 PLA 67/2A and 706F FD1.

I found that if the two are connected together matching the coloured leads :- Green to green, Blue to blue, White to white and Red to red with 12 volt DC in series with the red connections, everything works well as far as the speech between the two stations is concerned, but the bells do not ring.

I could not find a way of making the bells work, it is obvious from the construction that the bells are AC (or interrupted DC) and the coils are of very high resistance, and include a magnet. However if you ignore the bells (and the dials) and wire in two buzzers, one in each phone, the circuit is beautifully simple.

You will need two ITT 12v buzzers, No. U5-35R from Greenweld, Maplin, or one of the other large suppliers. These are wafer thin and about 1½n. square, they will have a pair of wires each, a red and a black , and give quite a beep noise connected to l2v but only if the polarity is the correct way round, if no beep reverse the connections (it does not harm them if connected incorrectly).

Open up the two phones, either a single screw at the rear where the leads are, or on some models, undo the two screws located on top, close to the cradle rests.

With the works exposed, you will find two rows of terminals. On my two phones they are numbered like this 1 3 <u>4 5 6 7 8 9</u> 10 11 12 13 14 15 <u>16 17 18 19</u>

On both phones Nos 4,5,6 & 7 are strapped together, so are Nos 8 & 9, also Nos 16, 17, 18, & 19.

On model 706 PLA 67/2A you will find that the 4 wire lead is connected to red No. I, Green No. 2, Blue No. 3, and White to No. 10. Connect buzzer to Nos 2 &3, Red to No. 2 and Black to No. 3.

On model 706F FD! you will find that the red lead connects to No. 1, Green to No. 14, Blue to No. 12 and white to No. 16,17,18 or 19.

It is obvious therefore that you will need four wires to connect the two stations, double twin bell wire will do.

I have no doubt that other models can be made to work, the speech side should work anyway. If the buzzers don't, play around with the buzzer wires dabbing them on the terminals, trial and error. Don't forget that no sound will come if the polarity is wrong, so each dab should be made twice.

In my case I found that if I had my milling machine running or the grinder I could not always hear the buzzer (but funnily enough, if it was "coffee-up" I never missed it) so, although I have the buzzers fixed, I also strung another three wires between stations and made two 12v bells, so each station has a button to ring the bell at the other end, then one lifts the phone to talk.

A reader comments

R.F. Parsons writes from Cowley regarding a number of items which have appeared recently in *M.E.W.*

I was very interested by the article in M.E.W. *No. 16, by Alan Jeeves on Metal Polishing. This is a task which always gives me a problem. Because my workroom is so small I keep both my offhand and tool grinders elsewhere; I do not like the idea of spent grit getting near my lathe or milling machine.*

My late father, a self employed Master Millwright, used a modification of the standard calico mop, which he called an "emery bob". This device was made from the tattiest of polishing mops which he coated with Carborundum powder. Firstly the mop was given a good "graunching" by using it to polish an old half brick. This was done to clean it up. It was then given a thin coat of hot carpenters wood glue on the working faces (Croid Aero glue was the best, after that any fish glue or even scotch or french cake was used). When this was sticky the process was repeated and the gluey surface of the bob was rolled in Carborundum powder. Any loose materials were shaken off and the bob left to cool and set. He used 80 grit for derusting and descaling, 120 for cleaning up and 360 grit for finishing. When he wanted a 'High Finish' he would treat the bob with Russian Tallow, a nasty process as it went everywhere. The bobs were thrown onto the Pig Tails with the spindle still running (do not try it unless you know how, as there is a definite knack to it). When using a newly impregnated bob the operator stood well to one side for the first few minutes, as a shower of loose Carborundum powder obeyed Newton's second law of motion. When a bob was worn out you repeated the bricking, gluing and rolling to give you a new bob. This is much cheaper than using sander belts.

Electric Furnaces

I have bought an Electric Enamelling Kiln, but as it has no temperature controller I am fitting it with a Simmerstat device which can be bought from any electrical supplier for about £5. This will allow me to control the temperature and is cheaper than the very expensive pyrometers. A Simmerstat controls any resistance heater by pulsing the power to the element. You have to calibrate them using pyrometer pencils.

Brass Supplies

Mr Gomme of Wendover should try W. Smith (of Clerkenwell) -usual disclaimer- I think his nearest branch is in Biggleswade, Beds. I use the branch at Theale near Reading.

Small Screws

I sympathize with Mr J. Hotinger (U.S.A.), I use many 10,12, & 14 BA screws in my models if one breaks they are a total pain to get out unless you have a spark eroder. A watch-maker friend showed me a trick involving Ferric Chloride-and nail varnish. You pinch your wife's nail varnish and cover everything around the hole to protect the metal. You then etch the offending screw away with Ferric Chloride. You have to stir the little pool regularly with a pointed wooden match stick. The process takes time but it works especially on hardened steels.

A motor cycle restorer of my acquaintance has built a small "sparky". He powers it with his Mig welder. It is a very Heath Robinson contraption but it seems to work. If any one is interested I will run the rule over it and write it up. He uses it to dig broken studs etc. up to about ⅜in. diameter. I know he only uses it late at night as it seems to spoil the T.V. reception in the house.

Uses for a shaping machine

The shaping machine is a tool which could see more use in the amateur workshop. Derek Walters of Tetbury uses hisi occasionally for its intended purpose, but has found and alternative use for one part of the machine.

I very occasionally use my Adept No. 2 shaper. Recently I wanted the use of a large , wide vertical bracket. Casting around the shop, my eyes fell upon the table of the shaper which I duly removed, then removed its feathered key.

By drilling extra fixing holes it was able to be mounted upon the Myford and the job was completed. It could of course be similarly used on the milling machine, or other lathe.

I wondered if the tip was worth passing on to other readers.

Foot switches

Two readers have commented on the use of a foot switch to control of a drilling machine as mentioned in a recent article. First C.P. Adams of Belfast:-

I am a devoted subscriber and reader of M.E.W. *since the first issue and greatly admire the variety and excellence of the articles, not to mention the mine of information contained in each issue. Long may the magazine flourish and prosper.*

There was one point, however, in the issue for February/March 1993 in the article on the foot switch for a pillar drill that alarmed me.

This was the recommendation of a "push on, push off" switch. The writer, indeed, warned that "should the foot switch be operated in error whilst the main switch is off, the machine will start when the main switch is switched on."

This could, indeed, be dangerous but the problem need never arise if a "push on, release off" microswitch is used. Such switches are available up to 15 amp rating and a switch that comes off when the foot is removed is a much more speedy and sensitive control than the double action required with the recommended switch. The machine only remains running while the foot is down.

(I feel that most readers lathes and milling machines will not be fitted with no volt release starters, so will have the same problem. Provided the foot switch is suitably positioned it should be quite acceptable. However C.P. Adams suggestion of a non-maintained switch is worthy of consideration -Ed.).

And from G.O. Kefford of Dymock:-

Whilst having no intention of detracting in any way from Mr. Coe's excellent article in M.E.W. *No. 15 about a foot switch for his drilling machine, I think that there may be some interest in my own installation.*

Having long had identical thought on the matter, some years ago I at last got around to doing something about it and popped into my local electrical supplier for one foot operated switch. This I found would set me back about £25, when I explained the purpose it was suggested that I need not bother, a good alternative was a pull switch, which for the outlay of a couple of pounds would do the needful.

Suitably chastened at having saved more than £20 I went home to work out how to fit the thing. In case someone may wish to go down this road herewith one or two ideas from my experiences.

There is no switch on my machine which was originally controlled by a switched socket outlet. By disconnecting the live lead from the motor and re-routing it via the pull switch the socket can be retained as a master switch. The pull switch is rated at 6 amps which is more than enough for the ¼ hp motor fitted to my machine.

The switch is foot operated by depressing a pivoted lever on the side of the drill stand, its travel is limited to permit only sufficient movement to operate the switch. this is achieved by stops above and below the pedal. When released it is returned to its normal position by a spring. the cord of the pull switch is connected to the lever, and that's it, press for on - release - and press again for off. Very basic and simple.

If the switch cannot be sited directly above the lever however, achieving the connection may not be quite so easy. I first tried mine using about 10 ft. of Nylon cord around 3 pulleys to change direction from the switch, which was mounted sideways on a roof beam. this due to the amount of stretch under load was useless.

Where the switch is sited is really immaterial as is its attitude, but try to ensure that its operating cord is fairly straight with it, not deviating sharply to one side. Above all do not have the cord hanging by the machine. Any part of the cord which is exposed and could possibly be fouled by anything must be protected by conduit or similar - it can be very dangerous if the drill starts up unexpectedly!

Dovetails and Unimats

Two readers have offered basically the same solution for replacement belts for Unimat lathes, that is to use polyurethane belting. In the first letter from A. Cowie of Withersea, he does admit to the occasional problem with the patented connector. However, Richard Atkins of Wanganui, New Zealand suggests the heat method of joining.

Congratulations to your contributor Mr. D. Scroggins on his brilliant idea for producing dovetail slides. (Top slide for Unimat 3, M.E.W. April/May). I am sure that his idea will be taken up by those of us who prefer to make our own accessories rather than pay the inflated prices being asked for items which are, frankly, no better than we can produce ourselves.

A few years ago, I made a very similar top slide for my Unimat but made the dovetail slides by filing from rectangular bar. This may sound like an ambitious undertaking, but by using the time honoured method of centre popping along the scribed line and filing until only half the centre pop remains, I managed to achieve a very satisfactory result. The top slide and the vertical slide, which I made later, both operate with no hint of tightness or slack throughout their admittedly short traverse.

Like Mr. Scroggins, I encountered problems with the Unimat drive Belts, not so much from slipping, but from fairly frequent breakages. My particular machine also had a healthy appetite for motor brushes. I could stock up with belts from trade stands at exhibitions, but motor brushes were a different problem altogether, and when the originals wore out, I had to wait for six weeks for a new set, ordered through a local Unimat stockist. Later, I found that suitable size brushes could be obtained from shops which specialise in servicing sewing machines. It was however, necessary to salvage the spade connectors from the old brushes and solder them onto the new ones. This was easily done, but resulted in a rigid section in the otherwise very flexible brush lead, and care had to be taken to ensure that this was safely stowed away inside the plastic access bushes in the motor casing, and not allowed to make contact with any metal part. At each change of brushes the motor had to be completely stripped to clean out the accumulation of carbon dust.

The motor eventually burnt out although I had followed the operating instructions and allowed the recommended cooling off periods.

As I was unwilling to pay the very high price of a replacement Unimat motor, just to experience the same problems all over again, I decided to discard the Unimat motor and find something more robust and reliable. To cut a long story short, I made a small layshaft assembly comprising a shaft running in a pair of ball races spaced about one inch apart in a sturdy bearing housing. The housing was flanged and bolted to the lathe end plate in place of the original motor. The pulley was swopped from the motor to the layshaft so preserving the original drive configuration.

A 200w motor was obtained from J.A.Crew & Co. and fastened to the base board behind the lathe, and this drove the layshaft using a flat belt from a domestic vacuum cleaner. A pair of flat pulleys with end flanges were made to fit the motor spindle and the layshaft.

The set up worked very well, but the flat belt was prone to excessive flap no matter what tension was put on it, and it would ride up onto the pulley flanges and drive off these rather than stay on the flat. Turning the pulley to a convex profile similar to a traction engine flywheel kept the belt centred on the pulleys, but it would still fly off at awkward moments.

The solution came on a visit to a shop which specialised in bearings and transmission items, where I saw on the counter several reels of red polyurethane belting of various sizes. This is in the form of thick walled tube and is joined using a metal fastener which is pushed into the bore and is self gripping once in place. I now use this for all the belts on my Unimat.

The cost of the Unimat rubber belt will buy a yard of this tubular belting which is practically indestructible. The 3/16in. and ¼in. belt sections are suitable for the Unimat although I have found that the former will separate at the joint if used on the small pulleys and the latter will not allow the belt guard to close properly if used on the large headstock pulley, but at all other conditions these made up belts give no problem whatsoever. If a belt does separate after a lot of use, it can be remade simply by cutting 1/16in. off the end of the belt to give the fastener some fresh material to grip.

When I made the modification to my lathe the cost of a replacement motor was in excess of £100, whereas the cost of the modification, including motor, was about £10. I now have a lathe which has a useful increase in power, and is never idle for want of spares and could at a pinch, be driven by an electric pistol drill (if I could stand the noise).

I hope that the above may be of interest to Mr. Scroggins, and other Unimat users, and that it may provide a solution to his problem of dirty pulleys and black hands.

(Owners of Unimat SL lathes may be interested to learn of the availability of special belts for these machines. Contact Machine Tool Maintenance Service, Unit B, Sterling Court, Hambridge Raod, Newbury, Berks, tel. 0635 523525. Price is £13.42 per pair inc. VAT and p&p - Ed.).

And from Richard Atkins:-

Mr. D. Scroggins (M.E.W. Apr./May 1993) in describing his Topslide for a Unimat 3 makes reference to difficulties with the drive belts and his recourse to Hoover belts.

The answer is the use of round polyurethane belting, bought by the foot or the furlong. Cut squarely to length, the ends heated on a upturned domestic iron (with permission), when softened brought together with the help of a Vee block. the flash can be removed neatly on the grindstone.

He also makes reference to the need to have correctly ground and sharp tools. The late George H Thomas stressed the need for ground and honed tools. It is wonderful what a piece of ¼in. square. Arkansas stone will do if applied to the vital parts at frequent intervals.

Resolving bandsaw problems

Two readers have had the same problem with the Clarke CBS45MC bandsaw which was reviewed in Issue 16, they have come up with differing ways to combat the problem. In fact it appears that both improvements could be included on the same machine. See also my postscript after the second letter.

The first is from Cyril Drayton of North Ferriby:-

Having recently purchased a Clarke CBS45MC bandsaw I read with particular interest your review in issue 16 of M.E.W. *May I add a couple of points from my experience.*

When assembling the package the question arose at which end should the wheels be fitted. The exploded diagram suggested the heavy end; catalogue illustrations differed on the point. I opted for the heavy end partly because it suited the arrangement of my workshop and partly because it would be easier to lift the lighter end. All went well until one day when I was trying to move the machine it suddenly nosedived and crashed to the floor. Fortunately there was no damage but it was a bit of a struggle getting the thing back on its feet.

At the time the saw overarm was in what I assume is intended to be the parked position, that is one notch up on the support plate. In order to get the wheels fully on the floor and the feet clear a fair amount of elevation is necessary. At this angle the saw arm is not too far from the balance point and it is quite easy for it to tilt over into what would be its vertical position. If it does this the momentum is quite sufficient to overbalance the whole machine. Once this starts to happen it cannot be stopped because the handle collapses. My first reaction was to hastily interchange handle and wheels. This does make things quite safe but in my case at any rate more awkward and heavy to handle. Further thought suggested a number of alternative measures. I selected the easiest. I found amongst my Junk a piece of 1½ x ⅜in. steel, 16in. long. There were already several holes drilled in it evenly disposed about the centre. It so happened that the inner pair were exactly the same spacing as the handle holes on the saw. Two M10 bolts and the job was done. I now had a rigid transverse handle, handle bars so to speak. With the wheels back at the heavy end I can now repeat the conditions which caused the accident without losing control. Few things are perfect of course; although the handles do not project much they are at a suitable height to catch one's shins. This hasn't happened yet. I also modified the support plate to ensure a lower rest angle.

The second point concerns the operation of the saw. I put it to work as received and it functioned correctly cutting through the work and descending on the stop switch with a clunk. However when the guide was moved up to the work as in your photographs 3 and 5 it would barely cut through the workpiece and the cut out failed to operate. this was because the underside of the LH guide was bottoming on the casting and could go no further. Some fairly delicate adjustment was carried out and now the saw will just cut through and the limit switch works, but it is a close run thing.

Mr. H. Killingback of Oakham writes:-

I was very interested to read the excellent review on the Clarke Bandsaw in M.E.W. *April/May issue. Other readers may be interested in a safety problem (which I discovered the hard way!) and the approach that I've adopted to solve it.*

I bought mine from Machine Mart last October, it was already fully assembled (being from their display). The wheels were mounted at the motor end. This is in accordance with the assembly instructions drawing.

As you note the machine has to be tilted to bring the wheels into contact with the floor. I found that I had to tilt it quite a lot to prevent the stand scuffing the floor, and perhaps a bit more to manoeuvre it into a tight space, when crash, the weight of the overhung motor caused the saw part to swing over bringing the whole lot down onto the ground.

An obvious answer would be to fit the wheels at the end opposite to the motor, an illustration of this configuration was shown in your article. One does then have to carry more weight when moving the saw as the handle is now at the heavy end.

As mentioned in your review the frame is rather flimsy, and having experienced one overturn, I was worried about the possibility of the saw overbalancing when used in the upright position. I therefore tackled both problems by fitting wooden rails, one each side, bolted to the left and right hand legs. The length of these was sufficient to protrude beyond the legs on the motor end, thus extending the base and making the saw less likely to overbalance. The wood I had handy was 4 x 1½in. in section and it protrudes 5in. beyond the motor end leg. I made the wood a bit lower than the feet of the stand. I have found that the resultant increase in rigidity is well worth the little trouble it took.

Congratulations on an excellent magazine.

The following are a few comments regarding the above letters.

The photograph showing the wheels at the non-motor end was provided by the supplier; in fact the review machine was assembled according to the instructions, as were the two readers machines: that is; with the wheels at the motor end.

The ability to park the saw, as Mr Drayton describes it, in a semi-raised position is for the purpose of allowing the length to be cut to be set and the vice tightened, without the need for the operator to hold the saw in a raised position. When the saw is being moved the saw should be in its lowest, that is cutting position for maximum stability.

The review did comment on the fact that moving the machine on a rough concrete garage floor was less than ideal, but considered that for use on a smooth floor it was adequate. It is therefore up to the reader to decide whether the above changes are worthwhile in their individual circumstances. As all makes of this type of band saw are of a very similar construction, it is likely that they will all suffer from this problem to a greater or lesser extent.

As with Mr. Drayton's saw, the review machine did require precise adjustment for it to cut completely through the workpiece when the guide was extended. Do not attempt, at the expense of accuracy, blade life and safety: to operate the machine with the guide not extended when cutting narrow items, thus avoiding the need for this adjustment.

Copying attachment for a Hardinge lathe

I doubt, but I may be wrong, that any reader will have the experience in their home workshop activities to answer these questions, posed by Andrew Ward of Swadlingcote. However, has any reader had involvement with such equipment in industry, and can as a result help Andrew?

I have bought from my present employer a Hardinge centre lathe with which they let me have a Mimic UT Tracer, an American copier. Having set the tracer up I have had some problems getting it to respond to changes in patterns. When switched on the tool moves forward and stays there. I think the problem is in the solenoid.

Could any of your readers help in letting me know just how this thing should be set up? It may be that I have done it wrong, alternatively does anyone know where, or how, I can get it tested?

Don't fall foul of the law!

Terry Gould of Shrewsbury suggests that you check legal and insurance requirements prior to adding welding gasses to your workshop equipment

I saw in issue 16, your request for an article on the use of gas for welding etc. I have been working with gas for the past 20 years or so at home and professionally.

I often wonder how many others in our hobby use gas at home, other than domestic or butane. The regulations covering the other gases, especially oxygen are becoming very tight, covering their use and storage; to get a gas bottle filled and to get the gas bottle in the first place one has to be registered. Before you can be registered you must have your premises inspected by the fire service. If, and a big if, your domestic location, where you intend to keep your gas bottles is O.K. then they will issue you with a ticket to say so, then you can be registered.

If your workshop is a wooden shed, this is a non-starter. I am not trying to put anybody off.

There is another aspect of using or keeping gas on domestic property, and that is insurance.

After a conversation with my insurance man , I have recently discovered that my house insurance is not valid, all because I keep gas bottles in my workshop. The workshop is alongside the house and is part off it. There is one exception, that is the storage of oxygen for medical purposes. A note from your doctor is required for this purpose.

Whilst trying to obtain further information on this matter of insurance I also find that I am not allowed to keep more than 2 gallons of inflammable liquid in or on the property; i.e. petrol, paraffin, etc, without it affecting the insurance, although it seems O.K. to put a car in the garage/workshop with more than 2 gallons of fuel in the tank!

I have also tried to get in writing what I can and cannot have (so has my insurance man) in the workshop, they seem very reluctant to assist me in this fashion.

Is this a one off case, do you have any readers who are into insurance who could shed more light on this matter? How many people have looked into this side of it, I *only found out by way of a chance conversation.*

Please don't let this put anybody off, the Fire Prevention Officer was most helpful, he was the first person I had to see.

Specifications

Allan Jeeves of Huddersfield gives us some thoughts on materials and specifications

Richard Gommo (Scribe a Line, issue 16) and other newcomers to engineering, model or otherwise, often have difficulty in obtaining the correct material for the job or have some difficulty in obtaining the correct material in the correct condition. Many suppliers of materials are unable to help with specifications of materials and selection can be quite confusing to the novice. In Richard's case I think that much of his problem can be overcome by annealing the brass rod. As it is only ¼in. dia. it can be heated quite easily with a blow torch and successful results should be obtained. The rod is heated to a temperature of around 540 deg.C, when it will appear dull red in colour. At this point it is plunged directly into clean, cold water when once cooled it should be in an annealed state, and thus bendable.

Depending upon how much bending is to take place will dictate as to whether further annealing will be required. (brass work-hardens easily due to bending).

This highlights the Editor's proposal that an article dealing with gas torches might be considered and prompts me to suggest that an easily understandable brief article on British Standards may be of value to a large proportion of the M.E.W. *readership. Such an article could have the effect of providing a starting point for investigating the specifications of different materials; i.e. the relevant British Standard.*

This is what standards are for, they are not out of bounds to amateurs.

(The points raised in this letter will hopefully be covered in a number of articles which are planned for future issues of *M.E.W.* - Ed.).

An answer to the Editor's problem

David Dew of Mykits, Kings Lynn, Norfolk solves the problem relating to the use of the lower Tee slots on the dial test indicator base featured as a constructional project in issue 17 of *M.E.W.*

You queried the use of the lower tee slot in the dial test indicator base. This was described in the June issue as a milling feature. As it's use was not indicated the slot was not machined. "Ah" says I. "Mine 's not like that, mine has a vee groove." (1½in. across the top on a 2½in. base width.)

This thus solved your problem - the drawing was wrong. But a check in an old Buck & Hickman catalogue showed that it wasn't, merely that all the accessory pieces had not been shown. To quote:

"A tee slot block which fits in the bottom tee slot: either across the base or longitudinally, to act as a guide for working along the edge of marking out tables, machine beds, etc. price..."

I acquired my base secondhand many years ago and had never fathomed out the use of the vee guide, there being no rotational stop. Perhaps it was an apprentice piece. I used to use it as a very robust scribing block, but it has been gathering dust for some years. I must now remember there is an accurate vee block 10in. long which will take 1½in. dia. when I need it!!

Scrap Boxes and their contents

P. Bryan of Jersey makes a useful suggestion, all ideas received in answer to this one will be published

I am constantly amazed by what some of your correspondents are able to find in their scrap box. The time can surely not be far distant when one of these gentlemen will claim that all the materials to construct a Gipsy Major aero engine were to hand. My experience is to the contrary. Bits available are always too small.

On a more serious note would it not be possible to compile a list of useful articles that could be found on a scrap heap perhaps, or available in shops and which could be modified or indeed vandalised to get the desired piece of metal. To give just one example: bicycle cranks provide a source of aluminium bar. There must be countless others. Your readers might like to contribute their ideas.

A poem - re metrication

Albert Wallis has sent this poem which indicates that the thorny question of going metric is far from a new one. He also provides the first suggestion for P. Bryan, as requested in the preceding letter.

In the recent M.E.W. Jonas Beausang in Scribe a Line mentions the use of more metric systems and I wondered if the following poem might be of some interest, bearing in mind that I copied it from a book of poems written by W.J. Macquorn in 1850.

The Three Foot Rule

When I was bound apprentice I learnt to use my hands,
Folk never talked of measures that came from far off lands,
Now I'm a British workman too old to go to school,
So whether chisel or file I hold, I'll stick to my three foot rule.

Some talk of millimetres and some of kilograms,
And some of decilitres to measure beer and drams,
But I'm a British workman too old to got to school,
So by pounds I'll eat and by quarts I'll drink, and work by my three foot rule.

A party of astronomers went measuring of the earth,
And forty million metres they took to be its girth,
Five hundred million inches though go through from pole to pole,
So let's stick to inches, feet and yards and the good old three foot rule.

The great Egyptian Pyramids a thousand yards about,
And when the masons finished it they raised a joyful shout,
The chap that planned that building I'm bound he was no fool,
And now 'tis proved beyond a doubt he used a three foot rule.

Here's a health to every learned man that goes by common sense,
And would not plague the workman on any vain pretence,
But as for those philantropists who'd send us back to school,
Oh, bless their eyes if ever they tries, to put down the three foot rule.

I am like most readers I am sure, they scrounge odd bits of steel perhaps from the local scrapyard. This is all very well for some jobs, but if it is for any item that takes a lot of strain it could, to say the least, be very dangerous. For many years I have been rebuilding Brough Superior motor cycles and for the front fork pins, wheel spindles and fork spindles on which one's life may depend I go to the car breakers and get an old car half shaft, this can be turned without annealing if one uses a tipped tool.

A mystery lathe

Can anyone help Mr. M.A. Yallop of Beccles to identify the lathe shown in the photograph?

I enclose a photograph of a work colleague's lathe. It has no name or identity number. It is need of new bushes, but without a maker's name we have no idea as to who to approach.

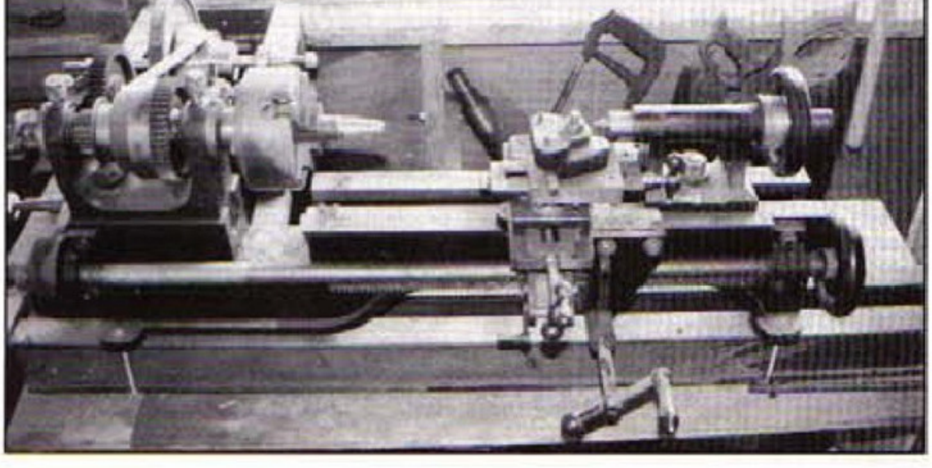
Several thoughts have gone through the grey matter, bushes no longer available - is the shaft worn so badly as to be irreparable - turn up special bushes, then overcome the problem of in line reaming etc.

However any help with identification of the machine, and any possible sources of spares would be much appreciated.

Tooling identified

George Swallow of Dorking offers some

The mystery lathe queried by Mr. M.A.Yallop.



more detail regarding the items seen in Geoff Walker's workshop in our last issue.

I am writing mainly to remark on the June/July issue of M.E.W., *which surely must be the best there has ever been. (I am almost sorry I already have a wood-planer). Having built a Dore Westbury miller myself in five months with midnight oil, I am amazed to hear of it being done in two weeks. I recollect spending almost that time on the spindle, which starts out as a 1.25in. bar and finishes at ⅝in. for about two thirds of its length. The nose was my very first screwcutting job!*

In the visit to Geoff Walker's workshop you did not mention that the design of the Swing-clear toolholder was by Martin Cleeve, a distinguished contributor to M.E. *on workshop equipment for many years. This toolholder appeared in* M.E. *no less than three times, in* E.I.M. *twice, and was later marketed ready-made; it was also available as a kit of materials. I made mine from the latter in 1984, and Geoff Walker's version looks like this later design.*

Its great virtue is not for screwcutting as shown, but for boring out tight-fitting cavities for ball-bearings; getting it out of the way to do the measuring of the last millionth is a great advantage.

Wanted - help on a knurling tool for a Raglan lathe

Mr. Bennet of Brownhills asks for help:-

Do you think you could run a small article on making a knurling tool for the 3½in. lathe (Any offers? - Ed.). *I would prefer one running from the toolpost.*

Has anyone got any spare changewheels for the 5in. Raglan lathe? (Perhaps we could assist if we had details of gear DP, width, bore etc. - Ed.). *I would just like to close by saying how much I enjoy* M.E.W.

White metalling in industry

R. Welsh of Newbury comments on White metalling from his experiences in industry

After the war I worked in a small shipyard where vast quantities of White Metal (Hoyts No. 11 was melted down over two blacksmiths forges. Two were used for continuity of melt. Some of the larger crosshead slipper guides took about 1 cwt of metal each.

To obtain the correct temperature for pouring the melt a strip of newspaper folded to keep it straight was used. It was dipped into the molten metal; when it was scorched to light brown the metal was ready to pour.

The machining was carried out on an Archdale Radial Drill using a flycutter with Wimet tipped tools - carbide tools were in everyday use in those far off days!

Any ridges left after machining were hand scraped prior to re-assembly.

This type of heavy engineering seems to have passed into history. (Largely, but not entirely - Ed.).

File storage

This useful idea for the storage of files has been sent in by J. Refson of Thurso

I read Mr. Loader's article on Files and Filing *in* M.E.W. *with great enjoyment and not a little envy at his skills in this aspect of our shared hobby. I note that in his article he mentions his "cooks knife block" type of file tidy. I had a similar problem and toyed with a similar solution, but found the idea of cutting a couple of dozen long rectangular holes in a large block of wood quite daunting. On the other hand a rack, whilst easier to make takes up too much wall space.*

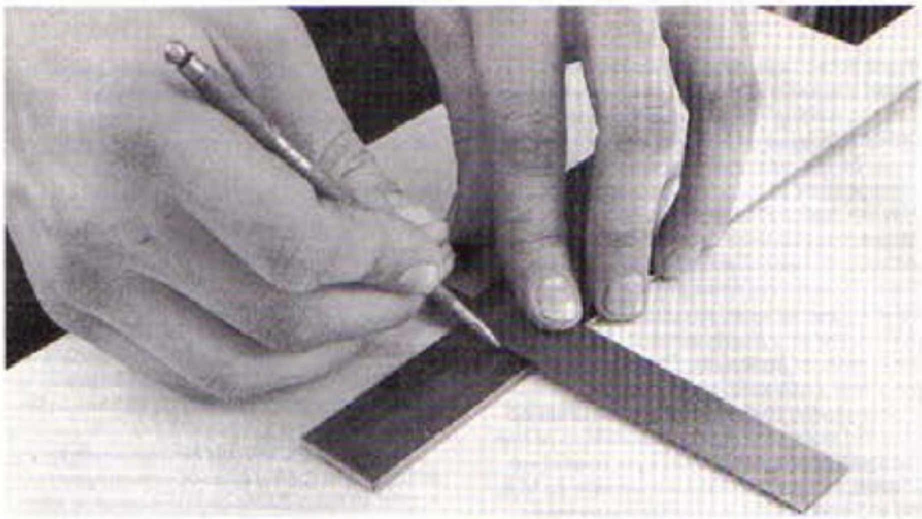
However I eventually arrived at a successful lazy man's solution, which I thought may be of interest to other readers.

I made myself a fabricated stand from a bundle of 15 tubes but from 32mm bore plastic plumbing pipe, the type used for wash hand basin drains. These were assembled into 5 horizontal layers of tubes, arranged in a rectangular matrix with all the tubes flush at the front end. The bottom layer has 12in. long tubes to accommodate the largest files, whilst the others comprised 10, 8, 7, and 6 in. long tubes respectively for the 2nd, 3rd, 4th and 5th layers. For convenience in construction, and because I had some to hand I cemented all the tubes together along their line of contact using plumbers PVC solvent cement. The complete bundle was then encased for rigidity in a glued and screwed frame made from 12mm plywood, about 8in. deep, with its front edge flush with the front of the tube bundle.

This produced a very compact and portable holder, only 8in. tall by 5in. wide with individual usable spaces within and between the tubes for at least two dozen files of various lengths and breadths.

I find its portability quite useful as it can be stored out of the way in a cupboard or corner when not in use.

Please keep up the good work with M.E.W. *a truly excellent magazine.*



Louis Parke offers some sound advice on marking out, of particular interest to those readers new to workshop activities. However, the experienced should still read on

WORKSHOP BASICS FOR BEGINNERS

On looking through the pages of any issue of *Model Engineers' Workshop* readers will soon notice that a wide range of projects is covered. These may be quite complex ones possibly taking several weeks to complete; on the other hand they may be quite simple designs needing but a few hours to make and which could confidently be undertaken by a beginner or less experienced worker.

In his editorial in an earlier issue of the magazine our editor writes that a large number of readers wish to see articles written with the beginner especially in mind. For some time I, too, have felt that the less experienced worker might appreciate some notes on basic workshop processes. Perhaps if I and other authors contribute in this way we might even attract new recruits to the ranks of our fascinating (and sometimes exasperating) pursuit. Almost 60 years ago, as a teenaged beginner, I now recall how much help I received from the many instructional articles published in *Model Engineer.*

thereof. The other system, a metric one, uses millimetres, a one thousandth part of a metre (about 39in.) for the kind of small measurement with which we are concerned. This is the modern system and now largely taught in schools. There is no doubt that eventually the Imperial system will become quite obsolete, but resistance to change is great. As these notes are intended to be mainly practical I do not propose to embark on a discussion about the merits or otherwise of either system. At the same time I do feel that practical information should be leavened with discussion or opinion if it adds to a better appreciation or understanding of the topic being dealt with. I would welcome, via the editor or *Scribe a Line,* any comment on this view.

To return to practicalities, I suggest that the beginner, who may be building up a basic kit of tools, should buy two rules, one with metric graduations and one marked in Imperial units. A convenient length is 150mm long for the metric rule and 6in. for

twice the value of the previous one. Some rules are available with 1/100in. markings but I consider these to be of little assistance: below 1/64in. other means of measurement are called for.

To complete, at least for the present, the list of items needed for marking out, or marking of as it is sometimes called, we should add a 6in. engineer's square, a scriber, a small centre punch and a 4oz. engineer's hammer. This is rounded at one end and is known as a ball pein hammer. The engineer's square should be of best quality you can afford, e.g. Moore & Wright. In addition you will soon need to purchase a pair of 4in. dividers for marking off circles and arcs. A protractor will also be needed but an ordinary plastic school one will suffice for the present. The final item needed is some layout blue and/or a spirit-based fibre tipped pen with a broad tip. These two items can be used to coat bright metal before scribing a line and this enables the line to stand out clearly.

Take great care of your engineer's

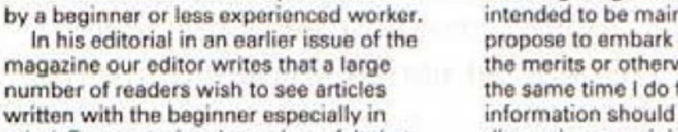


FIG 1a WITH SQUARE TURNED THROUGH 180° LINES WILL BE PARALLEL, AS SHOWN, IF SQUARE IS ACCURATE. ©

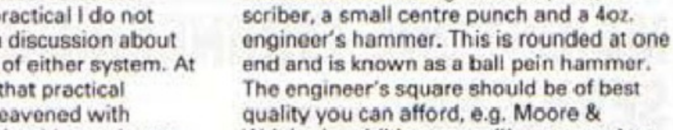


FIG 1b WITH SQUARE TURNED THROUGH 180° LINES WILL DIVERGE, AS SHOWN, IF SQUARE IS INACCURATE. ©

Marking out

To start at the beginning let's think about measuring and marking lines on hard materials, usually metal in our case. As far as measurement is concerned we at once run into a slight complication because a dual system operates, especially in the field of model engineering. The old system, which I expect will be the most familiar one to the older members of our fraternity is known as Imperial measurement and which is, for our purpose, expressed in units of feet and inches and fractions

the Imperial one. Get rules with clearly engraved graduations. A useful addition is a thin flexible 4in. type – **Photo 1** shows all three.

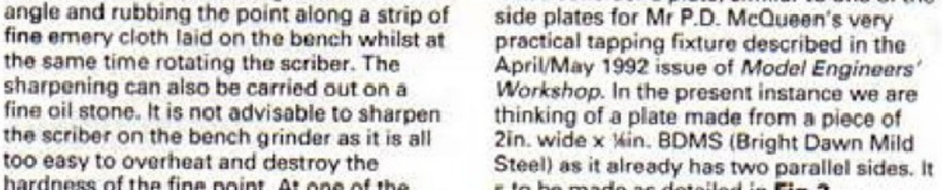
The tools

The metric rule is, of course, graduated in millimetres and often ½ millimetres, but the Imperial one has various graduations from 1in. downwards. The smallest graduations are usually 1/64in. followed by 1/32in., 1/16in., 1/8in., 1/4in. and ½ inch. It will be noticed that each fraction as it ascends is

square and try to avoid dropping it especially if your workshop floor is of concrete. Squares are of little use if blade and stock are not at 90 deg. and adjustment is not easy. To check the accuracy of a square use it to scribe a line on a piece of material with a true edge. Turn the square through 180 deg. and scribe another line on top of the first one. If the square is accurate the lines should coincide. If the square is inaccurate, however, the lines will diverge. **Figs. 1a** and **1b** will make this clear.

Many, if not all, the designs in *Model Engineers' Workshop* need a good standard of workmanship if they are to be entirely successful. This is not too difficult to achieve if we are prepared to take pains and work as carefully and accurately as our experience will allow. We shall also gain in terms of job satisfaction when we are conscious of a task well done.

Scribers blunt quite quickly, especially on harder metals, but they can be kept in good condition by inclining at a suitable angle and rubbing the point along a strip of fine emery cloth laid on the bench whilst at the same time rotating the scriber. The sharpening can also be carried out on a fine oil stone. It is not advisable to sharpen the scriber on the bench grinder as it is all too easy to overheat and destroy the hardness of the fine point. At one of the model engineering exhibitions I purchased quite cheaply a scriber with a tungsten carbide tip. This stays sharp for a considerable time but does require a green stone on which to sharpen it when this eventually becomes necessary.



Three examples of rules – all are extremely useful in the workshop.

Although the centre punch has a much more oblique point than has the scriber it too should be kept in a sharp condition. This can be done on the fine wheel of the bench grinder. Be careful not to overheat and dip it in water frequently so that the hardness is retained. A small bracket with a vee notch can be attached to the grinder to support the point when sharpening. The point must, of course, be rotated while in contact with the wheel.

Imperial/metric conversion

Before going on to a practical example of marking out a brief note relating to metric and Imperial measurement may not come amiss. It is useful to remember that 1mm is almost 0.040 inch. Memorise this; it is most helpful when making conversions. Here is a practical example. You need to make a clearance hole for a piece of 3mm dia. rod, but you have no 3mm drill. What fractional drill can you use? First find approximately how many thousandths of an inch there are in 3mm by multiplying by 0.040 inch.

$$3 \times 0.040\text{in.} = 0.120\text{in.}$$

⅛in. equals 0.125in. and this fractional drill is the one to use. One soon learns the decimal equivalent of engineering fractions and many suitable tables are published.

If, however, you wish to find how many millimetres there are in a certain fraction you simply divide by 0.040. For example, how many millimetres are there in ¼ inch?

$$\tfrac{1}{4}\text{in.} = 0.250\text{in. Then } \frac{0.250\text{in.}}{0.040} = 6.25\text{mm}$$

Note that the answers given above are approximate because 1mm equals 0.039372in. and not 0.040in., which is near enough for most purposes.

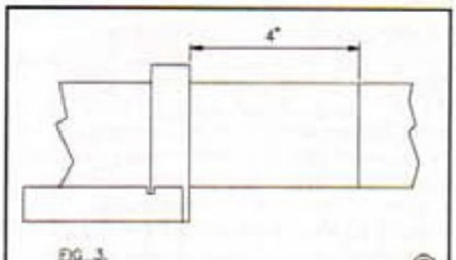
As a practical example of marking out and preparing a piece of metal for drilling let us consider a plate, similar to one of the side plates for Mr P.D. McQueen's very practical tapping fixture described in the April/May 1992 issue of *Model Engineers' Workshop*. In the present instance we are thinking of a plate made from a piece of 2in. wide x ¼in. BDMS (Bright Dawn Mild Steel) as it already has two parallel sides. It s to be made as detailed in **Fig.2.**

1) Remove any oil or grease from the plate and with a fine file take off any blemishes or burrs. (Burr = a rough raised edge).

2) Coat with marking out blue and position the square near one sawn end and scribe a line with one single stroke of the scriber. Be careful to keep the stock of the square firmly pressed against the material. **Photo 2** shows how the scriber should be tilted so that its point makes close contact with the blade. This line is called a datum line, i.e. it is a reference line from which other measurements are made.

3) Turn the square through 180 deg. and establish the length of the metal required by sliding it along the metal for a distance of 4in. and scribe a line as before, **Fig.3.** Be careful to hold the rule parallel to the edge of the metal so that the length is accurately measured. The rule itself should be tilted on its edge to enable it to be accurately set to the datum line.

4) Mark a centre line through the length of the metal by measuring 1in. up near either end, scribing a small line and joining them up. *(When using the rule it is safer to measure from a convenient point, i.e. 1in or 10mm. This will eliminate one chance of error, very often the end of a rule becomes slightly damaged and therefore inaccurate. – Ed.)*



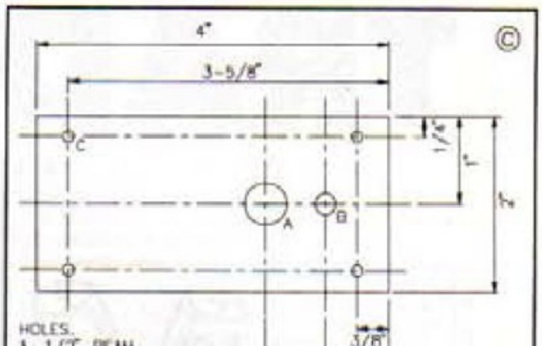
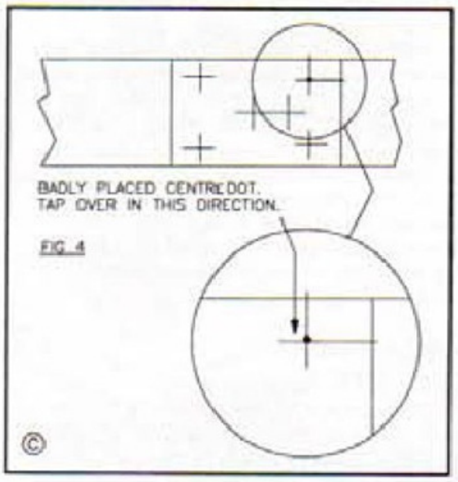


FIG. 2 MILD STEEL PLATE.
NOTE, ALL HOLES ARE DIMENSIONED FROM COMMON DATUMS, THAT IS EDGE AND END, MARK OUT IN A SIMILAR MANNER

5) Mark the centres for the various holes. Short vertical lines are scribed at the spacing shown. When a series of lines is to be marked out always measure each one separately from the datum line. This is to avoid any cumulative error which could arise if you measured from each line as you go along. Mark off the horizontal centre lines from the edge of the metal.

6) Centre dots are now needed where the holes are to be drilled. Gently move the point of the centre punch across the surface of the metal until you feel it make contact with one of the centre lines. (The punch must be sharp). Now slide the punch along the line until you feel it enter the point where two lines cross. Holding the punch quite vertically give it a *light* blow. Check that the dot it has made is in the centre of the cross lines. If it is, deepen the dot with two more blows to the punch. Should you be unlucky and have a slight error hold the plate in the vice and with the centre punch and hammer gently tap the dot until it is drawn over to the right position, **Fig. 4.** This changes the original



dot into a small groove and it must be made circular again by holding the punch vertically and giving it one or two heavier blows. But the aim should always be to get matters right in the first place.

Acknowledgement

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TRADE COUNTER

A first look at products which may be new to you

Patent connector for use with tubular Redthane

Redthane belting

Polyurethane belting supplied by PFL of Birmingham is available in a number of sizes. There are five tubular sizes from 3/16in. to 1/2in. and in solid, three sizes from 5/16in. to 1/2in.

The five tubular sizes are likely to be of the most interest to readers of this magazine and these are, 3/16in. and 1/4in. for low power drives. Also available 5/16in. which can replace most "M" section vee belts, similarly 7/16in. to replace most "A" section vee belts and 1/2in. replacing most "B" section belts.

The belting is purchased in lengths and cut to length and joined, either with patented joiners or simply using heat as follows:

Using Joiners

Check length of belting, reduce value by 7%, (7/8in. per foot) and cut to length.

Using long nose pliers, insert fastener into tube, taking care not to damage the flange.

Insert the fastener into the tube at an angle and "walk" it in until completely home.

Insert the fastener into the other end of the tube using the same principle to form an endless belt.

Stretch on to pulleys

Where fitting a belt may often necessitate some dismantling of the machine, using this form of belting it can be achieved without this requirement, making the belt in situ.

Using heat

Cut belt to length as above.

Press both ends onto the heat source and melt back 1mm. Press ends of belt together and hold for one minute.

Use a vee block or a short length of angle iron, or similar, to assist in alignment.

Grind or cut off the flash.

Leave for five minutes before stretching belt over pulleys.

For more details of the product and location of your local stockist, contact: Polyurethane Products Ltd, Alfred Road, Sparkhill, Birmingham, B11 4PB Tel 021 772 0669.

Engineering fastenings

Obtaining engineering fastenings in small quantities can be a problem; one company that can go a long way to solving this problem is Screwfix Direct. This company has been trading for some 20 years and whilst its latest catalogue, its 31st, deals mainly with items more related to building and DIY activities, it does have four pages of machine and high tensile screws, nuts, washers and studding.

Sizes range from M3 to M12 and lengths

are typically from 8mm to 20mm for M3 machine screws through to 50mm to 150mm for M12 high tensile bolts. Machine screws (M3 to M6) are available in quantities of 25 and 100 (25 x M3 x20 long £0.47 +VAT) whilst high tensile screws (MS to M12) are available in quantities of 10 and 100 (10 x M6 x 50 long £0.95 +VAT).

More unusual items are available such as penny washers, large washers with a small hole, from M5 to M10 in quantities of 10 and 100. Nylon lock nuts are available from M3 to M12 with the smaller sizes available in 100 quantities (100 x MS £0.73 +VAT) and the larger sizes in 10s and 100s (10 xM12 £0.89 +VAT). Studding is available from M4 to M12 and in lengths of 300mm, quantities are 1 off and 10 off (1 x M4 £0.41 +VAT, 1 x M12 £0.76 +VAT) Other items include wing nuts, blind rivets, hacksaw blades, and Wet and Dry abrasive papers. However, the bulk of the items, as indicated earlier, are building based, including a very wide range of wood screws and similar, nails, hinges, catches, knobs and many others.

There is no minimum order charge but there is a delivery charge of £3.50 for orders under £40-00. The prices quoted above are typical examples.

For a copy of the free catalogue send to, Screwfix Direct, 15 Oxford Road, Pen Mill Trading Estate, Yeovil, Somerset, BA21 5HR. Tel 0935 414141, Fax 0935 32375

Edding 850 Marker

This makes an ideal marker for metal when carrying out marking out operations. It has a felt tip 10mm x 17mm which makes surface marking a rapid operation. Its dries almost instantly and the marker is refillable. These types of markers are sold in all good stationary suppliers, however this larger size may be more difficult to find. It can be obtained from Tilgear, Bridge House 69 Station Road, Cuffley, Herts, EN6 4TG. Tel 0707 873434.

Metal finishing in small quantities

A company prepared to carry out metal finishing in small quantities is Doug Taylor

Metal Finishing Co. They are of special interest to the Vintage and Classic enthusiast, carrying out such activities as metal polishing and plating in nickel and chrome, also lacquering. However they also carry out other plating such as zinc.

The company is prepared to plate small quantities and has no minimum order charge, for details contact:

Doug Taylor Metal Finishing Co, Unit 7, Knighcott Industrial Estate, Banwell, Avon, BS24 6JN. Tel. 0934 820454 (Evening 0934 510706)

New manuals

Users of Rishton Vertical Milling machines may be interested to learn that new user manuals have been produced for the VM60, VM45 and Promil 35 machines, which have also now been redesignated VM601 VM451 and Promil 351.

Whilst not pretending to be an authoritative work on the art of milling, the new manuals contain a number of useful hints on machine use, materials and the thorny subject of speeds and feeds. Also details for the setting up, operation, maintenance and fully detailed exploded views.

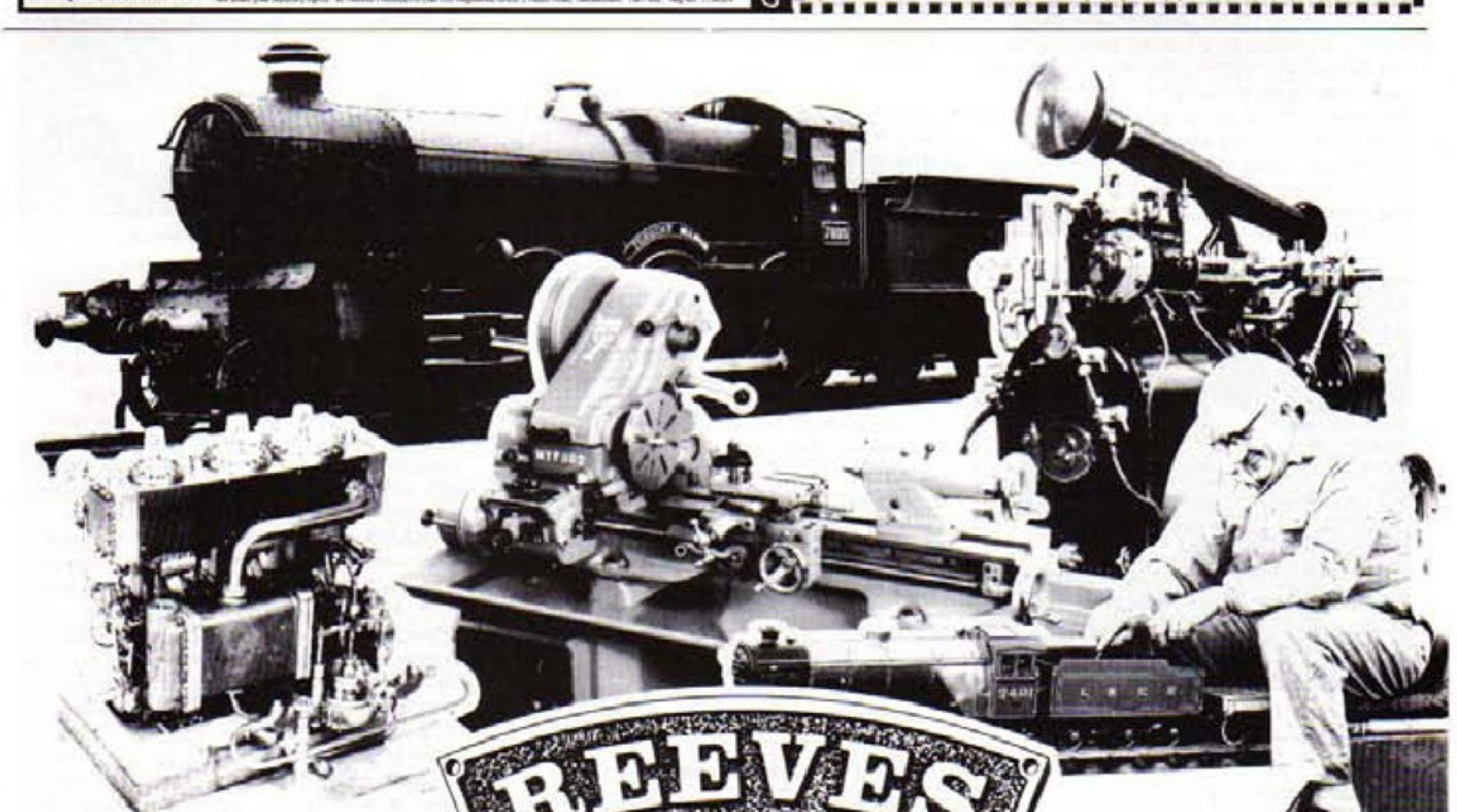
Complimentary copies will be sent to those who have purchased a machine in the last 12 months, other owners can obtain a copy price £6-00 for the VM60/45 manual and £3-00 for the Promil 35 manual, prices include postage. For further details or to place an order contact:

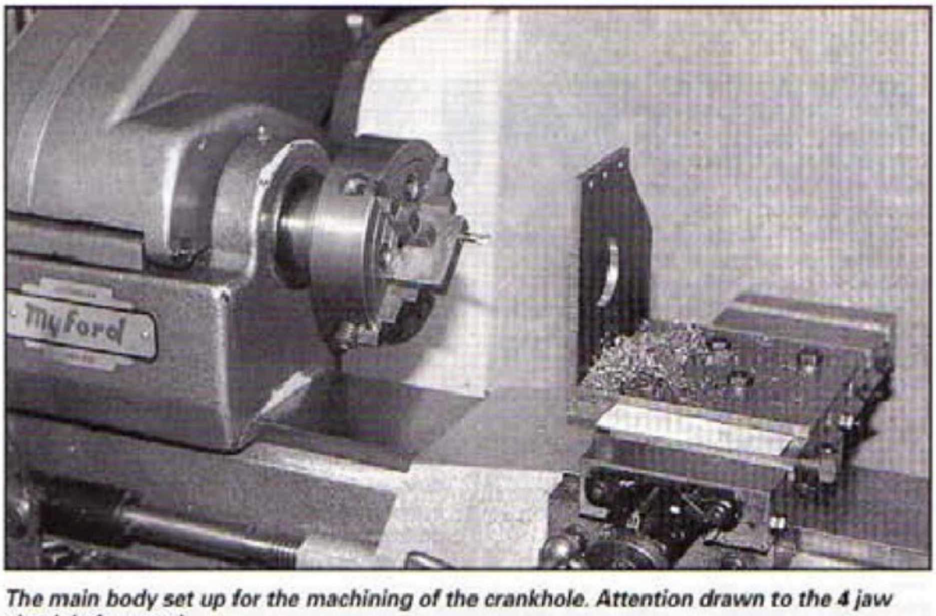
Precision Engineers Limited, Mary Street, Rishton, Blackburn, BB1 4RF. Tel 0254 888001.

New Catalogue

The latest catalogue (number 27) is now available from J.A. Crew and Co. This catalogue with a very wide range of items, includes raw materials, hardware items, small tools, electrical and electronic components. Purchases are by mail order only. Orders are accepted from overseas customers. Payment can be by credit card. For a copy of this latest catalogue send £1.00 in stamps to:

J. A. Crew and Co, Watery Gate Farm, Dovers Hill, Chipping Campden, Gloucestershire, GL55 60U. Tel 0386 841979





The main body set up for the machining of the crankhole. Attention drawn to the 4 jaw chuck being used.

A LATHE MOUNTED FRETSAW

Bob Fletcher made this lathe mounted fretsaw and provided this article as a result. However, looking at the design it would be relatively easy to motorise and make it a free standing independent machine should any reader prefer to adopt that course of construction

I must admit that for a long time I was of the opinion that a fretwork machine did not have a great role to play in the field of model engineering. When one desires to produce articles to intricate shapes there always seemed to be other ways of doing the job.

One day I was asked by a friend who had just moved house if I could design and make a brass name plate for his new home, something a little different than those commercially available at the local D. I. Y. store, in other words, a one off. After some hours on the drawing board I came up with a design which required the letters interworked in a lattice pattern, cut out of brass and mounted on a mahogany board. Quite a few hours with a coping saw and Swiss files etc. were spent in making the brass plate which was then mounted on a piece of mahogany. Although my friend was highly delighted with the finished item, I had the feeling that it did not justify all the time it had taken to produce. I began to think that if I had been in possession of a small fretsaw the intricate shapes on the brass plate could perhaps have been cut out in one workshop session; also there could be a few items made more quickly in my model engineering activity. I started to look around for the availability of such machines on the commercial scene. I found that there are quite a few very good machines on the market but in what I term as true home workshop fashion I examined the possibility of making one before buying one ready made.

The completed machine set up and ready to be used.

The design

There were two possibilities at the design stage, one was a free standing machine in its own right, and two, an add-on accessory to the lathe. I was still of the opinion that the machine would only have occasional use, but would be useful to have around when needed hence I concentrated on a machine which would mount on the lathe cross slide and take its drive from the three jaw chuck.

I have three lathes a Zyto, a Myford Speed 10 and a Harrison. The Zyto was considered to be limited in it's centre height although it does have a gap bed. The cost of running the 1½ h.p. electric motor on the Harrison just to drive a fretsaw did seem a little excessive, hence the choice fell on the Myford Speed 10.

Dimensions given are for this machine, but can be varied to suit individual requirements, as can the throat depth to suit your own requirements.

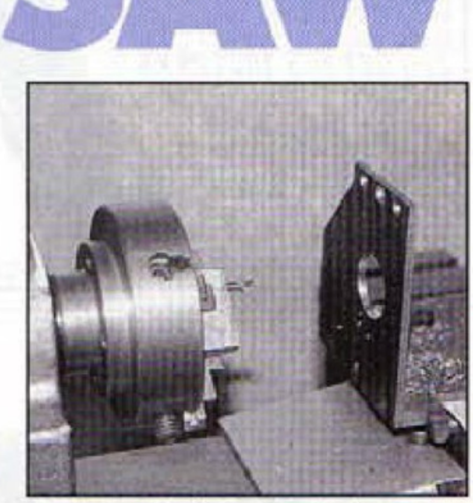
Just a word of caution, it may not be just a matter of making the frame arms longer, doing so could have an affect on the frame support. For example if the arms are increased in length by 4in. or more it may be advisable to increase the thickness of the support arm to the next stock size of ⅝ x ⅜in. and the support end plate from ¼in. to 5/16in. also the hind roller from 3/16in. to ¼inch. What I wish to say is that if one part is altered it could have a chain reaction effect on other components of the machine.

Please do not let the foregoing put you off, just consider the consequence of your actions in the interest of safety. With a little thought the machine base could be mounted on a suitable board driven via pulleys and drive belt through an electric motor mounted to the rear of the machine, making a free standing fretsaw. A suitable ratio would have to be worked out for the drive pulleys according to the motor used.

Constructional notes

Let me start by saying that any reference to trade named products in this article are given solely as a guide and that I have no connection with any of the products. I feel sure that other products on the market will do the job just as well.

Having got that out of the way I can start on construction.



Another angle of the 4 jaw chuck.

There are quite a few parts to this machine; most of them are straightforward to produce so I only intend to mention them in brief. For the benefit of newcomers I will suggest methods of construction.

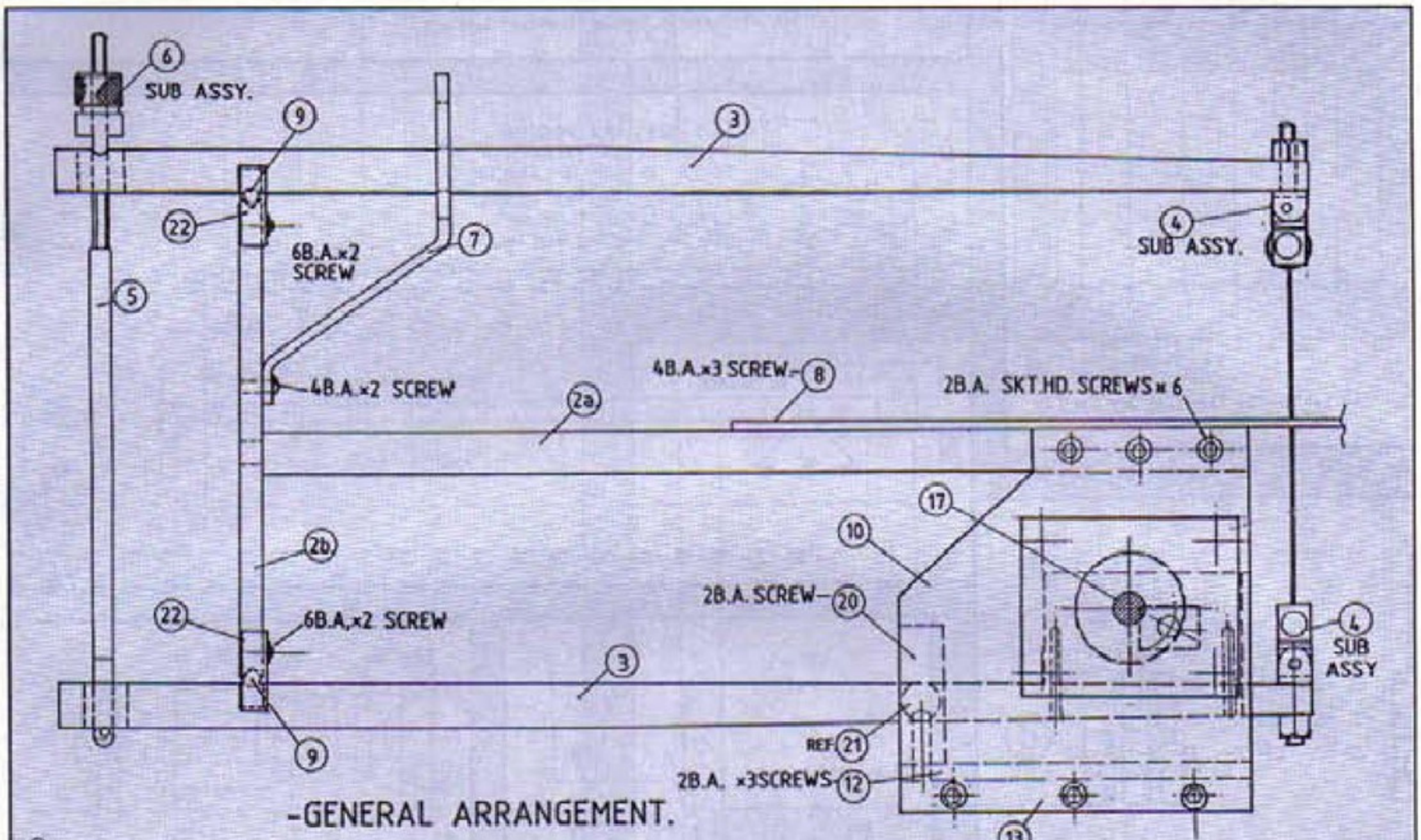
Start with the main body, consisting of two flat plates (Items 10 and 12), held at 90 deg. to each other by a buttress piece (Item 13). Cut the plates as shown in the drawing and drill the mounting holes, note that these holes are spaced so that the tapped holes in the buttress piece do not intersect. The large 1¼ in. dia. hole is machined later.

In my first design I had intended to attach the plates by electric welding the joints in the interest of speeding the job up. I exercised great care in holding the two plates at 90 deg. and ran a fillet of weld down the joint; unfortunately due to the intense concentrated heat the amount of distortion that took place you would not believe, and after spending some time on the anvil with a large hammer trying to rectify the problem it was eventually scrapped.

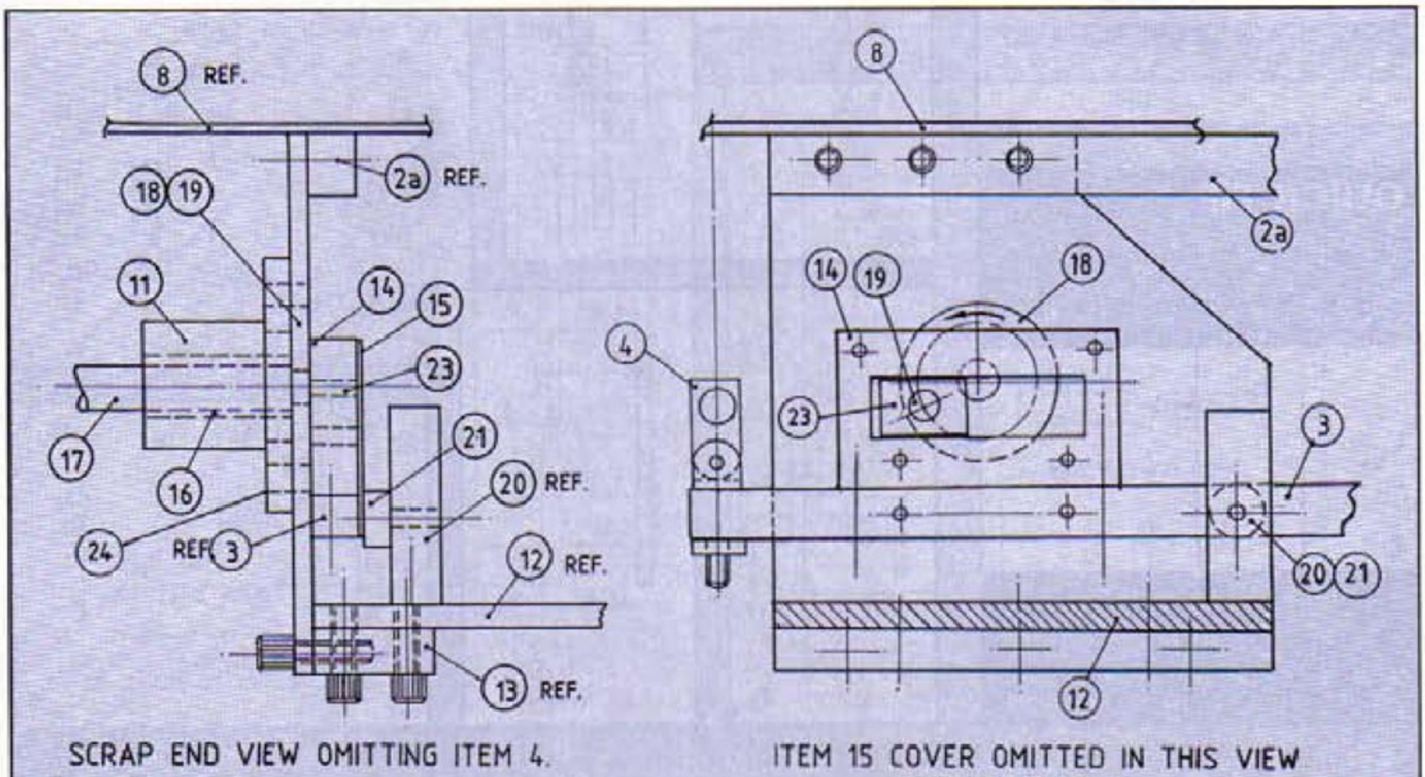
This design is my second attempt and although more time consuming the end result was well worthwhile. A bonus in using this construction is that if the buttress piece is assembled onto the base plate first and the fixing screws are firmly tightened it can be mounted in its intended position on the cross slide of the lathe, a suitable fly cutter mounted to the mandrel or face plate and the work traversed across with very light cuts, this will bring the face of the buttress piece square to the lathe axis. The vertical plate is now mounted and the screws firmly tightened, a spot of Loctite Screwlock (221) on each screw will make a more permanent fixture. I used 2BA countersunk socket head screws.

Mark off a vertical line on the upright plate to the dimension shown on the drawing for the 1¼in. dia. crankhole. Refit the main body assembly to the cross slide; with a centre drill in the three jaw chuck. Adjust the cross slide so that the vertical mark lines up with the centre drill and make a deep centre drilling in the upright plate, follow this with a small drill and gradually increase the size of the drill until the hole has been opened out to the largest size drill suitable for your lathe. There is quite a force required to make a drill cut, I would recommend the use of a block of hard wood at the rear of the upright plate, pushing the workpiece forward with the tail stock, thus relieving the pressure on the lathe saddle. Change over to a boring head and bore out the hole to 1¼in. diameter. This method will ensure that the crankhole is at the correct height for your lathe.

For the newcomer, who may not have got around to making a boring head as yet, I include a photograph of a set-up I use at times, it will be seen that the four jaw chuck has been pressed into service as a makeshift boring head. With care quite satisfactory results can be achieved. If you prefer, a between centres boring bar could also be used. Note that in the photograph the chuck guard has been removed so that the chuck and cutter can be clearly seen.

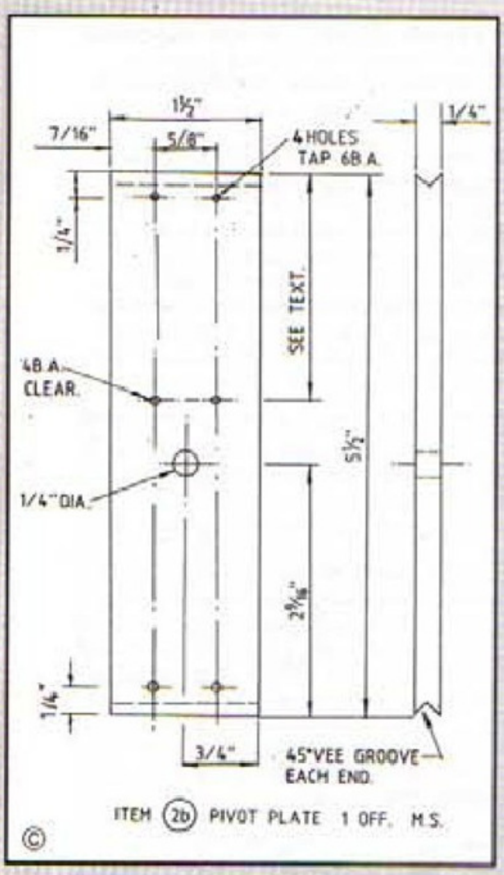


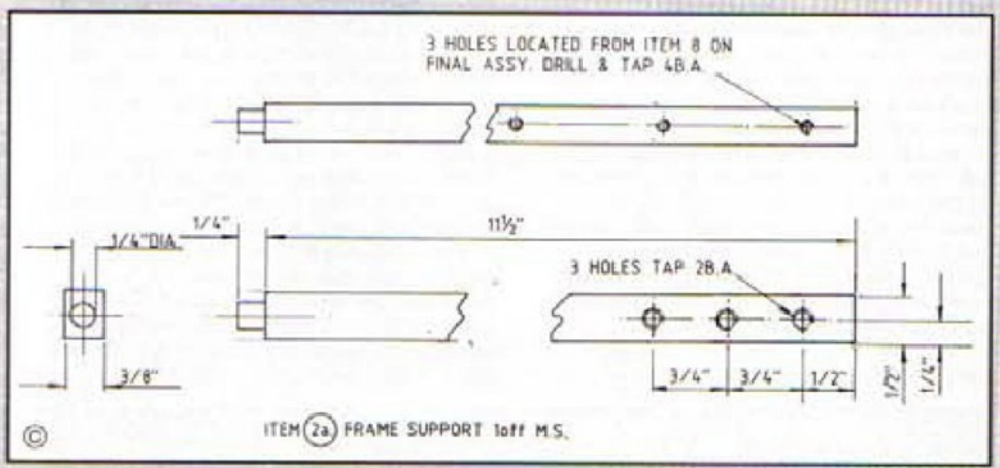
-GENERAL ARRANGEMENT.

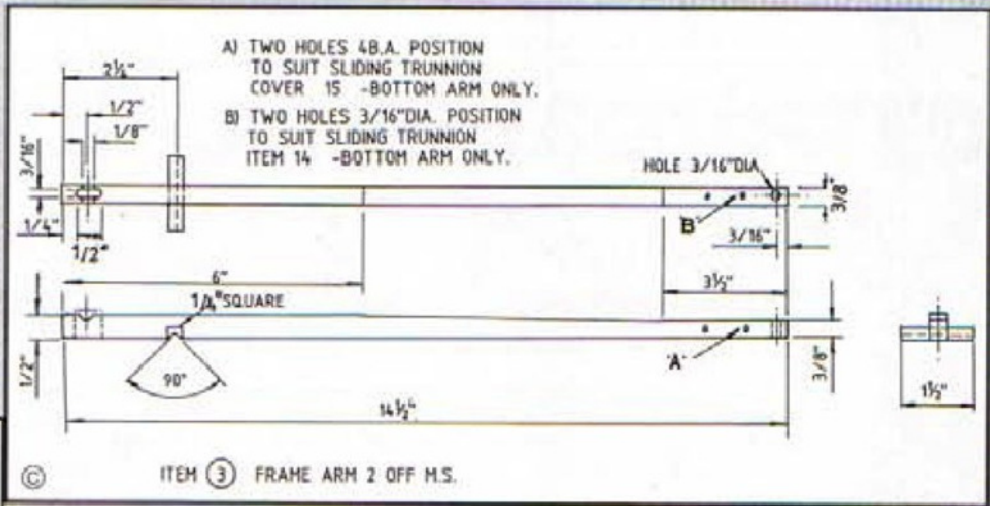


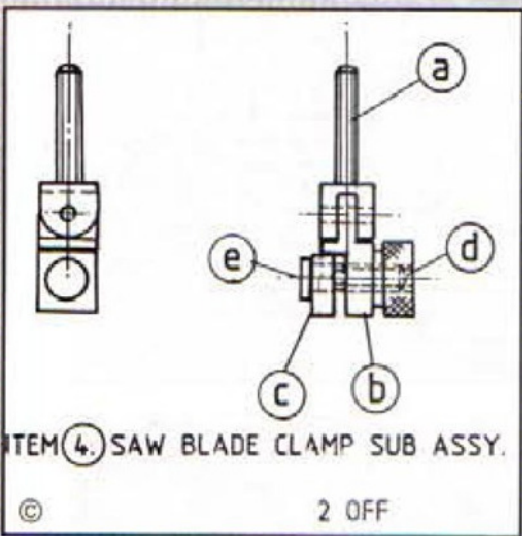
SCRAP END VIEW OMITTING ITEM 4.

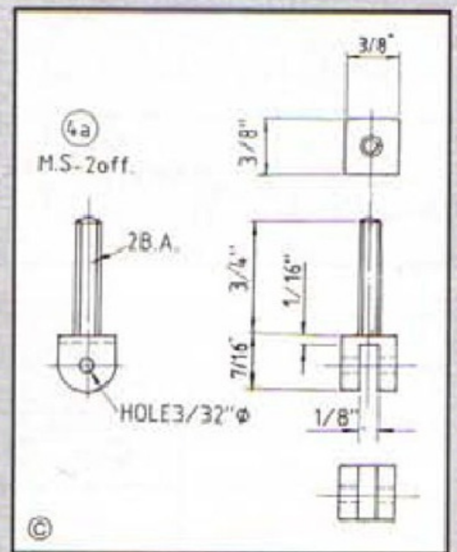
ITEM 15 COVER OMITTED IN THIS VIEW FOR CLARITY

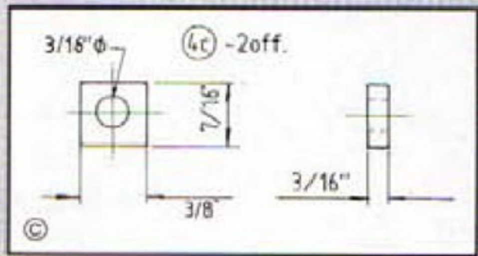


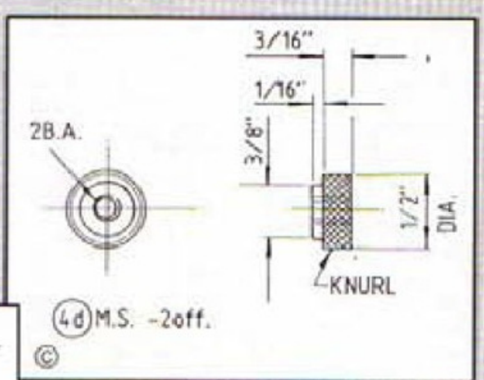






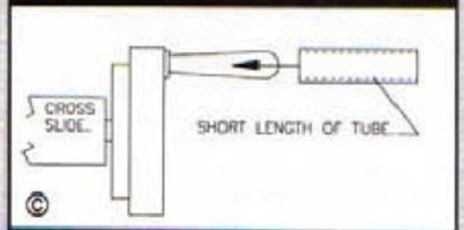




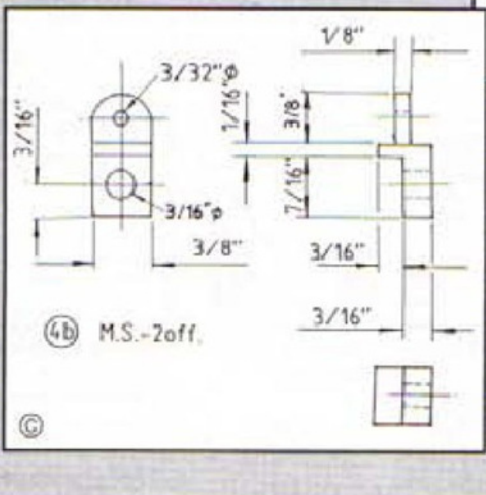


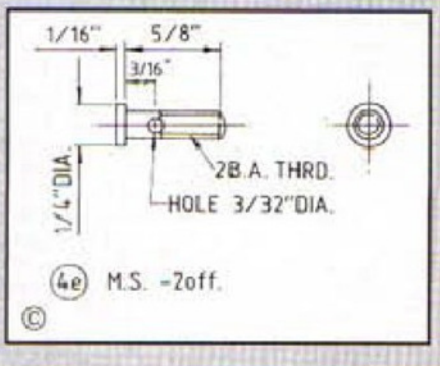
QUICK TIP

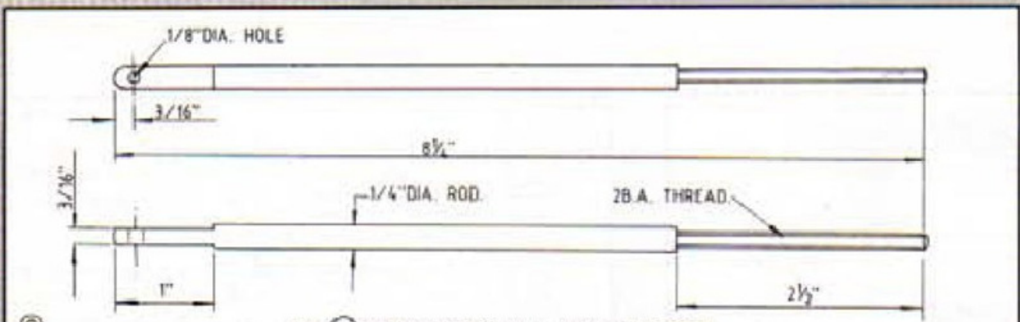
A sewing needle inserted in a small pin vice makes a very good fine scriber. If it gets blunt put a new needle in, they are very cheap to buy. **Lou Riley**



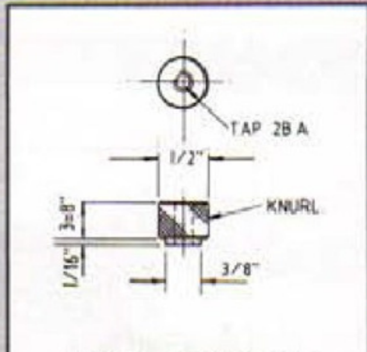
If your lathe is not fitted with a power cross feed, you will find that you will get a much smoother cut if a piece of tubing is put over the handle of the cross slide as you are cross feeding. **Lou Riley**



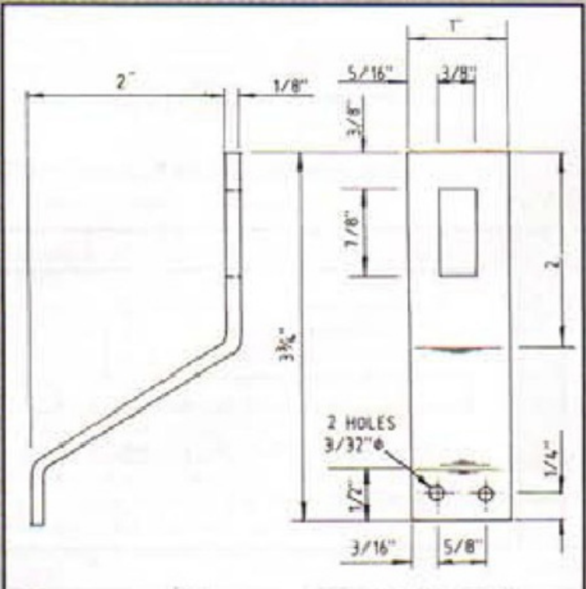




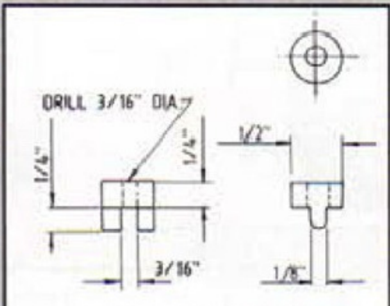
ITEM (5) FRAME TENSION ROD 1 OFF MILD STEEL



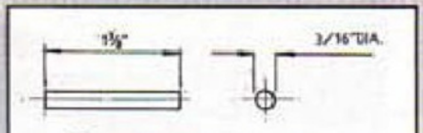
ITEM 6a THUMB NUT 1 OFF.
1/2"DIA. B.M.S.



ITEM (7) TOP ARM GUIDE 1 OFF. MILD STEEL.

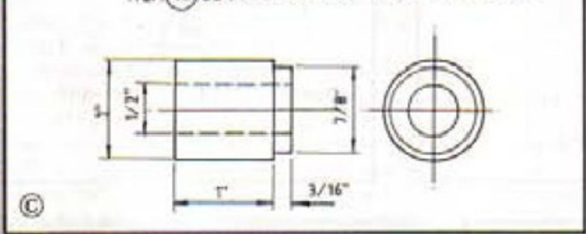


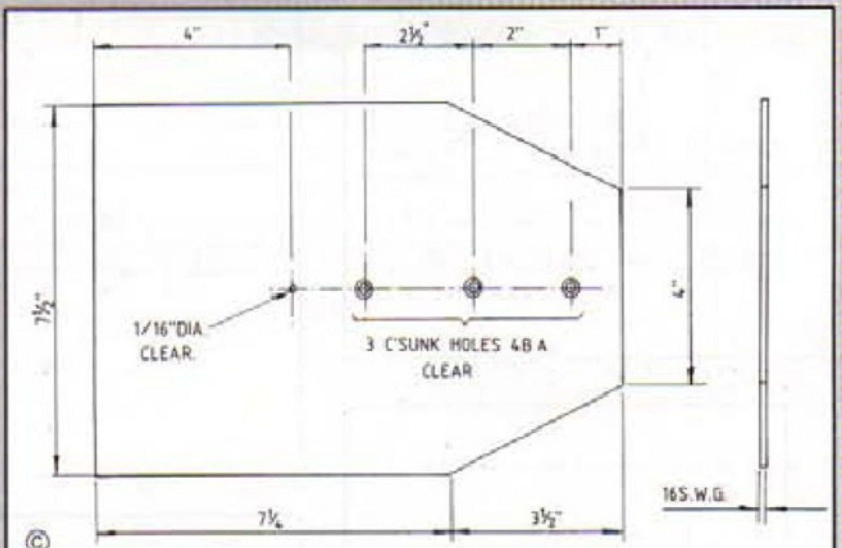
ITEM 6b ROCKER BUSH 1 OFF.
1/2"DIA. B.M.S.



ITEM (9) HINGE ROLLER 2 OFF. - SILVER STEEL.

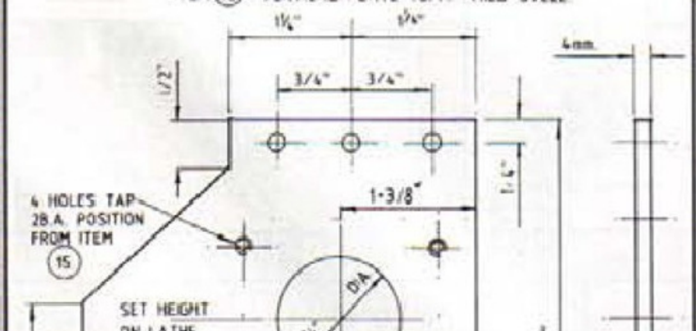
ITEM (11) BEARING HOUSING. 1 OFF. - MILD STEEL.



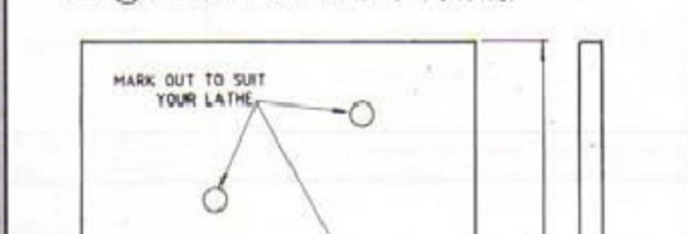


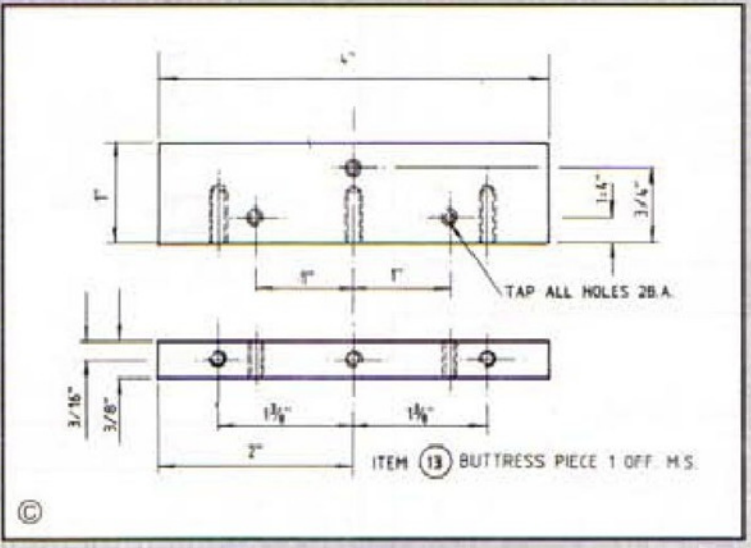
ITEM (8) WORK TABLE 1 OFF. - MILD STEEL

ITEM (10) VERTICAL PLATE 1 OFF. - MILD STEEL.

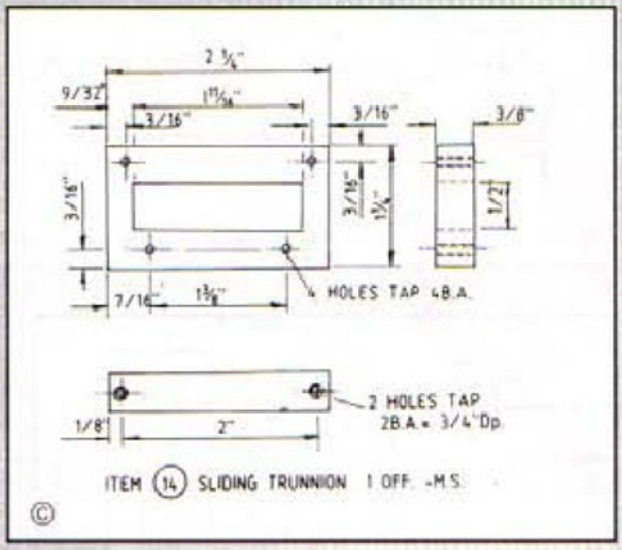


ITEM (12) HORIZONTAL MOUNTING PLATE 1 OFF. M.S.

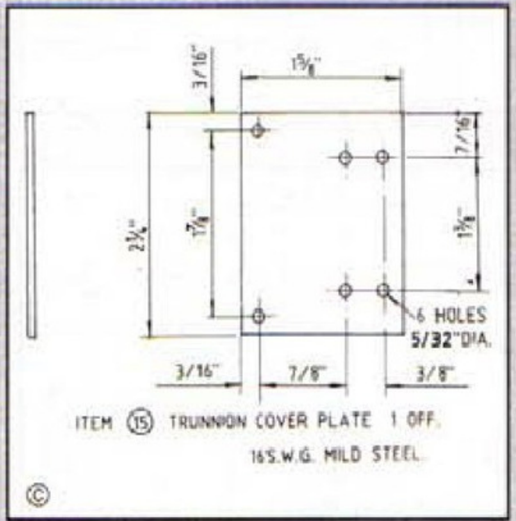




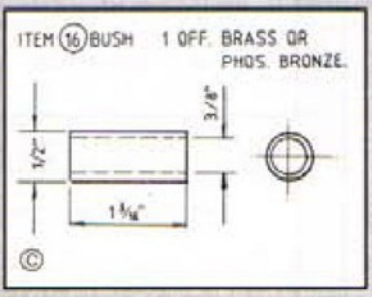
4"
1"
1/4"
3/4"
1" 1"
TAP ALL HOLES 2B.A.
3/16"
3/8"
1 3/8" 1 3/8"
2"
ITEM (13) BUTTRESS PIECE 1 OFF. M.S.
©



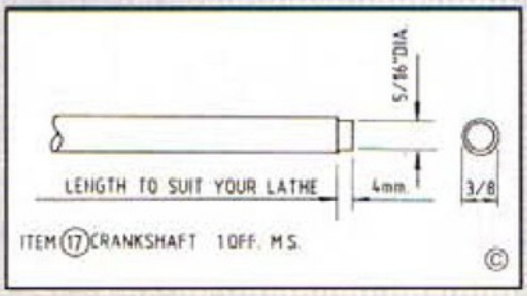
2 3/4"
9/32"
1 11/16"
3/16"
3/16"
3/8"
3/16"
3/16"
1 1/4"
1/2"
7/16"
1 7/8"
4 HOLES TAP 4B.A.
2 HOLES TAP 2B.A. × 3/4" Dp.
1/8"
2"
ITEM (14) SLIDING TRUNNION 1 OFF. -M.S.
©



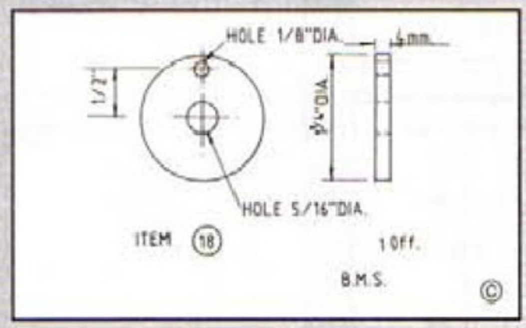
3/16"
1 3/8"
7/16"
2 1/4"
1 7/8"
1 3/8"
6 HOLES
5/32" DIA.
3/16"
7/8"
3/8"
ITEM (15) TRUNNION COVER PLATE 1 OFF.
16 S.W.G. MILD STEEL.
©



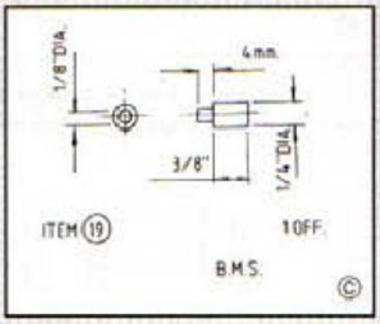
ITEM (16) BUSH 1 OFF. BRASS OR
PHOS. BRONZE.
3/8"
1/2"
1 3/16"
©



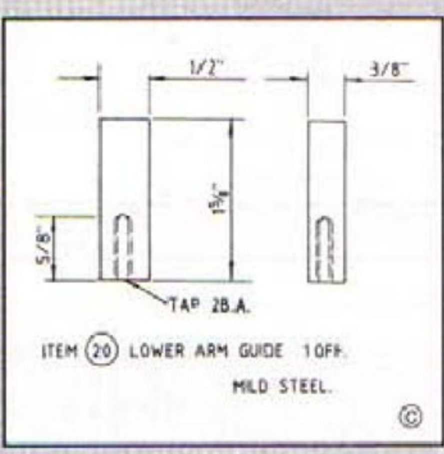
5/16"DIA.
LENGTH TO SUIT YOUR LATHE
4mm.
3/8
ITEM (17) CRANKSHAFT 1 OFF. M.S.
©



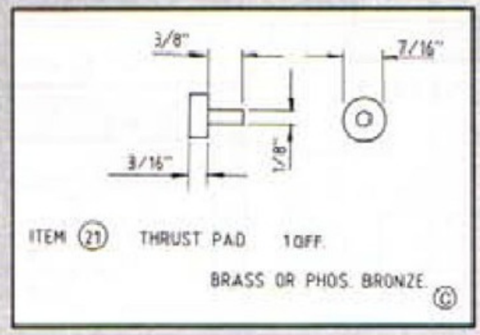
HOLE 1/8"DIA.
4mm.
1/2"
1 1/4"DIA.
HOLE 5/16"DIA.
ITEM (18)
1 Off.
B.M.S.
©



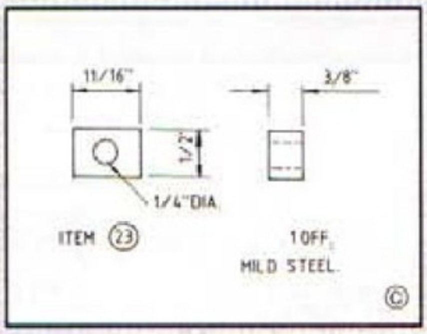
1/8"DIA.
4mm.
3/8"
1/4"DIA.
ITEM (19)
1 OFF.
B.M.S.
©



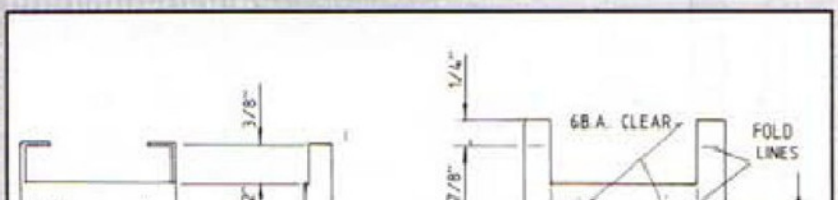
1/2"
3/8"
1 5/8"
5/8"
TAP 2B.A.
ITEM (20) LOWER ARM GUIDE 1 OFF.
MILD STEEL.
©



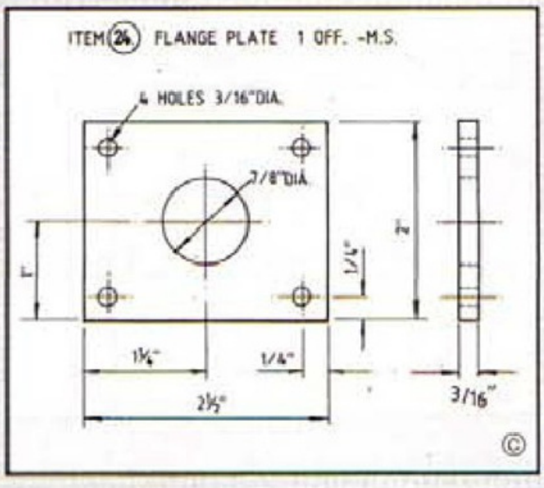
3/8"
7/16"
3/16"
1/8"
ITEM (21) THRUST PAD 1 OFF.
BRASS OR PHOS. BRONZE.
©



11/16"
3/8"
1/2"
1/4"DIA.
ITEM (23)
1 OFF.
MILD STEEL.
©



3/8"
1/2"
ITEM (22) ROLLER KEEP PLATE 2 OFF.
22 S.W.G. MILD STEEL.
1/4"
6B.A. CLEAR
FOLD LINES
7/8"
1/4"
11/16"
5/8"
1/4"
1 1/2"
1/4"
DEVELOPED VIEW.
©



ITEM (24) FLANGE PLATE 1 OFF. -M.S.
4 HOLES 3/16"DIA.
7/8"DIA.
2"
1"
1/4"
1 1/4"
1/4"
2 1/2"
3/16"
©

The crankshaft

The simple crankshaft is made up of three parts, the ⅜in. dia. silver steel shaft (Item 17), and the ¼ in. dia. crankpin are machined to the sizes on the drawing. The 1¼in. dia. crankdisc (Item 18) should be machined up oversize and the final cut taken so that the disc is a tight thumb press fit in the crankhole in the upright plate. The reason for this will become clear latter. The three parts are assembled and silver-soldered together using Easyflo 2; a good penetration is required. I would recommend roughing up the surface of the spigot end on the shaft and pin to help the silver solder penetrate right through the joint.

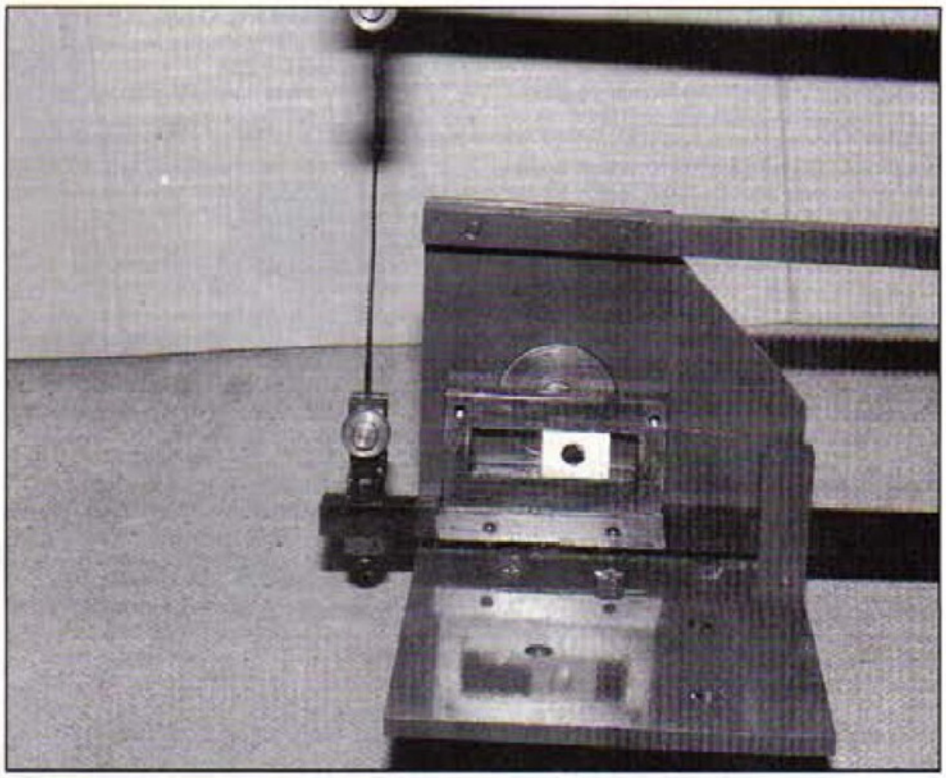
The crankshaft bearing housing

The two parts of the bearing housing (Items 11 and 24) are made and held together with braze. A small bronze bush (item 16) is made and pressed into the housing; when the bush has been pressed fully home, a 1/16in. dia. hole is drilled through the housing and bush to allow a drop of oil to be applied occasionally. A ⅜in. reamer is passed through the bore to bring it to the correct size.

I have specified that the two parts of the housing are held together with braze, if your equipment will not reach the temperature required for brazing then silver solder would make a satisfactory joint.

Frame support

The next part to be made is the support for the saw frame which consists of two parts. The first is a ½in. x ⅜in. steel bar cut to length as shown. A short stub end is machined on one end ¼in. dia.x ¼in. long. The second piece (Item 26) is a ¼in. flat steel bar 1½ x 5½in., cut to length and a small "V" groove machined at each end. The position for the ¼in. dia. hole is marked off and drilled, the flat bar is now placed onto the stub end and set vertical to the support arm. Note that the shortest part of the flat bar is to the bottom of the assembly. It is now brought to a bright red heat and brazing rod run into the joint. If you wish to leave out the brazing operation, although I have not tried it myself, I see no reason why, if an allowance is made to the length of the support arm so that the stub end could be made longer and a ¼in. dia. thread put on the stub.

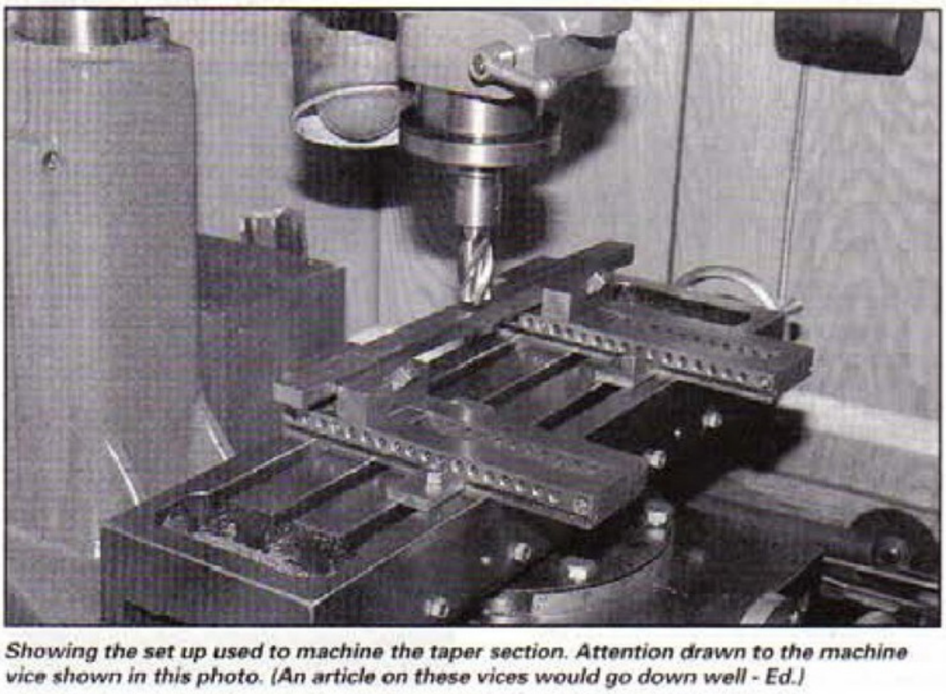


Showing sliding trunnion crank connection.

It could then be passed through the ¼in. dia. hole and held with a ¼in. nut, here again Loctite could be used to make a more permanent fixture.

The assembly is offered up to the vertical plate of the main body as shown in the G.A. drawing and held in place with clamps. The holes for the mounting screws can now be spotted through the holes in the upright plate and then drilled and tapped 2BA. Finally, the fixing screws are fitted and firmly tightened.

The bearing housing can now be fitted; this is the reason for making the crankdisc oversize. The crankshaft assembly is fitted into the crankhole in the upright plate and the housing will slide over the shaft up against the vertical plate. The crankshaft will align the housing central to the crankhole, the housing is held in this position with clamps and the mounting holes spotted through the holes in the vertical plate. They are now drilled and tapped 2BA and the screws fitted and tightened. The crankshaft is removed and returned to the lathe, a one or two thou. cut is taken from the diameter of the crankdisc. When the crankshaft is refitted it should turn freely and have the minimum of clearance between the crankdisc and crankhole. If the mounting screws protrude through the upright plate They must be trimmed off and filed flat.



Showing the set up used to machine the taper section. Attention drawn to the machine vice shown in this photo. (An article on these vices would go down well - Ed.)

The saw frame arms, Item 3

The frame arms are made from ½in. x ⅜in. steel bar and at 2¼in. from one end a slot is machined across the bars ¼in. wide. The arms are machined to a taper as shown in the drawing, as the top and bottom arms are the same They can be machined together. The photograph shows the set-up I used to machine the taper section.

It may be of interest to the beginner to take note of the machine vice shown in this photograph. They are a matched pair I made some time back and can be used independently of each other. A register is fitted to the under side of each vice which is a snug fit in the slots of the milling machine table. When used as in the photograph the register automatically lined up the two sets of jaws. Although the setting-up for machining so that they are as accurate a matched pair as possible without the use of a surface grinder is complicated and demanding, if there is an interest in this type of equipment it could form the subject of a future article. *(Yes please -Ed.).* Back to the fretsaw I do hope the Editor will forgive these short diversions but my old typewriter keeps branching off onto other subjects of interest. I hope it will be seen from the drawing of the saw frame arms that there is a 3/16in. dia. hole required at one end for the blade clamps and a 5/16in. slot for the tension rod at the other, also there is a small groove cut across the arms central to this slot to locate the rocker bush, Item 66, and the keep pin – not detailed, for Item 5.

A hinge bar is made from a piece of ¼in. square bar 1½ in. long with a "V" groove machined along its length. It is placed central in the slot in the saw frame arm and held with braze or silver solder.

Saw blade clamps, Items 4a - 4e

Two of these are required, they should be quite straightforward to produce from the drawing. Just a couple of points to take note of; one is the swivel pin which needs to be only lightly riveted over – the knuckle should be perfectly free to move back and forth. The second point is that I have not given a dimension for the position of the 3/32in. dia. cross drilling in the clamp screw. This hole should be marked off from the job, it should be positioned so that the clamp plate covers half the hole. This is so that the clamp screw does not impose any shearing action to the blade, which must be held by the clamping plate.

The tension rod, Item 5, Tension nut, Item 6 and Hinge Roller, Item 9

These are straightforward pieces to make and need no explanation. The hinge rollers are cut from a length of 3/16in. dia. silver steel and although I have not found it necessary. They could be hardened and tempered to dark straw if required.

At this stage the machine can be temporarily assembled and we come to the connecting link for the crankshaft. Due to the limited space, the type of link I chose to use, I have always referred to as a sliding trunnion connection. However, taken from the *Applied Mechanics Transmission of Motion and Power*, the mechanism is more usually called the Infinite Connecting Rod, as the motion of the sliding bar is the same as would be produced by a connecting rod of infinite length.

The dimensions given on the drawing are basic and due to the possibility of slight accumulative errors on the parts already made it would be as well to check each measurement from the machine and adjust as required. The first piece (Item 14), is a block cut and machined to 2¼ x 1¼ x ⅜inch. The position for the slot is checked and marked out. The machining was done with a ¼in. slot drill and the ends of the slot made square with a square file. A trunnion (Item 23) is made and filed up, it should be a snug fit in the slot. The two parts are offered up to the machine, the saw arms are held at the centre of their travel; I used a clamp. The crankshaft is positioned so that the crankpin is to the front and on the horizontal centre line. The block is now positioned so that the sliding trunnion is just, and only just, touching the front end of the slot. This position can be marked or the block clamped against movement, the lower arm is now removed from the machine and the position for the mounting screws determined, the holes in the arm can be drilled and the holes in the block drilled and tapped 2BA.

The cover plate (Item 15) is made and the holes for the securing screws drilled, using the cover plate as a drill jig the holes in the block can be drilled and tapped 4BA. Note that the two bottom holes are spaced so as not to intersect with the block mounting screws.

The sliding trunnion mechanism is assembled, with a bit of luck when the crankshaft is turned the frame arms will bob up and down. I found mine to be a little tight, due to the trunnion being too good a fit. The machine was fitted to the lathe and with plenty of oil applied, it was run slowly for ten to fifteen minutes after which it turned over by hand very smoothly. The assembly was stripped down and washed clean, on reassembly all moving parts were coated with graphite grease. If you have difficulty in obtaining graphite grease in small quantities an alternative I would suggest is a product named Copper Slip which is easily available in small tubes from most good car parts and accessory shops.

Top guide brackets, Item 7

There are two guide brackets to be made and the one for the top arm has a very important part to play. Fretsaw blades are fragile, they will eventually break when the machine is being used. The top bracket has been purposely incorporated in the design to limit the amount of movement of the top arm in the event of a blade failure. It is intended to prevent the arm from flailing or thrashing about, doing damage to its surroundings. It is very easy to make, please make and fit the bracket before the machine is put to work. A length of flat mild steel ⅛in. x 1in. is required. A slot is milled or filed at one end to the dimension shown, the bending lines are marked off and the bar is bent to shape in the vice, two holes are drilled for 4BA bolts. The bracket is placed over the arm and the saw assembled using a standard fretsaw blade. Blade tensioning is done from the tension screw at the rear of the saw frame.

The crankshaft is now turned so that the saw is at the top of its stroke. The guide bracket is positioned up against the frame support plate and set so that the top of the slot is clear of the arm by 1/32in. min. to 1/16in. maximum. It is held with clamps. The crankshaft is turned over by hand to check that the bracket is not fouling the arm. When satisfied that all is well, a 4BA clearance drill is passed through the two pilot holes in the bracket and 4BA nuts and bolts fitted.

Lower arm guide, Item 20

The bottom arm guide consists of an upright post and a thrust pad located in the lower arm. A piece of mild steel ½in. x ⅜in. bar is cut to 1⅜in. long and a hole in one end is drilled and tapped 2BA. A ¼in. dia. hole is drilled 4⅜in. from the front end of the arm and a thrust pad (Item 21) made and fitted to this hole.

The guide post is positioned and marked on the mounting plate, the position for the single mounting bolt is marked out, and drilled 2BA clearance. The guide post can now be assembled and held with a 2BA bolt passed through the machine mounting plate.

Roller keep plate, Item 22

I have used my machine a good number of times by now and although the hinge rollers have not attempted to move sideways, I have made and fitted a roller keep plate to the top and bottom hinge, on a just in case principle. A piece of 22 gauge mild steel sheet is cut and folded up to drawing and fitted to the top and bottom hinge.

They are positioned over the hinge and held with two 6BA screws.

The final piece to be made is the work table (Item 8). It is cut as shown in the drawing and held in place with three 4BA countersunk screws. The drawing shows the shape I used but it could be made any shape that suits you and the material to hand.

I think that's about it. All that remains is the final assembly of the machine and then to paint it to the colour of your choice. You have a handy fretsaw attachment.

I will make a point about blades to be used. I have found that it is always best to use cutting tools for the job that the manufacturers recommend, fretsaw blades are no exception. The manufacturers of fretsaw blades make them in various grades for different materials and thicknesses, some suppliers even colour code their blades to make it easy to recognize the recommended use.

Blades are also specially made for cutting non-ferrous metals and I recommend their use for this type of work.

At the outset of this project I never intended the machine to cut mild steel, but I have found when circumstances have made it desirable, that if an Abra file type of blade with the ends snipped off to make it the same length as a standard fretsaw blade and fitted to the machine it will cut steel to intricate shapes.

I will sign off for now with a final line which seems to be coming a regular one for me. When it is playtime in the workshop do have fun and please work safely. Remember no matter how much money you spend on tools for your workshop, the most valuable tools you will ever have are your eyes and your hands.

QUICK TIP

Typists correcting fluid has a myriad of uses in the workshop - it can be used as a barrier when silver soldering or brazing to keep the brazing material within bounds and save ugly tear drops, or runs of material - incidentally saving you money! Another use is as a marking fluid on rough castings, it seems to resist cutting oil etc. quite well and the lines show up excellently. When buying the fluid get a little bottle of the thinners at the same time, it will extend the life of the product several times, add a little whenever the fluid gets "gummy" on the brush. With care it can be used for emergency marking of metal - useful if you have inadvertently cut the wrong end off a rod of silver steel. Even the empty bottle can be useful - wash it clean and fill it with oil, the little brush can be used to place a spot in many awkward locations.

Even at close quarters the twelve-times full size valves retained their convincingly lifelike appearance. Little wonder they foxed the scrap dealer. For those interested in off beat methods the Vee section screw threads were produced by securing lengths of patternmakers' leather fillet to the otherwise plain surfaces. (Photo: Mack of Manchester Ltd).

ALL THAT GLITTERS

In *Scribe a Line*, issue No. 16 Alan Jeeves commented on home workshop owners working in 1:1 scale. In this brief article W. Brian Taylor gives details of some oversize models made by the firm he worked for. A case of 12:1 or is it 1:1?

It was not unusual to receive orders for larger than life items. Some were needed for demonstrating small mechanisms, others - as in this case - were to attract attention from a distance.

"We want 'em to look exactly like these only twelve times larger," he said, handing over a selection of phosphor bronze steam valves. "Include all the minute details so they have a truly life like appearance but, as they're to be suspended way above our exhibition stand, you'll have to make 'em as light as possible."

Our client handed over various specimens from his company's range of valves, some flanged others with BSP threaded connections. Typical of valve construction, the samples consisted of "T" shaped sand-cast bodies. Each had machined faces and a bonnet-assembly. Some were check-valves while others where hand operated stop-valves with a valve-stem, gland unit and a hand wheel. Clearly, when reproduced at 12in.:1in. scale, each replica would be roughly four feet long.

When completed, the accurately shaped hollow replicas had a most convincing appearance,' machined areas finished smooth and bright, inlet and outlet ports threaded where appropriate, other surfaces textured to appear "as-cast".

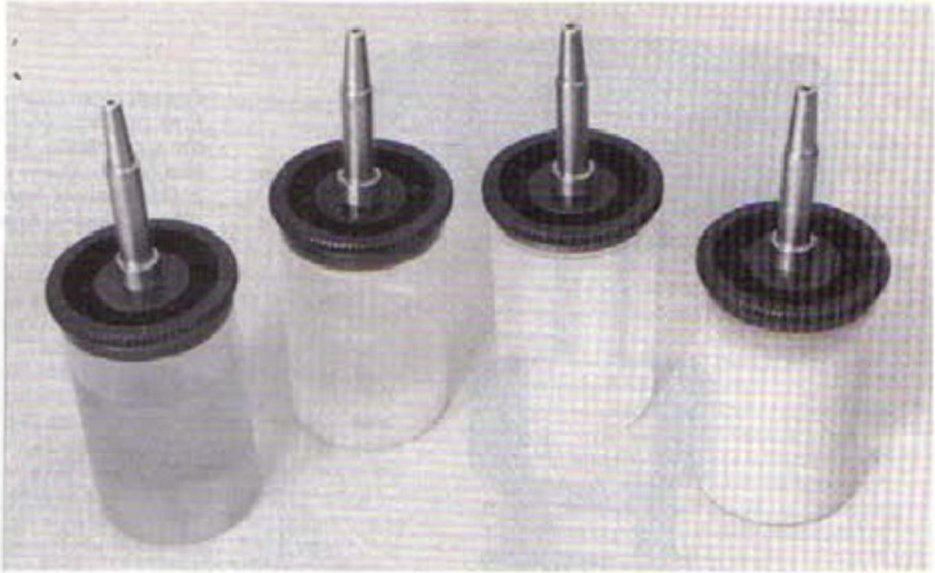
Each was light enough for an easy lift and, with a high-tensile steel suspension rod firmly secured to the carcase, presented no hazard when suspended high over the exhibition stand.

Some weeks later a letter from the valve company complimented us on achieving a convincingly lifelike appearance which proved to be a popular ice-breaker and talking point during the exhibition. Their letter also informed us how they had used the replicas in a pre-meditated leg-pull...

Subsequent to the exhibition, they were intentionally placed in the area where metal turnings and other swarf materials were dumped prior to collection by a scrap merchant. Seen even at close range, their lifelike appearance so deceived him he assumed they had been scrapped and offered to "weigh 'em in".

QUICK TIP

With the introduction of man made fibres into clothing and other household textile items the supply of absorbent rag for use in the workshop can be a bit of a problem. Effective and reasonably priced substitutes are kitchen rolls, one square will absorb a surprising amount of muck. From long experience in my own shop I have found it better to make up wooden holders for the rolls, the plastic type used by the domestic authorities have a habit of letting go when the roll is jerked, causing much use of expressions which in calmer moments one may regret.



Recycling is a new idea to many people, but I suspect that it has been commonplace in the home workshop since they first came into being. These little oil cans give a chance to pursue this aim. They can be made in less than an hour and cost is almost nil. A few around the workshop will ensure that the machines etc. are always well lubricated

A SIMPLE OIL CAN

Many readers these days are no doubt becoming more inclined to consider the possibilities of recycling items of no permanent use, these are many and varied in this throwaway age. The reason is doubtless twofold, cost and conservation, with perhaps cost being the predominant one in most peoples minds.

Many of such items are well made and maybe quite complex. Frequently they are made in very large numbers, principally as items of packaging or similar. Their cost to the manufacturer is very low and, as a result they have no potential for recycling for re-use for their original purpose.

Recycled

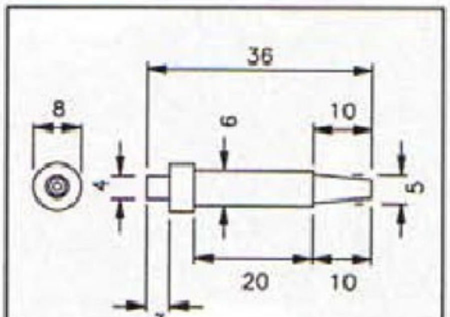
In this case a small plastic canister in which 35mm films are supplied has been used to provide a small and very effective oil can. A number have been made and found to be very useful, having a number of benefits over items purchased, not least virtually zero cost.

Being so cheap there is no real excuse for not making a number of these. This will enable one to be placed at each machine that requires regular lubrication. Such action will help to avoid the machine being run with inadequate lubrication. The container being transparent (at least in the case of those used for the prototypes), some indication of the grade of oil contained may be possible. It will also be possible to tell, visually, if the can is in need of refilling. The lid, having a recess, collects oil that runs down the spout after use preventing oil running down the can itself, thus keeping it clean and pleasant to work with. The recess can be periodically cleaned with a piece of cloth.

Manufacture

Making the oil can is straightforward there being no real problems. The lid is easily drilled and the size of hole is not important as the required seal is achieved by the flange, and not by the spout being a tight fit in the hole.

To make the spout, start by turning the outer end, made parallel rather than the traditional taper. This permits it to be returned to the chuck for turning the end which enters the hole in the lid. Drill the



hole about half way down the length of the spout, and to a smaller diameter than that considered probably required.

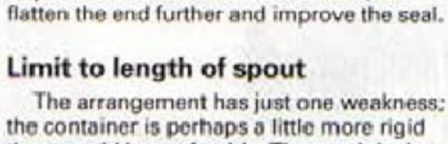
The reason for the smaller hole is that the hole can easily be opened up to suit the viscosity of the oil, even after fitting to the lid. It would be much more difficult to close up the hole if it were found to be too large. Part off to length and return to the chuck the other way round for completing the other end.

Turn the reduced diameter to enter the hole in the lid, note the flange is made slightly undercut to ensure a perfect seal. If preferred the diameter can be changed to suit an available washer, rather than having to make the washer, this can be a time consuming and fiddly job. The clearance between washer and spout should be no more than 0.1mm on diameter. Follow this by drilling the slightly larger size hole to break into the smaller hole already drilled.

To fit the spout, it is lightly held in a vice with the flange against the jaw. The lid is then placed on the spout followed by the washer and the inner end of the spout splayed using a broad end centre punch. This is then followed by a large pin punch; or piece of rod about 8mm diameter, to flatten the end further and improve the seal.

Limit to length of spout

The arrangement has just one weakness; the container is perhaps a little more rigid than would be preferable. The result is that the oil displaced at one squeeze is quite small, such that, if the spout is too long, or the hole too large, the oil displaced will be insufficient to more than fill the spout, and no oil will be dispensed. Unless the containers you are using are more flexible that those in the prototype, it is unlikely that the spout can be longer than that indicated in the drawing. Of course, if very thin oil is being used, a smaller hole would permit a longer spout.



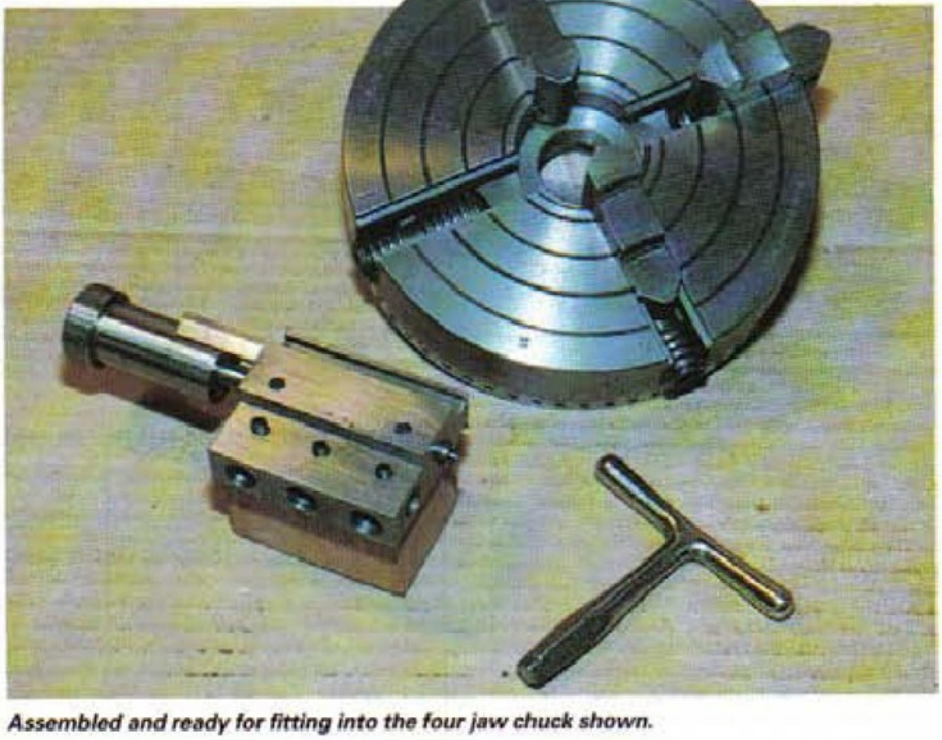
Use without modification

Without modification these containers can be used for other substances. They will permit storage of workshop substances in small quantities, permitting larger quantities to be stored where there is more room. This could be for such things as marking blue, grease and having airtight lids, even paints and solvents. Being plastic tests may be necessary with some materials to ensure they can safely be stored in these containers.

Most readers will have at some time placed a block of steel fitted with a form of boring tool into the four jaw chuck to be used as a makeshift boring head. Al Longworth suggests replacing one of the chuck jaws with a special jaw which is fitted with micrometer adjustment, to achieve a professional result with the minimum of parts to be made

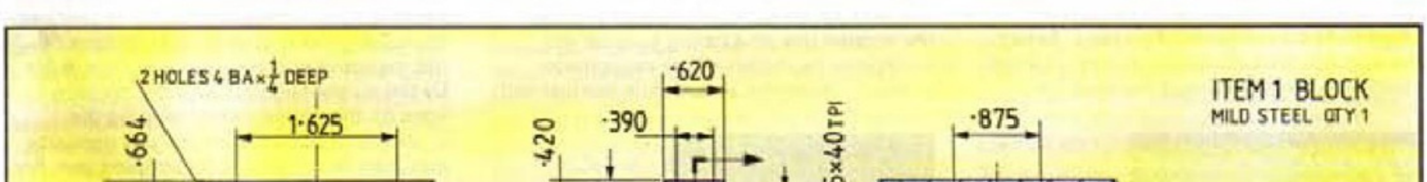
Micrometer boring heads are relatively expensive, especially if only occasionally required. This consideration led to the development of the Micrometer boring adaptor which utilises the precision and mass of the 6in. 4jaw chuck and is easy to assemble and low cost.

The drawings and photographs are, in the main, self-explanatory and it will be seen that the adaptor comprises of a block, cursor bar and micrometer screw.



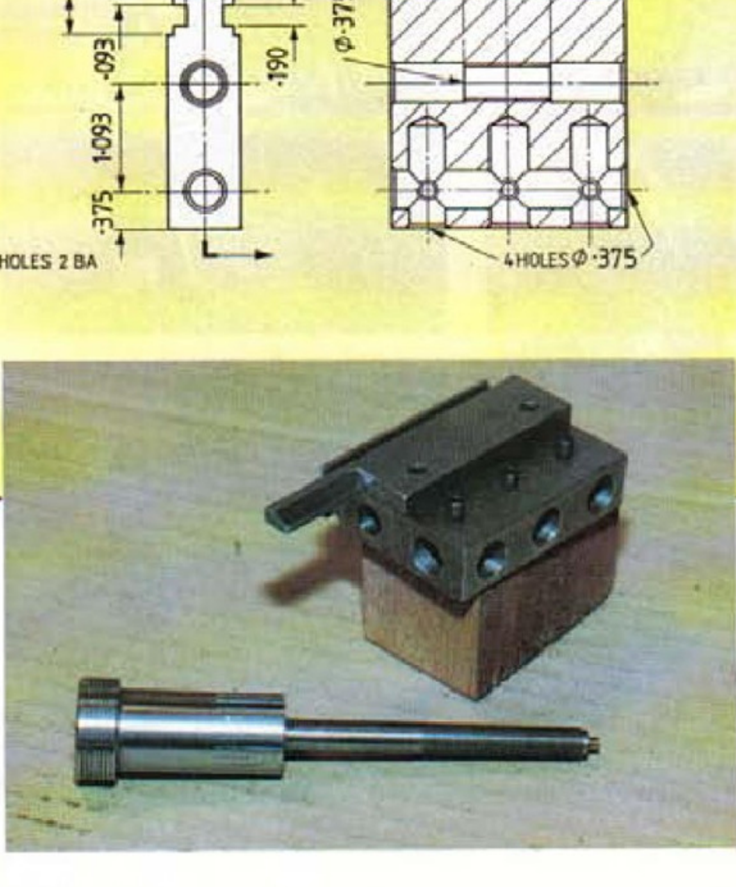
Assembled and ready for fitting into the four jaw chuck shown.

A MICROMETER BORING ADAPTOR

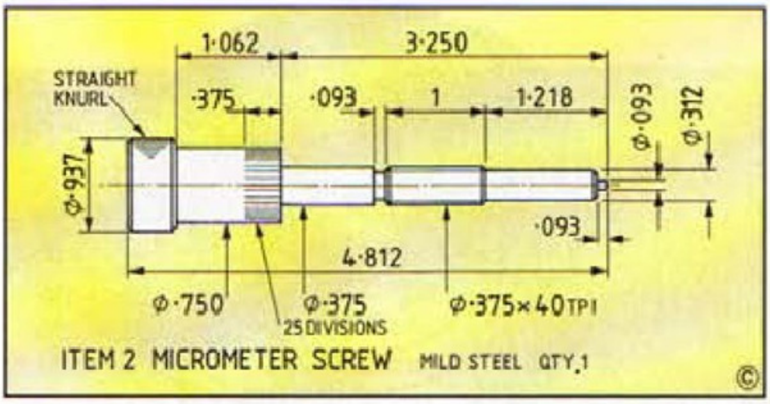


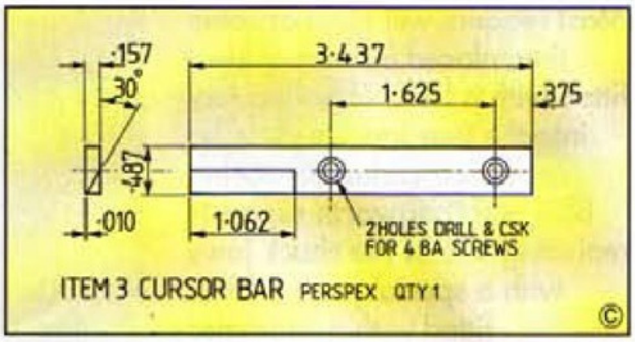
The replacement jaw

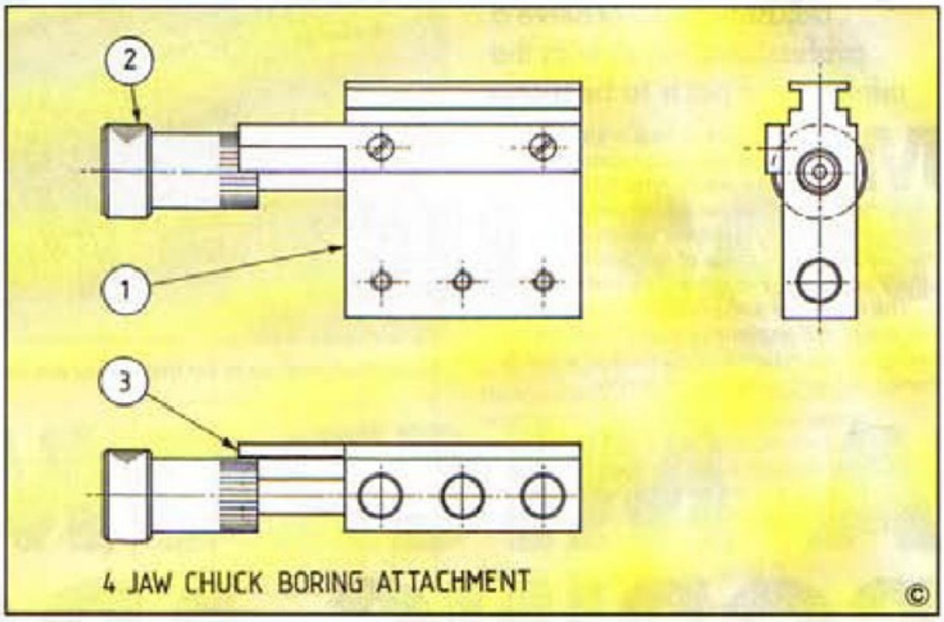
The block is machined to slide into the chuck body in place of one of the jaws and will require the same precision of fit as the jaw. The dimensions shown for the grooves are applicable to the Pratt Burnerd 6in. 4-jaw chuck but can be changed to suit any other make of chuck. The face bores and cross bore are shown as ⅜in. dia. in order to take standard ⅜in. dia. boring bits,



The three parts which make up the adaptor. The cursor is already fitted to the jaw and the separate micrometer screw.







or ⅜in. boring bit holder. Again, these can be changed to metric sizes or to suit bits which are readily available. The alternative positions provide the means to carry out boring, turning, internal grooving and recessing, thread cutting and fly cutting to fairly large diameters.

The cursor bar can be either milled or carefully filed to shape and either screw-fixed as shown or silver-soldered to the block.

The micrometer screw should be a close fit to the bore and with minimum play in the 40 TPI threads upon assembly. The 25 divisions will, in conjunction with the 40 TPI thread, provide 0.001in. adjustment per division.

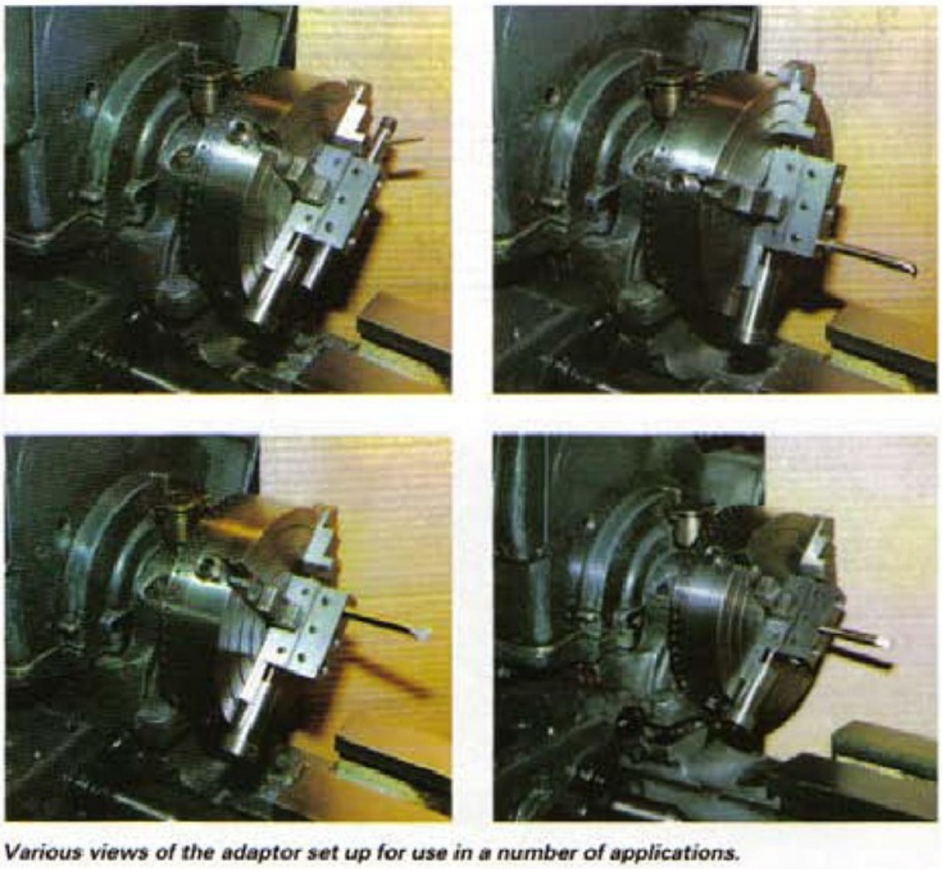
It will be noted that the bit holder bores are provided with two grub screws per bore to provide additional security for the bits during machining.

In use

To use the adaptor, first remove one jaw from the chuck. Slide the adaptor into the chuck with the micrometer screw fully into the block. Retract the jaw opposite to allow the block to be positioned approximately central to the chuck. Lightly clamp the block with the remaining two jaws. Select the appropriate bore and fit the boring tool relative to the job in hand. Release the clamping jaws but leave them lightly touching the block. The cutting tip of the bit can now be brought into alignment with the scribed line or existing bore on the workpiece by means of the micrometer screw, keeping the screw tip in contact with the jaw opposite. Now clamp the adaptor with the top jaw. To readjust, it is only necessary to release the clamping jaw and then apply the required cut by means of the micrometer screw, counting the thous by the cursor aligning with the division lines on the screw, whilst keeping the screw tip in contact with the jaw opposite, and then re-applying the clamping jaw. For external machining, the initial positioning would be made with the micrometer screw retracted with only the tip protruding from the block. These settings become quick and easy after some practise.

From the photographs, one can see that the prototype slightly differs to the drawing. This is a result of it being made before the drawing and certain improvements then suggested themselves. For instance, the 40 TPI thread is centrally disposed in the block and arranged on the screw so as to be protected from accidental damage. The block is also thicker to give more depth of thread for the grub screws which hold the boring tools.

Utilising the mass of the 6in. chuck helps to dampen the shocks during fly cutting operations and the alternative bores for the cutter help to keep out-of-balance forces low, thereby enabling higher speeds to be achieved.

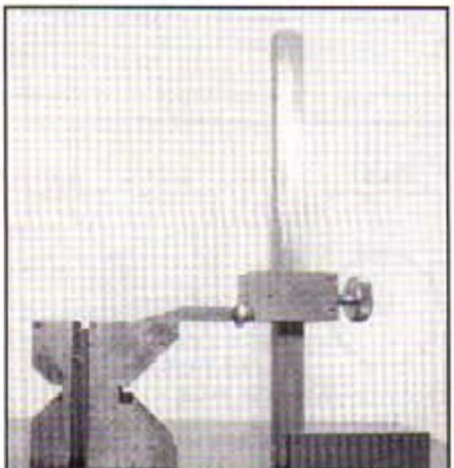


Various views of the adaptor set up for use in a number of applications.

BLACKBOARD

A small blackboard fixed adjacent to your lathe and/or milling machine is very handy for noting feed collar readings when working to coordinates or doing repetition work. **Fettler**

A HEIGHT GAUGE, USING AN INSIDE MICROMETER



Setting the knife edge scriber square.

Mr. N. Smith suggests a simple height gauge, using an inside micrometer to achieve a high degree of precision

Recently, I was asked to make some components for a friend which called for accurate "marking off". I decided the best way to do this was with a Height Gauge, but the price for a conventional one was far too high so, after studying my measuring equipment, I decided to make my own. This proved to do the job very satisfactorily. If anyone has the same problem, I submit my design, which is based on using an inside micrometer to set the height.

The whole tool was made on my Myford Super 7 lathe, it consists of:-

Setting height with the micrometer prior to transferring to the workpiece.

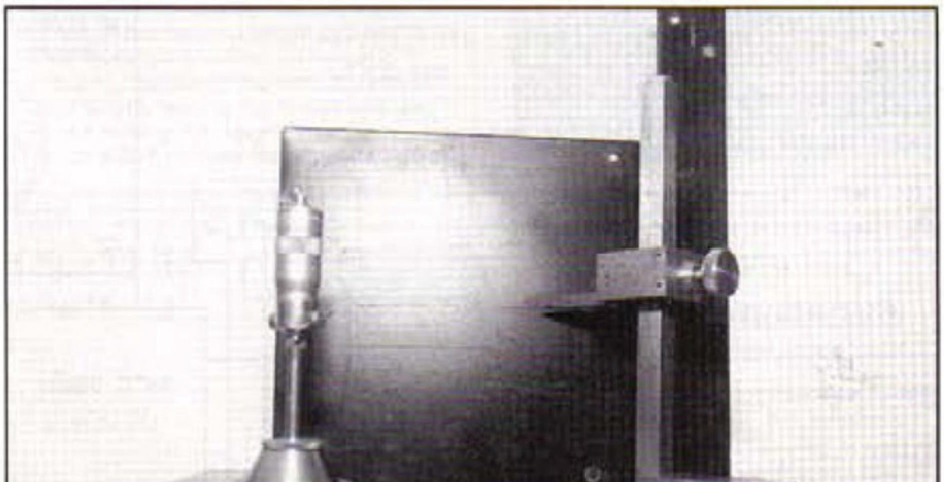
1 off main Body, 1 off split collet, 1 off collet tightening screw, 1 off column (on which slides the marking finger), and 1 thumbscrew, plus of course my inside micrometer.

The main body **(Item 7)** is turned from 1½in. dia. mild steel. All the remaining parts are also mild steel, except the split collet which is made from brass stock.

The main body is machined on the O.D. to 30deg. taper leaving a ⅛in. wide knurled ring around the centre. The taper is cosmetic. After knurling I drilled and tapped the 5/16in. BSF hole for the tightening screw, then the hole was drilled for the micrometer stem. In my case this was No. 12 drill. The tapped hole and the No. 12 hole should be concentric one with the other.

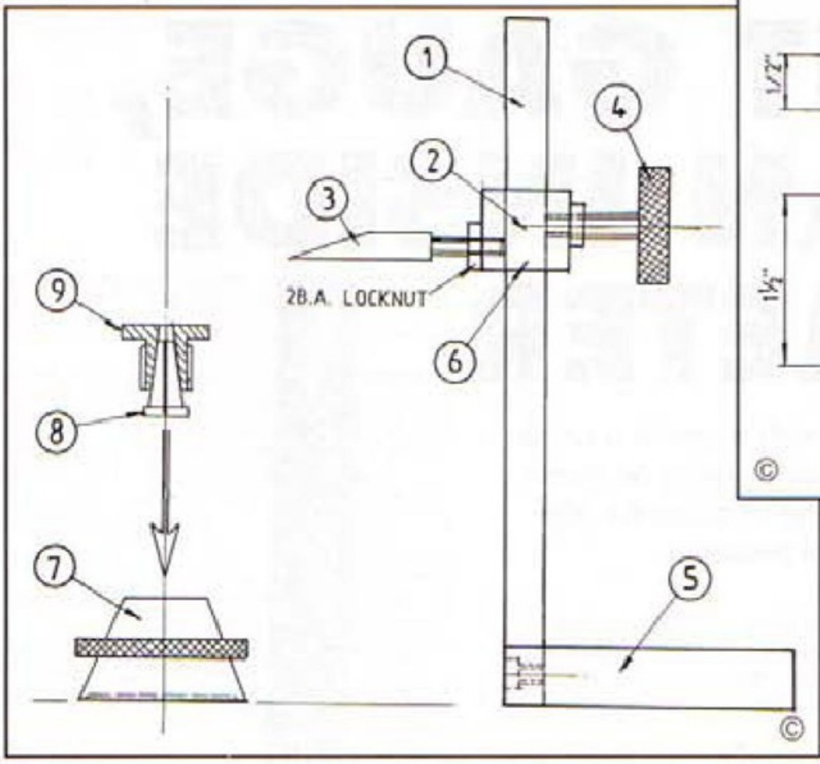
The next part was the tightening screw **(Item 9)**. This was made from ¾in. dia. stock. I knurled the O.D. first, as pressure from the knurling tool could displace the stock in the chuck. I turned the 5/16in. dia. and screwcut it BSF to suit the main body and drilled a No. 12 hole. Then, with care, I reamed this with a No. 4 taper pin reamer, this is for the split collet.

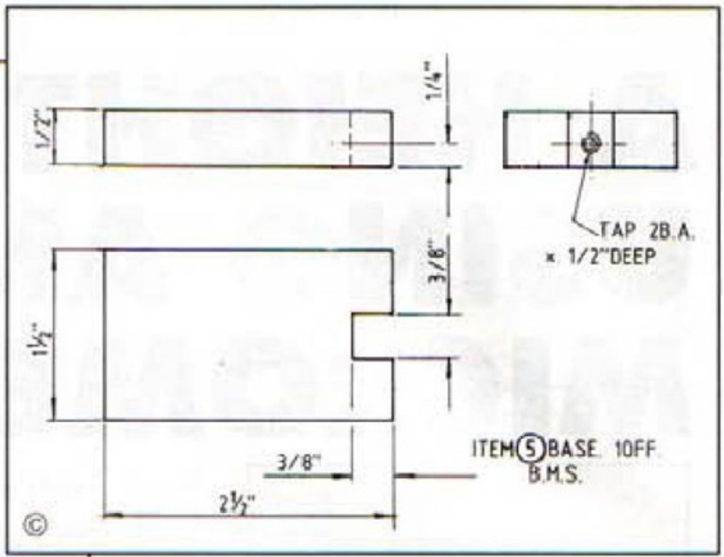
Marking the workpiece.



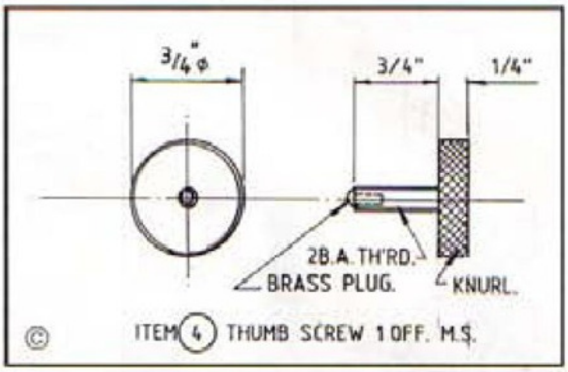
Base and pillar.

The collet **(Item 8)**, is as mentioned, made from brass stock ½in. diameter. The parallel portion is machined to just clear the 5/16in. thread. Next drill a No. 12 hole, again to accept the inside micrometer stem, then turn the taper dia. using the top slide. This is machined to just allow the tightening screw to pass down the taper about ⅔rds of its length. Do not part off at this stage. If this is left on the stock length it

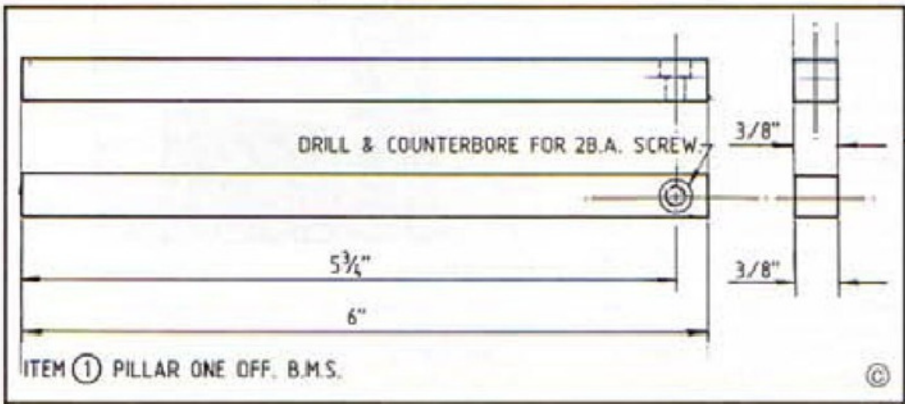




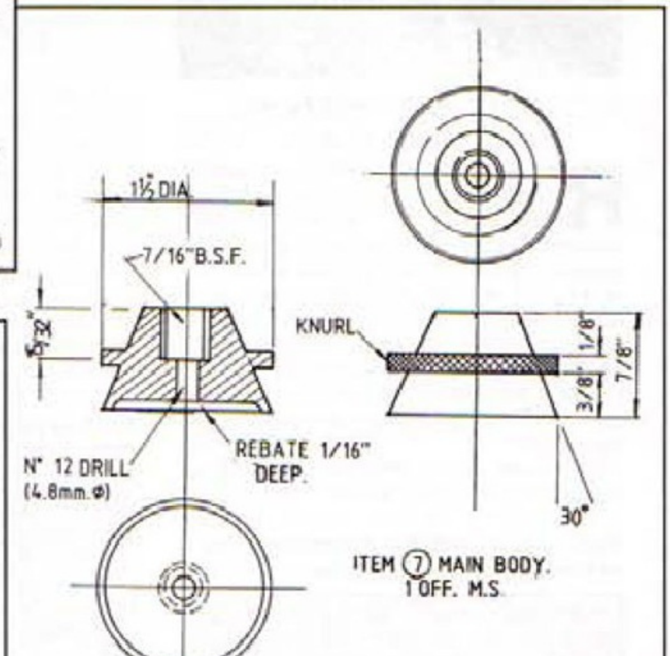
ITEM 5 BASE. 1OFF. B.M.S.



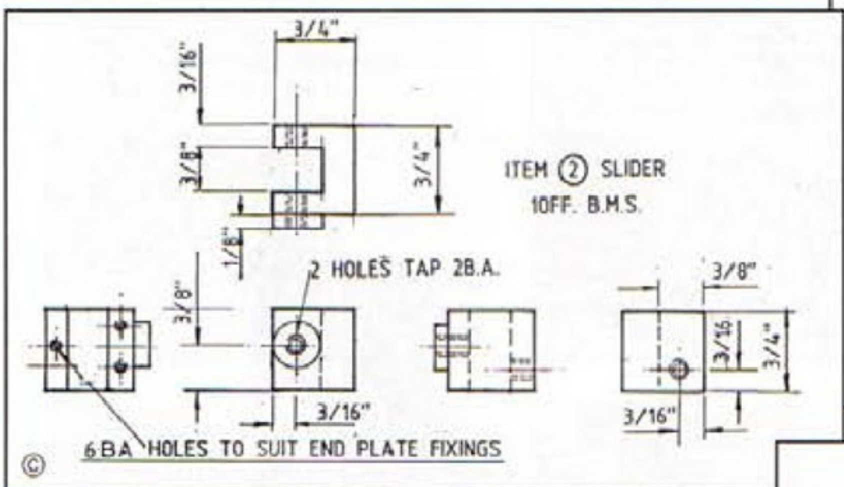
ITEM 4 THUMB SCREW 1 OFF. M.S.



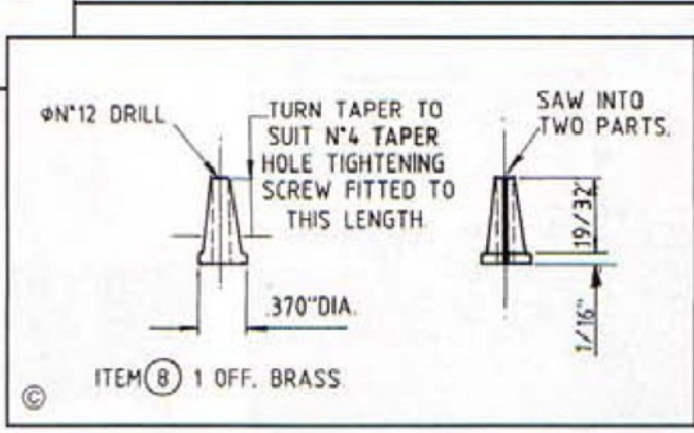
ITEM 1 PILLAR ONE OFF. B.M.S.



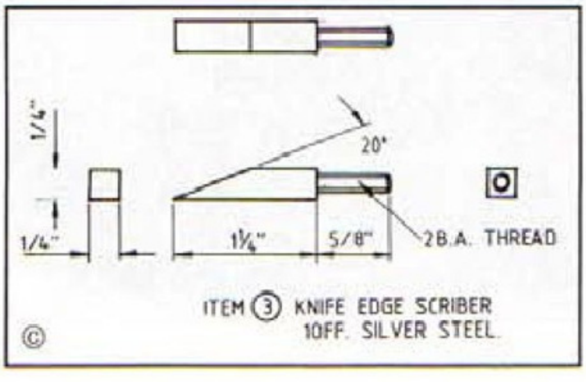
ITEM 7 MAIN BODY. 1 OFF. M.S.



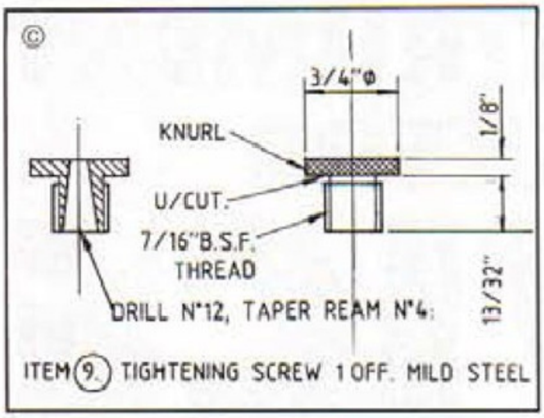
ITEM 2 SLIDER 1OFF. B.M.S.

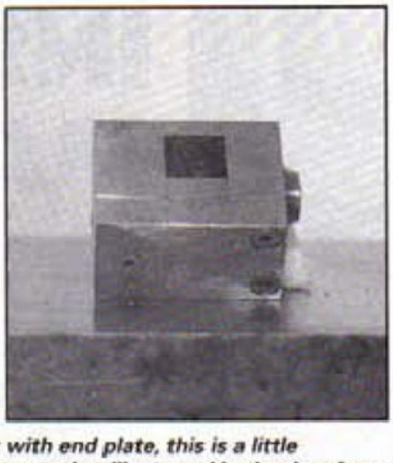


ITEM 8 1 OFF. BRASS.



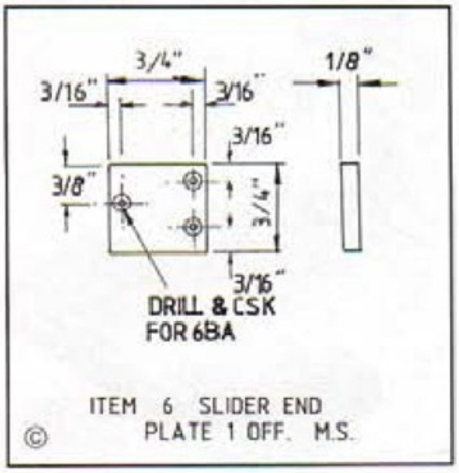
ITEM 3 KNIFE EDGE SCRIBER 1OFF. SILVER STEEL.





Slider with end plate, this is a little different to that illustrated in the drawings.

Knife edge scriber.



Main body.

is possible to slit the collet down its full length. After slitting, return to the lathe and, with care, part off from the stock. This will separate into two pieces.

The pillar **(Item 1)** part is straightforward, this being a length of ¾in. square stock. The base **(Item 5)** is a piece of mild steel which I had left over from a piece that had been surface round previously. This is 1½in. x ½in. x 2½in. with a ¾in. slot in one end, in which the pillar should be a snug fit. Drill and counterbore for a 2BA cap head Allen screw through the ¾in. section at one end of the column. Fit the column into the base by pressing it into the slot in the base. Drill through this, 2BA tapping size. Tap this hole and fit the two together with the Allen screw. This completes the base and column.

Next, the slider **(Item 2)** is made from ¾in. square stock. I milled a ¾in. slot in this, ¾in. deep. The milled slot ensures squareness, with sharp corners. The ¾in. column should be a slide fit, then the end plate **(Item 6)** was made and fitted to create a square hole in which slides the ¾in. square column. The slider has a boss turned on one end. After this was turned, I drilled and tapped 2BA into the ¾in. square hole for the thumb screw. I then knurled and turned the thumb screw **(Item 4)** from ¾in. dia. stock. When the 2BA thread was finished, a small hole was bored in the end and into this I pressed a pre-turned brass peg. This avoids marking the ¾in. square column and so allows the slider to move freely up and down without burring the side of the ¾in. square section.

Next the knife edged scriber **(Item 3)** was made from ¼in. square silver steel. I turned and screwed a length of silver steel, once again to 2BA. After turning and screwing I hardened the knife edge for a short length, leaving the thread soft, and fitted a locking nut. I then drilled and tapped a 2BA hole on the opposite side of the slider to the thumb screw near to the bottom. This is for the knife edge scriber.

The method I used to ensure the scriber is square to the column before tightening the locking nut was to offer the assembly to a Vee block, slide the slider and knife edge down on to the "V" block and tighten the locking screw against the edge of the slider. This should now be at right angles to the base.

After the micrometer is put in place, the tool is ready for use. Put the micrometer into the body through the split collet so that it touches the bed of the surface plate, or other base upon which it is to be used; adjustment can then be made from the micrometer body.

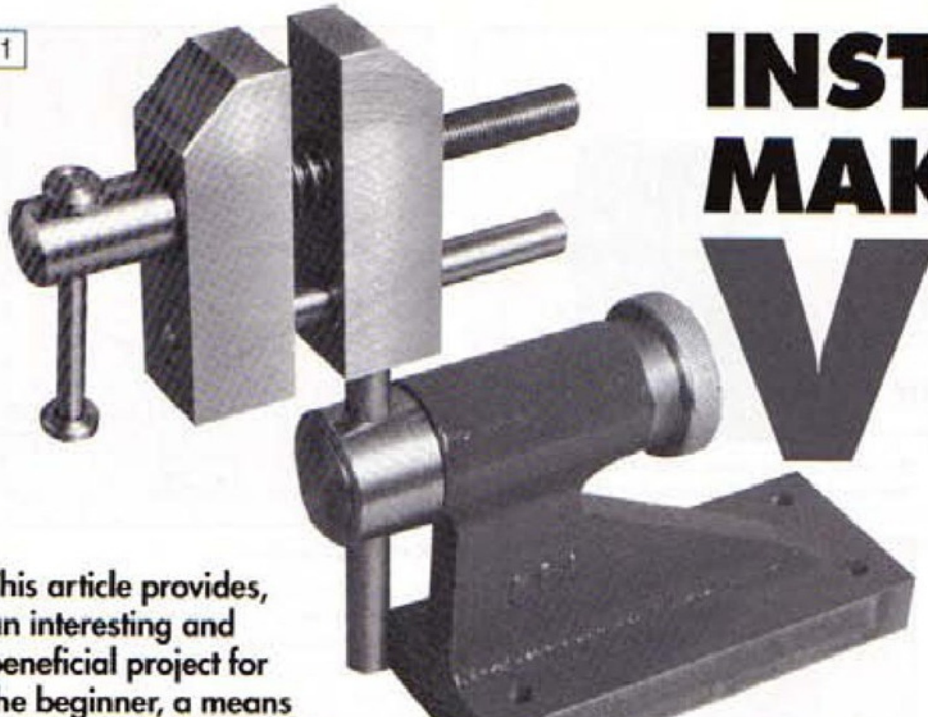
If shorter measurements are required, this can easily be achieved by making separate columns from ¾in. dia. mild steel. These are simply turned down to ⅜in. dia, leaving a ¼in. base, the overall length being machined to length using an outside micrometer. In order to mark the desired distance or height, put the micrometer in place and tighten into the main body. Place the knife edge on top of the micrometer or short pillar, and transfer this to the job.

QUICK TIP

The distance between centres of two mating gears is equal to half the total of the pitch circle diameters of both gears added together. **Alan Jones**

INSTRUMENT MAKERS VICE

1



1: *The completed vice, generally as per the College Engineering Supply drawing.*

2

2: *The base being used with an item from the recent DTI/Helping Hand article.*

This article provides, an interesting and beneficial project for the beginner, a means of putting the Promill-35 to work; this machine was reviewed in the June/July issue, and the useful end product of this further trial is an instrument makers vice

The subject of this article is a small instrument makers vice, for which the casting is supplied by College Engineering Supplies. It is written with three aims in mind. The first, the ultimate production of a very useful item of workshop equipment, in particular for the home workshop where small precision work is regularly undertaken. Also, being a relatively straightforward item to make it is written and illustrated as a project for the beginner. Finally, it is seen being made on the Rishton Promill-35 milling machine, reviewed in the last issue, and is an admirable small project to put this machine through its paces.

The design

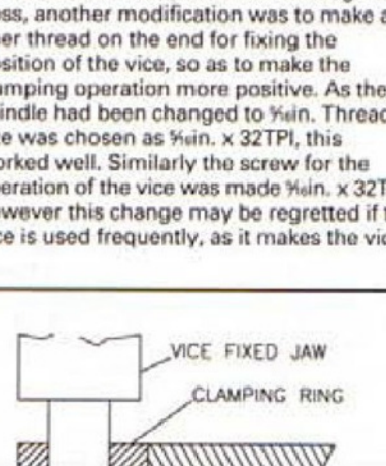
The main purpose of the vice is to hold small items and be movable in all directions, enabling the workpiece to be placed in the best possible position for working on; **Photo 1** shows the completed item. Similar vices are available commercially, however, those which I can recollect seeing are rather larger and quite expensive.

When purchasing, the casting it comes with a spring, the purpose of which will be seen later, also drawings adequate for its manufacture. In the case of the one being made in the article, some minor changes to the design, as seen on the drawings supplied, were made. The casting is available either in cast iron or aluminium, the one in the article is cast iron.

Some design changes

Firstly, the base seemed to lend itself to possible use with some of the items described in the recent dial test indicator cum helping hand accessories articles, these were in issues 14 and 15 of *M.E.W.*, a typical example is shown in **Photo 2.** To achieve this aim, the hole through the tubular clamp, intended for the spigot on the end of the fixed jaw, was made 5/16in. diameter. Similarly, but probably of less significance, the hole through the boss on the top of the main casting was also made 5/16in.

Having changed the diameter of the spindle to suit the smaller hole through the boss, another modification was to make a finer thread on the end for fixing the position of the vice, so as to make the clamping operation more positive. As the spindle had been changed to 5/16in. Thread size was chosen as 5/16in. x 32TPI, this worked well. Similarly the screw for the operation of the vice was made 5/16in. x 32TPI, however this change may be regretted if the vice is used frequently, as it makes the vice slower to operate. The short operating handle on the end of the screw should make it function satisfactorily with the coarser thread indicated on the drawings.



METHOD OF MAKING CLAMPING RING CAPTIVE.
SKETCH 1.

©

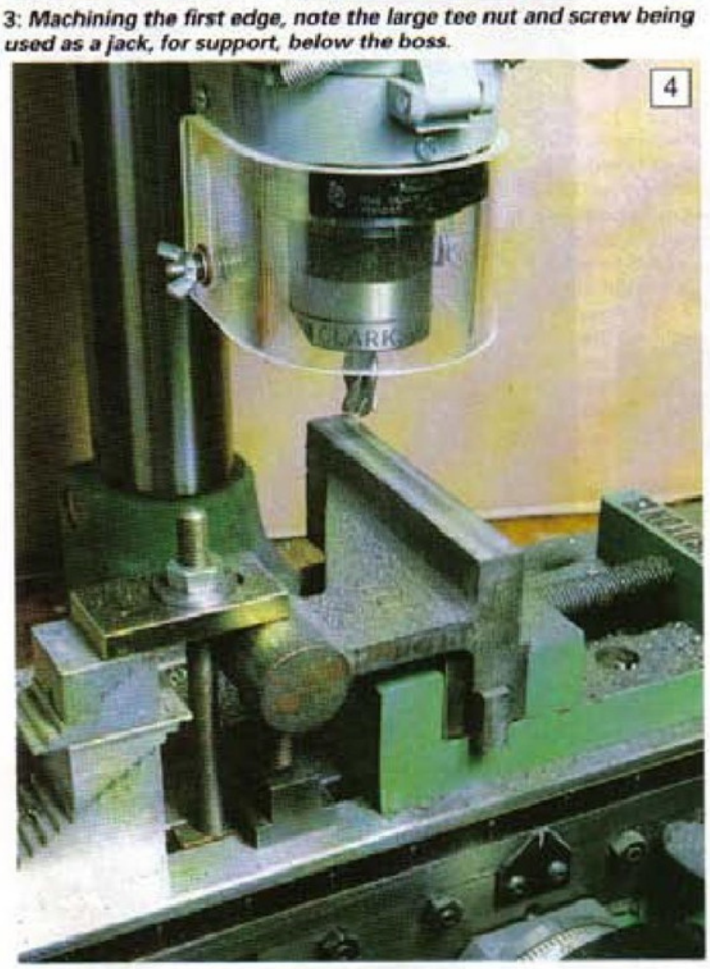
Another change, to make the unit easier to use, should it be used with a range of accessories, was to make the outer ring of the clamping assembly captive. To achieve this, the outer ring is made with an inside flange at the inner end, and the spindle made with a suitably reduced diameter to take this, this is best seen in **sketch 1**. The remainder of the drawings published with this article are copies of the drawings provided by College Engineering Supply, and do not reflect the changes referred to through the article.

Other minor modifications were made to simplify the construction and these will be detailed as the method of manufacture is explained. Also, as the manufacture of the vice is considered, at least for some, an exercise in milling, some operations are included which are not called for on the drawing, but provide beneficial experience. These are probably superfluous for the reader in a hurry to get the vice into use.

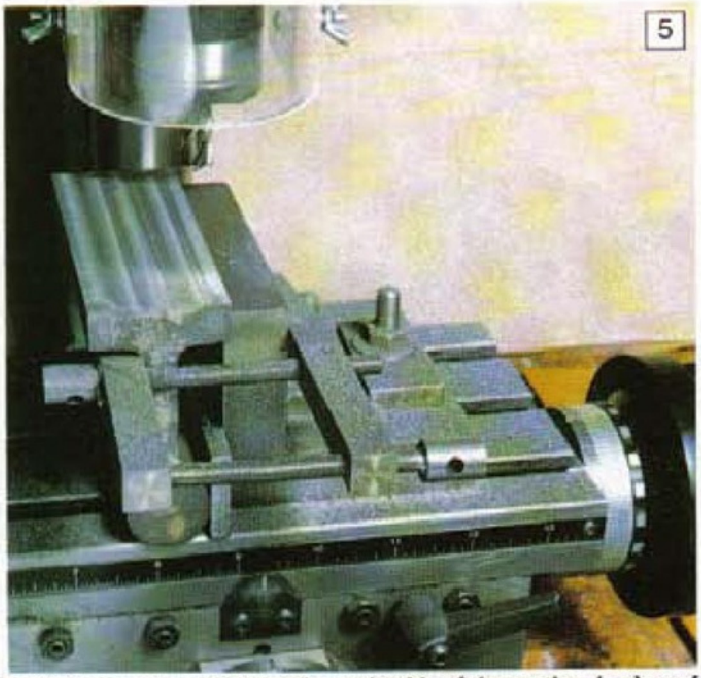
Machining the casting

The majority of operations are very straightforward with only the main casting presenting any real challenge. The machining of many castings presents a problem due to their irregular shape making holding them difficult, this is much less likely with parts made from stock material. The problem will frequently be greater when the part is being machined on a smaller milling machine, and even more so when milling operations have to be done on a lathe.

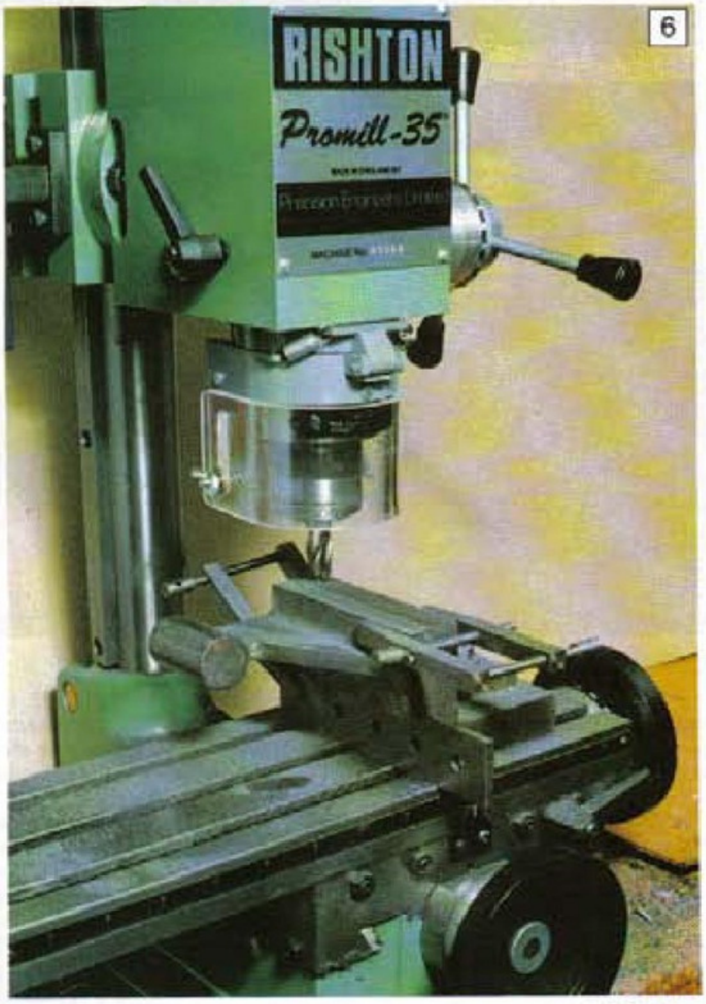
3: *Machining the first edge, note the large tee nut and screw being used as a jack, for support, below the boss.*



4: *The second edge being machined.*



5: *The set up for machining the underside of the casting. In view of the single toolmaker clamp fixing a normal endmill was used in place of a fly cutter with its intermittent cutting action.*

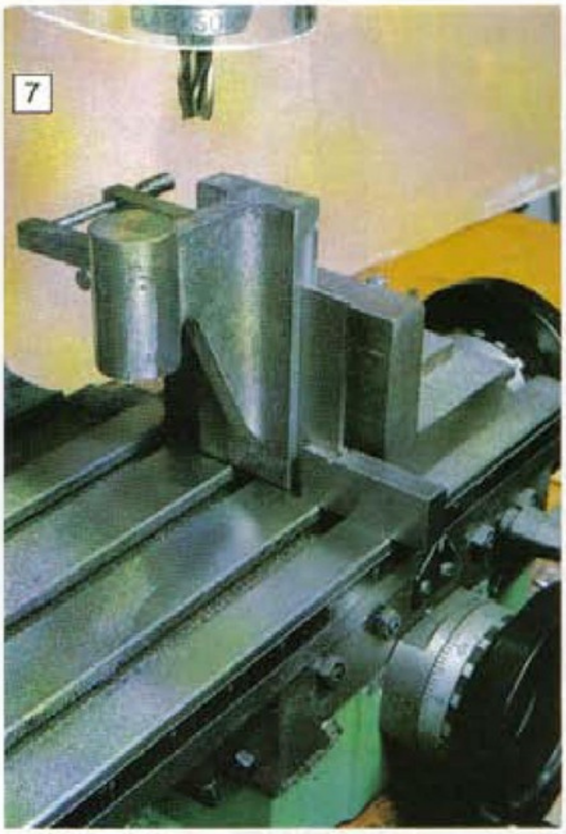


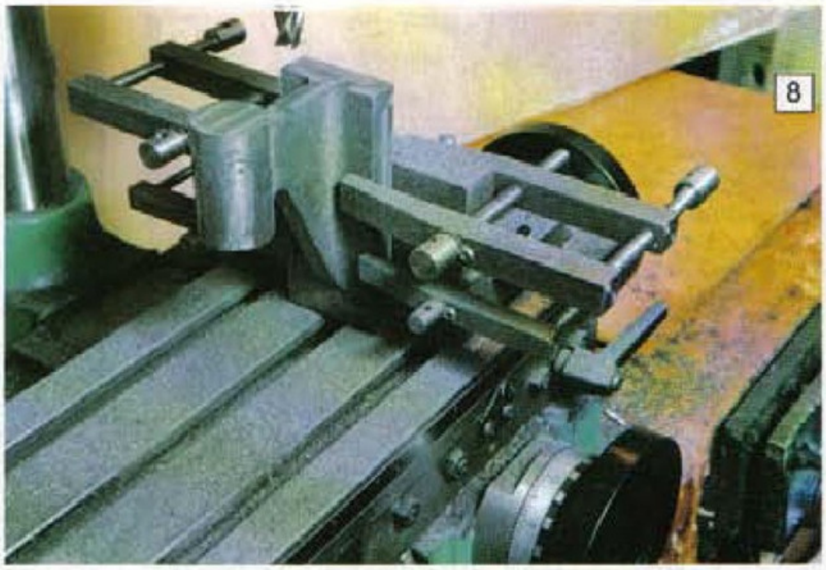
6: *With the bottom now machined, the edges were again lightly machined for improved accuracy.*

In this case it was decided that, in addition to the base and ends of the boss, all four sides of the base should be machined. This would provide useful milling experience, and also be preferable should it be found advantageous to grip the base in a larger vice, rather than having it permanently screwed down to a bench. It may even prove useful if it is required to be accurately positioned on a machine table, though this would be without the vice and its use in this manner is pure speculation.

It would appear logical to start by machining the underside of the base, and if this was being undertaken on a larger machine and with a large vice, this would probably be the way to proceed. Of course there is no hard and fast rule when it comes to such situations, and some readers would, I am sure, tackle the problem differently.

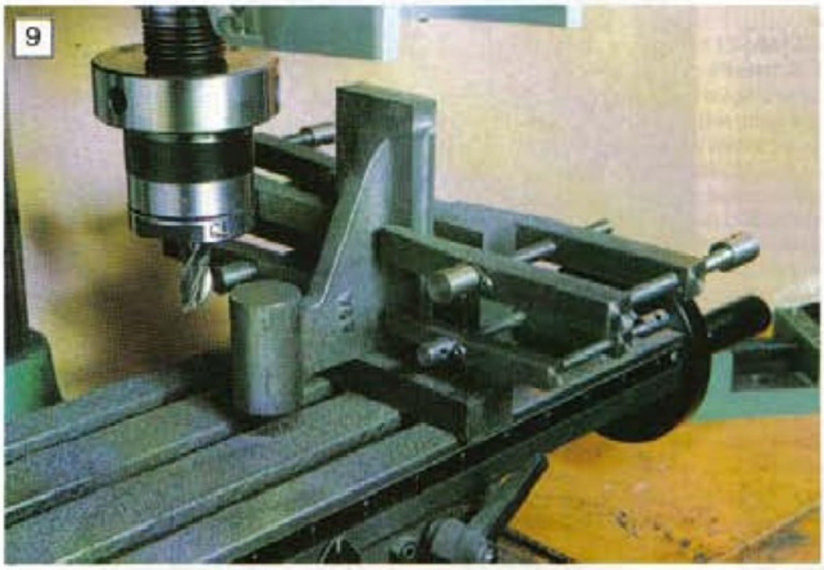
In this case it was decided to machine one edge of the base first, this being done with the lower edge held in a vice and additionally supported below with a parallel. Due to the taper on the casting as it joins the central web, the casting could





7: *Setting up the casting for machining the front edge of the base and face of the boss.*

8: *Machining of the front edge of the base and front face of the boss.*



9: *Machining the rear face of the boss*

10: *Drilling the hole in the boss, note the additional support under the boss whilst drilling.*

only be held close to its edge. This on its own would not hold the casting accurately or, more important, securely, and additional support and fixing was required. This was achieved by clamping the boss, however, this could not be done on its own as it would just lever the casting out of the vice. It was necessary therefore to add some support below the boss, and close examination of **Photo 3** will show a jack placed below. As can be seen, the jack is made from a large Tee nut and a normal screw, this is a very easy way of acquiring a jack for applications like this.

Before finally tightening the vice and the clamp onto the boss, the height of the jack was adjusted such that the lower face of the base was upright, being tested with a small square standing on the machine table. As the bottom of the casting was still unmachined, precision was of a low level at this stage.

With the vice and other items still on the machine the second edge of the base was machined in the same manner, **Photo 4.** Of course the jack required further adjustment and the base was again tested with a square.

With the vice removed and an angle plate fitted, the casting was positioned as in **Photo 5** for machining the base. Fortunately a piece of $\frac{3}{16}$in. thick material was adequate for use as packing between the boss and angle plate, no need for the addition of shims etc, and this can clearly be seen in the photograph. An end mill was used for this operation as, using only a single heavy duty toolmakers clamp for fixing, it was considered that the intermittent cut of a fly cutter may not be advisable.

When completed and removed from the angle plate the edges were checked for accuracy. The results of these checks were as would be expected, that is, the two edges were parallel along the length but were not square to the bottom. This was not surprising in view of the imprecise setting made when initially machining the edges. The error was not that great and would have been quite acceptable for the application, however, as an exercise in accurate manufacture, it was decided to improve the situation. To achieve this the angle plate was left in place on the machine table and the casting positioned

11: ***The casting machining complete except for the fixing holes; see photograph 16.***

as shown in **Photo 6.** A precision parallel was placed below the casting as can be seen and the top edge lightly machined, when complete the casting was reversed and the second edge machined. The end result of this was a much more accurate part thus far.

Again with the angle plate still in position the casting was fixed for machining the front edge and the front face of the boss. It was initially fixed with a single toolmakers clamp and the casting accurately positioned using a small square, this is illustrated in **Photo 7**. With the casting positioned additional clamps were fitted and both the front edge and front face of the boss machined, as seen in **Photo 8**. The front of the central web was also machined but only to within about 4mm of the boss, this left a little material enabling a fillet to be carefully made using a small round file.

The casting was then removed and rotated so as to permit machining of the other end of the boss. Due to the extension of the boss a packing piece was placed under the front edge just machined, however this was really just for holding the casting in the raised position whilst the first clamp was fitted, it was still positioned using a square generally as in **Photo 7.** The casting with the machining complete is seen in **Photo 9.**

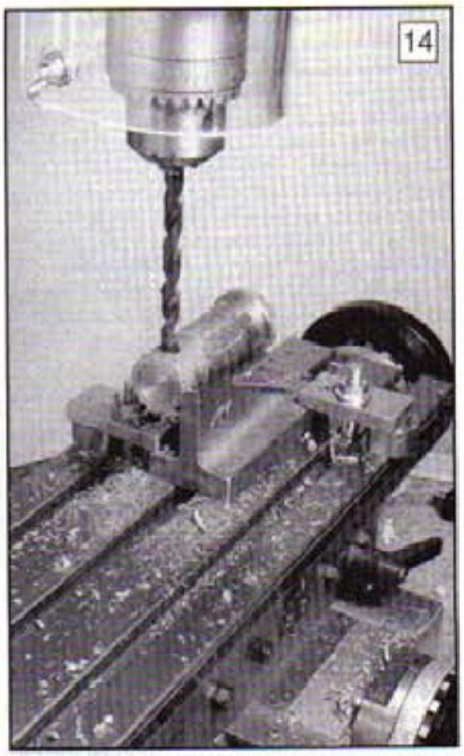
Whilst still in this position the hole in the boss was drilled. The downward pressure when drilling can be quite high so additional packing was placed between the boss and the table, see **Photo 10. Photograph 11** shows the almost completely machined casting, but still requiring the fixing down holes to be drilled.

12: ***The completed clamp arrangement, note the small flange inside the outer ring to make it captive.***

The remaining parts

The next stage was to make the three turned parts that make up the clamping arrangement for the spindle on the fixed jaw of the vice. As was mentioned at the commencement of this article some changes were made to this, being the reduction of the size of the thread to 5/16in. x 32 TPI and the provision of a small flange on the inside of the outer ring, so as to make it captive, this can be seen in **Photo 12.** To make the subsequent cross drilling easy, the thickness of the flange in the ring was initially made a little more than the width of the turned portion on the spindle. This arrangement ensured that both the ring and spindle were firmly clamped when the knurled nut was tightened.

13: ***Using an edge finder to precisely position the spindle relative to the outer clamp ring.***

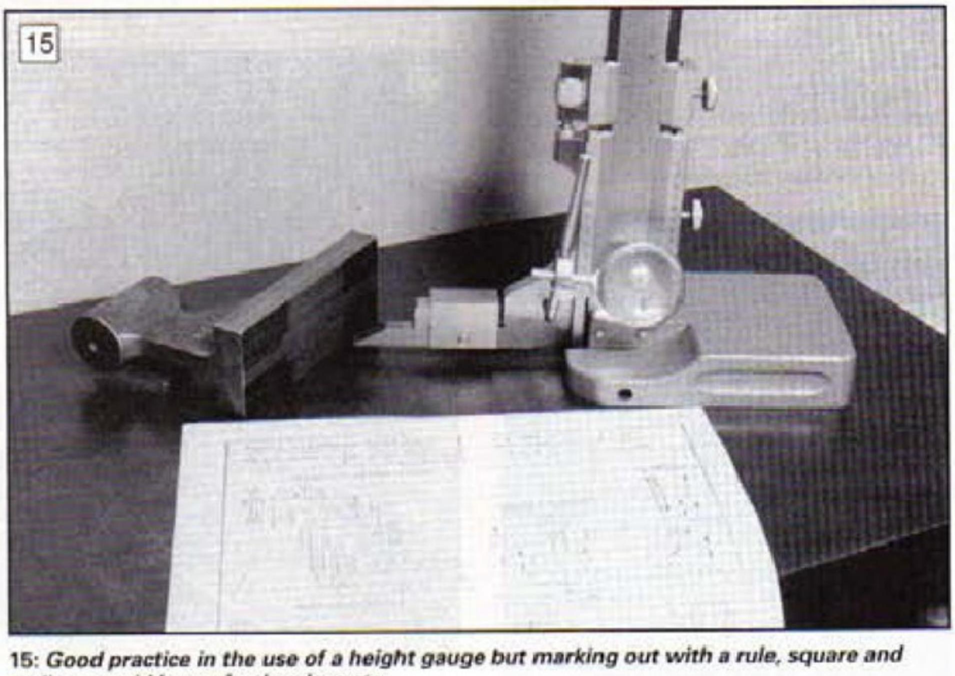


14: ***Drilling the hole for the vice spigot.***

The turned parts were then assembled and returned to the milling machine for cross drilling. An edge finder was used to locate the position of the assembly, **Photo 13**, and the top of the ring drilled with a centre drill. The aim was to accurately drill and ream the hole, such that it would accept the bar through it no matter which way the two parts were orientated, readers who have attempted this will know the difficulty of this operation. Having positioned and centre drilled the hole, it was then drilled through with a suitable size drill for reaming 5/16in., see **Photo 14.**

The hole was then reamed and the parts dismantled. If the parts were then left as they were, clamping of the rod through the hole would not take place. To ensure that the assembly would work as intended, it was necessary to return the spindle to the lathe and remove a few thou from the end, at the larger diameter, at the stepped end. The parts were reassembled and a rod passed through and clamped using the knurled nut, it worked perfectly. The real test of accuracy was now made, the bar was removed and the outer ring rotated through 180 deg., with this done, not surprisingly the bar would not enter fully.

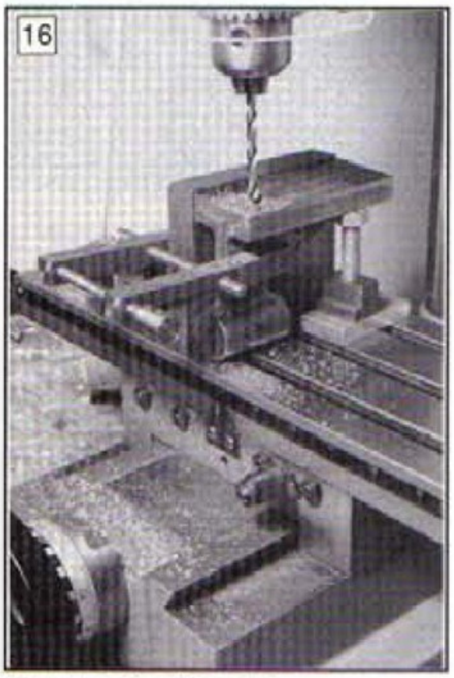
One possibility, to overcome this, would have been to place a small pin in the flanged end so that the parts remained in the same relative position, it could be



15: ***Good practice in the use of a height gauge but marking out with a rule, square and scriber would be perfectly adequate.***

arranged axially rather than radially so that it would not be seen when assembled. Another, and easier, solution would be to open up the cross hole in one or both of the parts, this would depend on the extent of the error present. On closer examination it was found the error was very small, hardly visible in fact, but attempting to place a piece of ⅜in. rod that was almost spot on diameter through a reamed hole, left little margin for error. All that was necessary to make it work as desired was to pass the reamer through the holes in this position and all was well, in fact the metal removed was minimal.

Photograph 15 shows the base being marked out for its fixing down holes, using a height gauge. This may seem rather like taking a sledge hammer to crack a nut, but as it was available it was all good practice in its use. The use of a surface gauge or just a rule, square and scriber would have been perfectly adequate for the operation.

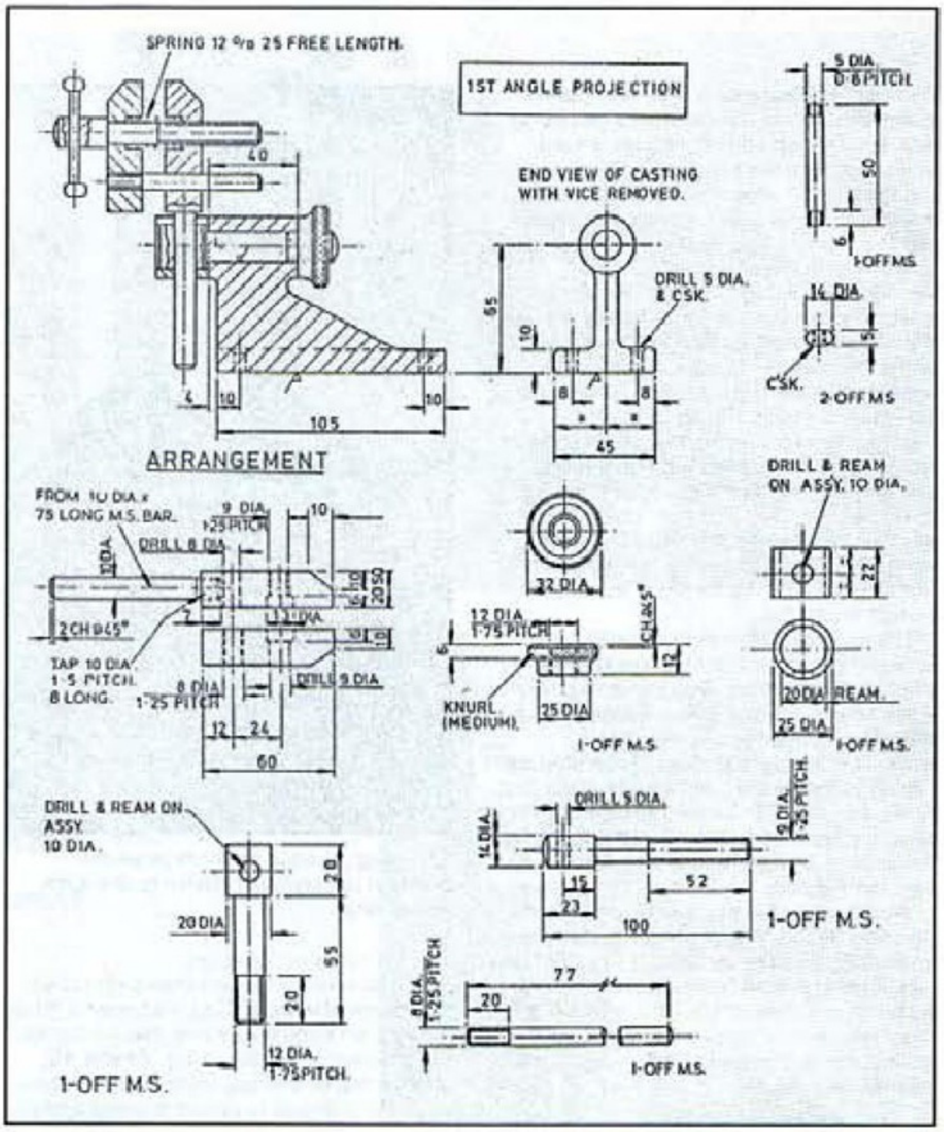


16: ***Drilling the fixing holes.***

The casting was then, as seen in **Photo 16**, returned to the milling machine and, using an angle plate, firmly fixed in position. The boss of the casting taking the weight at one end whilst the other is supported by a makeshift jack. I really must get round to making myself a set of jacks!

QUICK TIP

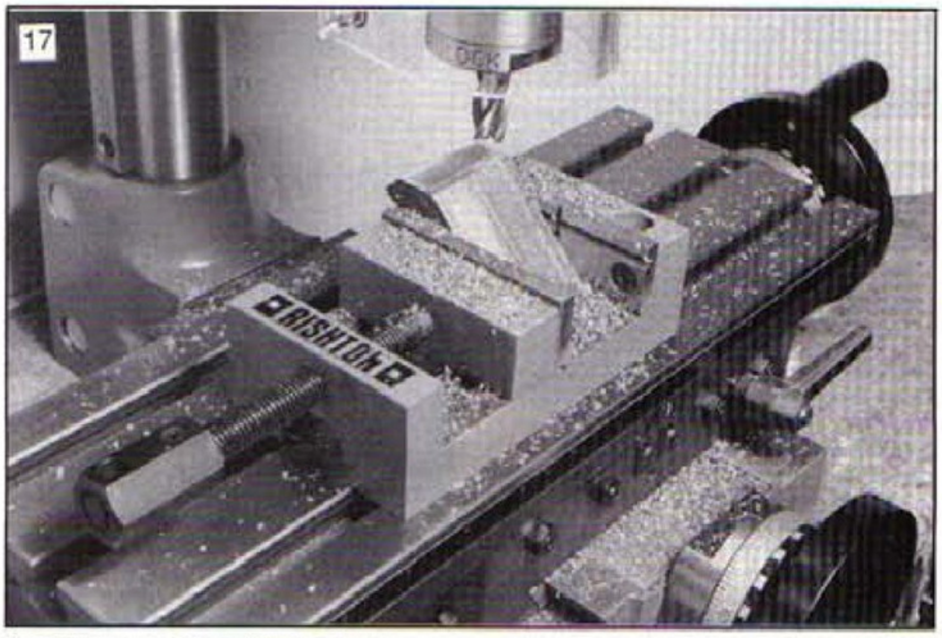
35mm film cassette holders are a useful thing to have around the workshop. They can be used to store small nuts, bolts etc., but having a waterproof top they are ideal to hold small quantities of ready mixed flux etc. I keep one filled with hand cleaner in the night school box, ideal to save the steering wheel of the car serving the purpose of a hand cleaner on the way home - a few squares of kitchen roll take up little room and make an effective towel at the end of an evening class session - especially if the day-time students have bagged all the paper towels from the washing area.



The holes were then drilled as can be seen, however had an edge finder been used to locate the casting, then the machine dials could have been use to place the holes in position and the marking out stage avoided. The C.E.S. drawings show the top of those holes as countersunk, however even with a long countersink, having a slim shank, the approach to the two holes at the boss end would have to be at quite an angle due to the width of the boss. Because of this it was decided to leave the holes parallel, as can be seen in **Photo 20.**

Making the vice

With the base complete it now remained to make the vice, again with some minor changes to the College Engineering design. The two pieces of 20mm square BMS for the jaws were cut to length and their ends faced on the lathe whilst mounted in the

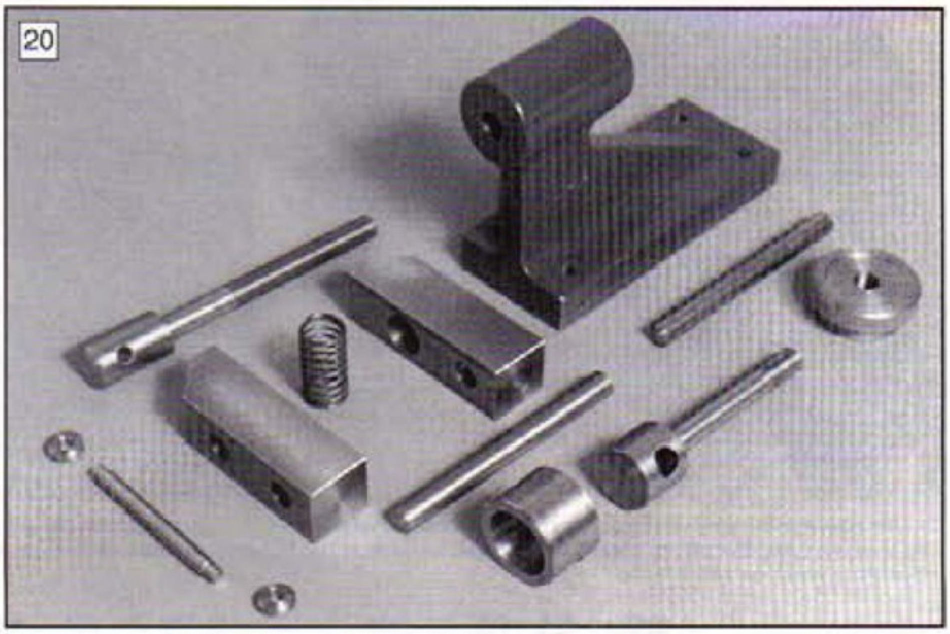


17: ***Milling the angle on the vice jaws.***

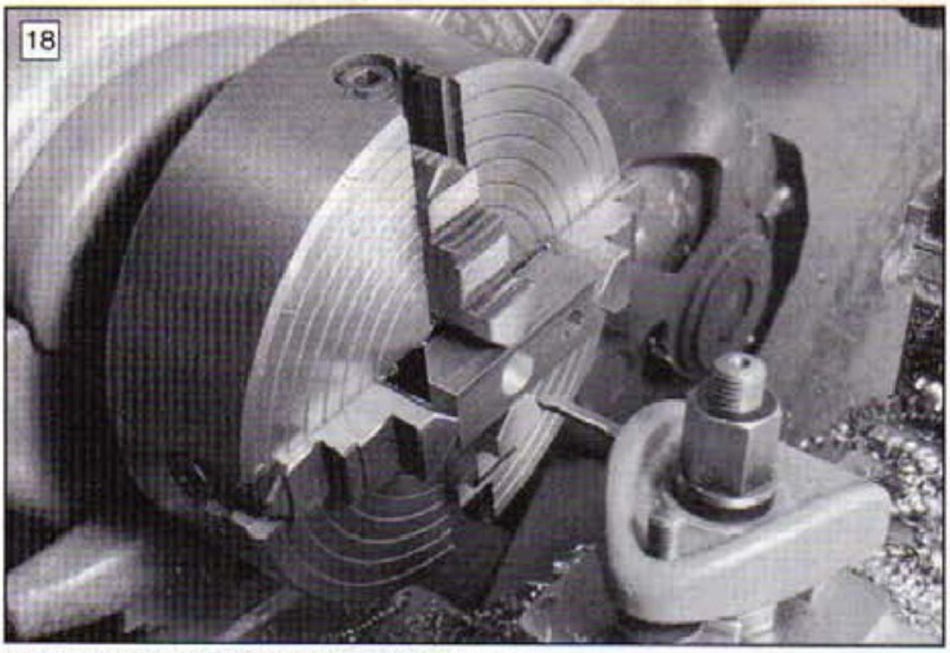
four jaw chuck, ensuring that both pieces end up the same length. Whilst facing the last end it was drilled 5/16in. diameter for the vice mounting rod. This was the first change, in that it was decided that it would be simpler to just take a plain end to the mounting rod and secure it with two part resin adhesive.

The two jaws were then transferred, as seen in **Photo 17**, to the milling machine and the angled ends made. A second change was made at this point, this time both for ease and also considered preferable. The drawings call for the guide rod fitted to the lower end of the jaws, to be threaded into the front jaw and be a sliding fit in the rear one. I considered that, unless the thread on the rod was concentric, I find them prone to wander, and that through the jaw square, the two jaws would not mate correctly. With this possibility in mind, I chose to drill and ream through the two whilst clamped together, and eventually to fit the guide, again using adhesive.

With the two holes drilled and reamed, and a short length of rod placed through



20: ***The completed set of parts ready for assembly.***



18: ***Counterboring the vice jaw to take the spring.***

the two parts to ensure they were in line, the upper hole in the jaws was drilled through at a size suitable for tapping 5/16in. x 32TPI. This was followed by opening up the hole in the front jaw to 5/16in. and using this as a guide through which to pass the tap for tapping the rear jaw, thus helping to ensure this was square.

It now remained to make the recesses to take the spring, this was done by fitting each into the four jaw chuck and boring out using a small boring tool, this ensured a square bottom to the recesses. The Rishton Promill-35 always appeared to have plenty of torque in hand, so no doubt would have been happy opening up the 5/16in, hole to 13mm, maybe not a one go, but it would have had an angled bottom.

The material used for the jaw was quite badly pitted and would give the vice a poor appearance, it would not affect its working, but even so it was decided to attempt to improve on the situation. Perhaps one day, someone will tell me why square and rectangular bar suffers this way, whilst round bar is much less affected *(any offers Ed.)* The marks were too great for a dose of wet and dry, or even draw filing, so it was a case of back to the mill and use a flycutter, as seen in **Photo 19**. When are we going to be able to obtain a not too expensive surface grinder? The edges of the jaws had already been chamfered using a fine file, but having now flycut all the faces, except the inner jaw faces, they were again chamfered to about 0.5mm.

A few turned parts remained to be made and the operating screw was next. There is little to be said regarding this other than has already been mentioned its change of thread size. The handle with the knobs for fitting to the ends were made next. Again it was considered that threaded ends were an unnecessary complication. As a result it was chosen to just turn the end of the bar down to 4mm, make plain holes in the knobs with a slight chamfer and very lightly rivet. As it was only possible to radius the outer end of each knob prior to parting off, a stub mandrel was made on which the knob was placed so as to radius the other. The bar was then placed in the operating screw and the knobs lightly riveted on.

Two rods were then made from 5/16in. BMS and one fixed into the bottom of the fixed jaw whilst the other was fixed into the moving jaw, both using adhesive. It was with considerable surprise that when assembled the two jaws did not come together parallel despite my having reamed both jaws whilst together. I then remembered that the bar I had used was slightly bent and whilst I had considered that this would not be important for such a short piece I was obviously wrong. At some time I will force out the bar and replace it, this will be an interesting test as to how firm a hold has been achieved with the adhesive. **Photograph 20** shows all the finished parts prior to final assembly.

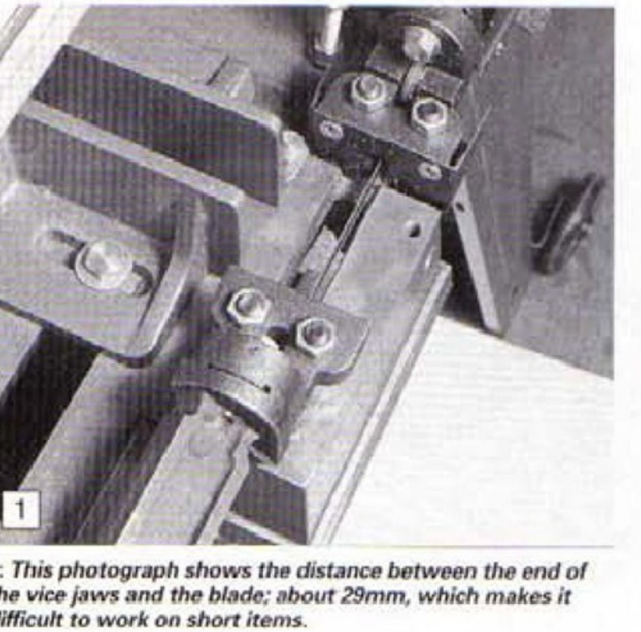
19: ***Flycutting the vice jaws to remove the pitting on the material and improve their appearance.***

The Promill-35

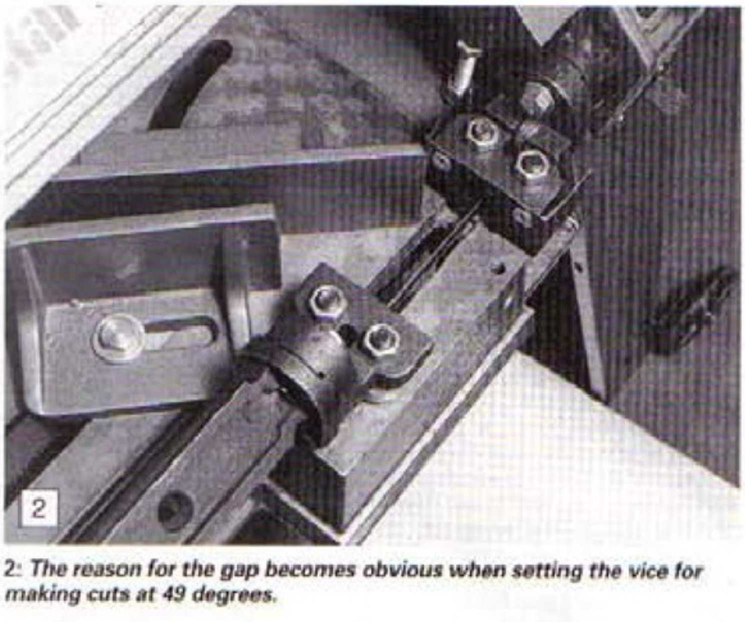
The operations chosen for making this instrument makers vice have been to make maximum use of the Rishton Promill-35 milling machine. The tasks set for the machine to perform were all done with ease, the variable speed drive being exceptionally pleasant to use, and at no time appeared to be the slightest bit stretched. Of course none of the work undertaken was that arduous, so perhaps something requiring a little more output torque will be attempted prior to it being returned.

Supplier

The College Engineering Supply, 2 Sandy Lane, Codsall, Wolverhampton, WV8 IEJ. Tel. 0902 842284.



1: *This photograph shows the distance between the end of the vice jaws and the blade; about 29mm, which makes it difficult to work on short items.*

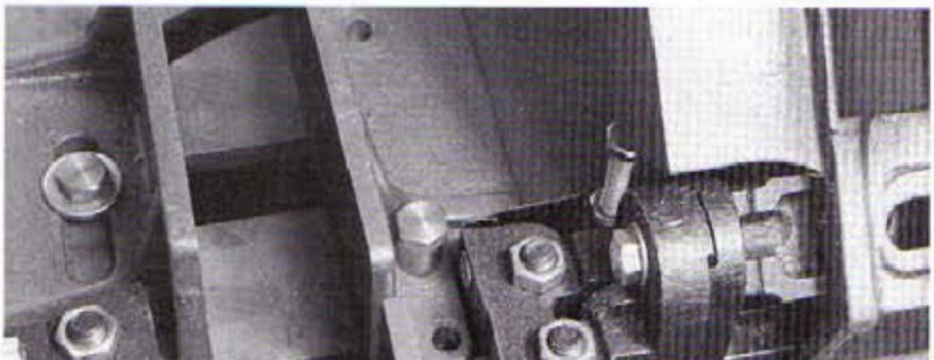


2: *The reason for the gap becomes obvious when setting the vice for making cuts at 49 degrees.*

BANDSAW VICE IMPROVEMENTS

Owners of the very useful universal band saws will, I am sure, have discovered their inability to hold short items for cutting in the horizontal mode. This is an unfortunate short coming. The simple modification proposed in this article will go a long way to eliminating the problem, at least when cutting at, or near, 90 degrees

Owners of the popular universal bandsaws will have found that, with a little effort in settng up the blade guides to ensure that the cut off is square, their performance is very acceptable. There is however one failing when actually sawing in the horizontal mode for which a modification would be worthwhile. A few non-performance related modifications may also be considered as worthwhile.



3: *After adding the small jaw on the outer side of the blade and providing a second position for the original fixed jaw. Note the closeness of the blade guide to the fixed jaw, also the provision of a spacer under the fixing screw to improve access to this item.*

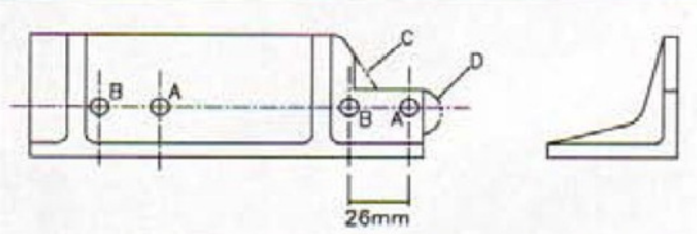
The problem

At first sight there is what would appear to he a quite unnecessary shortcoming in the design of the vice, being that the end of the jaws are some 25mm away from the saw blade, this can be seen in **Photo 1**. As there is obviously a limit as to how short an item can be gripped in the vice; the 25mm gap only means that the minimum length that can be worked on is further increased.

In use however, it soon becomes apparent that the gap is not so silly as at first would appear. The saw is designed such that it permits materials to be cut at any angle up to 45 deg. and this provision requires the vice jaws to he swivelled so that angled cuts can be made. With the jaws swivelled, it becomes obvious that the distance between jaw end and blade is provided to allow this to take place, **Photo 2** shows this situation, a design requirement when setting the vice at an angle. It can however be moved over to be within a few mm of the blade, even when cutting at right angles. This on its own, will be of little, if any, benefit, as the direction of the blade travel is towards the fixed jaw. As a result, this will be of no help in preventing short items being levered out of the vice due to the cutting action.

An additional fixed jaw

It was with this aspect of the problem being considered, that it became apparent that the flat area of the bed on the outer side of the blade, could be made to carry another small fixed jaw. This additional jaw would help considerably to prevent short items being levered out. It was very convenient that a suitable tapped hole was availablle in just the right place for holding the additional jaw, this can be clearly seen in **Photos 1 & 2.** The purpose of the hole is to grip a bar which extends from the bed of the saw , and on which is carried an adjustable stop for cutting repetitive lengths.



A. EXISTING HOLES. B. NEW HOLES 8.5 mm dia.
C. CUT AWAY AS SHOWN TO CLEAR BLADE GUIDE ASSEMBLY.
D. REMOVE PROJECTION ON END.
E. CHECK TO SEE IF MODIFICATIONS AND DIMENSIONS FOR THIS, AND OTHER PARTS, AS DRAWN, SUIT YOUR MACHINE.

BAND SAW VICE FIXED JAW MODIFICATIONS.

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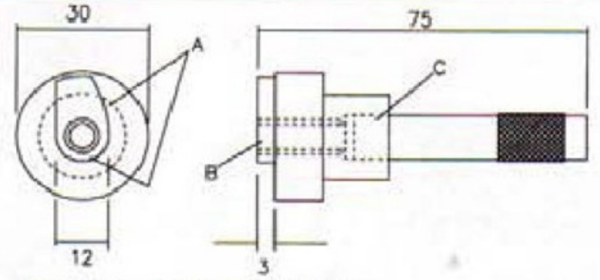
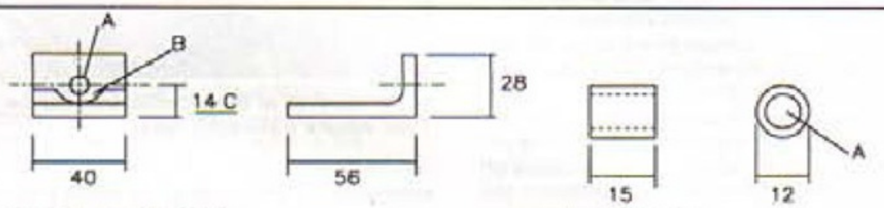


MAJOR DIMENSIONS ONLY GIVEN.
A. FILE TO CREATE CURVE TO SUIT SLOT IN BASE.
B. 5/16" WHIT.
C. TO SAVE MACHINING AND MATERIALS, MAKE PART FROM TWO PIECES. FIX HANDLE WITH RESIN ADHESIVE.
MATERIAL. 30mm dia BRIGHT MILD STEEL.
10mm dia BRIGHT MILD STEEL.

© TEE NUT WITH HANDLE.



A. 8.5mm dia HOLE.
B. CLEAR FILLET TO PERMIT ROTATION OF FIXING SCREW.
C. DIMENSION IS IMPORTANT AS IT ENSURES THE FACE OF THIS JAW, LINES UP WITH THE MAIN FIXED JAW.
MATERIAL. 60mm X 60mm X 6mm ANGLE IRON.

BAND SAW VICE ADDITIONAL JAW.

A. 8mm dia.
QTY. 2 OFF REQUIRED.
MATERIAL.
12mm dia BRIGHT MILD STEEL.

FIXING SCREW SPACERS.

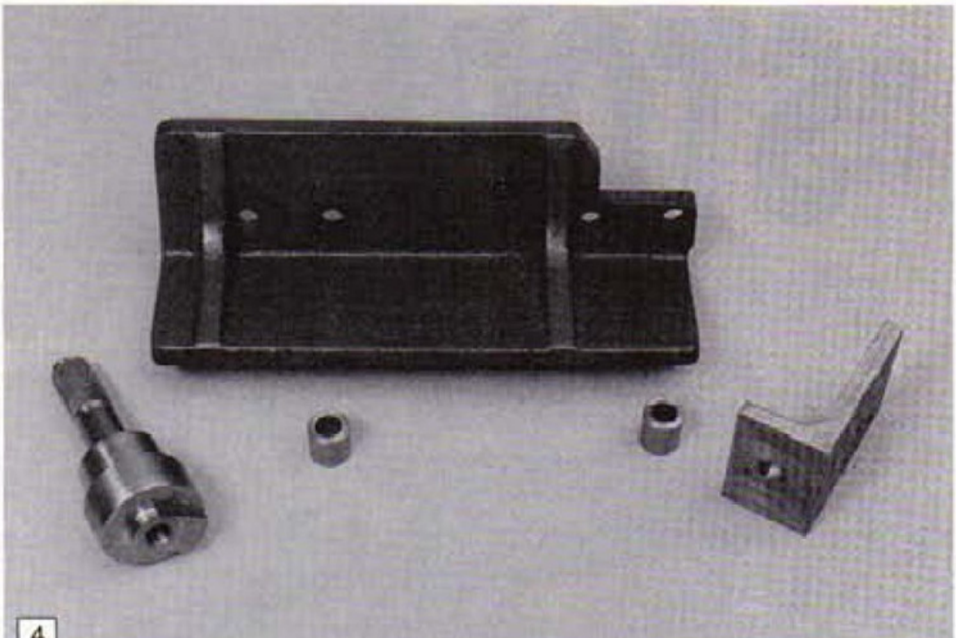
©

It has not been tried, but if the screw to hold the additional jaw is made only about 0.5mm short of clamping the bar also, then with a small plug of hard rubber under the end of the screw the bar should also be adequately held.

Moving the fixed jaw

Having decided to to add the additional jaw, it still seemed a good idea to attempt to reduce the gap between the existing fixed jaw and the blade. The fixed jaw is held with two screws, pivoting on the one nearest the blade, whilst the other runs in a curved slot in the bed and allows for the jaw to be fixed at any angle. As the two screws just pass through round holes in the base of the jaw, it soon became apparent that two additional holes could easily be drilled to permit the jaw to be mounted closer to the blade. As a result of the new positions for the screws, some minor adjustment would be required to the jaw. This consisted mainly of milling away a small portion off the lower web so as to clear the blade guide assembly; this requirement is seen in the drawing and the result in **Photograph 3.**

Another minor problem as a result of moving the fixings, was that the heads of the screws became close to the cast webs at the rear of the jaw, making access to them difficult. Because of this longer screws were fitted and spacers placed under their heads. This lifted the head clear of the web, overcoming the problem, also seen in **Photo 3**. The modified jaw together with the additional small jaw and spacers can be seen in **Photo 4**, which was taken prior to assermbling the parts onto the machine. Also in this photograph is a special nut or fixing the jaw at the curved slot.



4: ***The new parts and modified jaw prior to assembling onto the machine.***

5: ***Close up of the new tee nut used for clamping the movable jaw at the curved slot.***

Improved jaw fixing

The screw that runs in the curved slot has only a loose nut and washer under the bed of the saw, this necessitates the use of a spanner when tightening. As the position makes this very inaccessible, it has been replaced by a simple tee nut which enables the jaw to be tightened from the head of the screw only. This worked very well, but the new arrangement would require the screw to be removed fully each time fixings had to be changed in position.

In view of this, the simple tee nut was replaced by a tee nut with an extension, enabling the nut to be more easily added or removed. It had an end in the form of a tee nut, so that there would still be no need for a spanner to prevent it turning. However to make the nut run round the curve more easily the outer side is made curved, this helps in ensuring that the vice can be set at 90 degrees. The end has to be radiused to fit into the end of the slot, these can be seen in **Photo 5.**

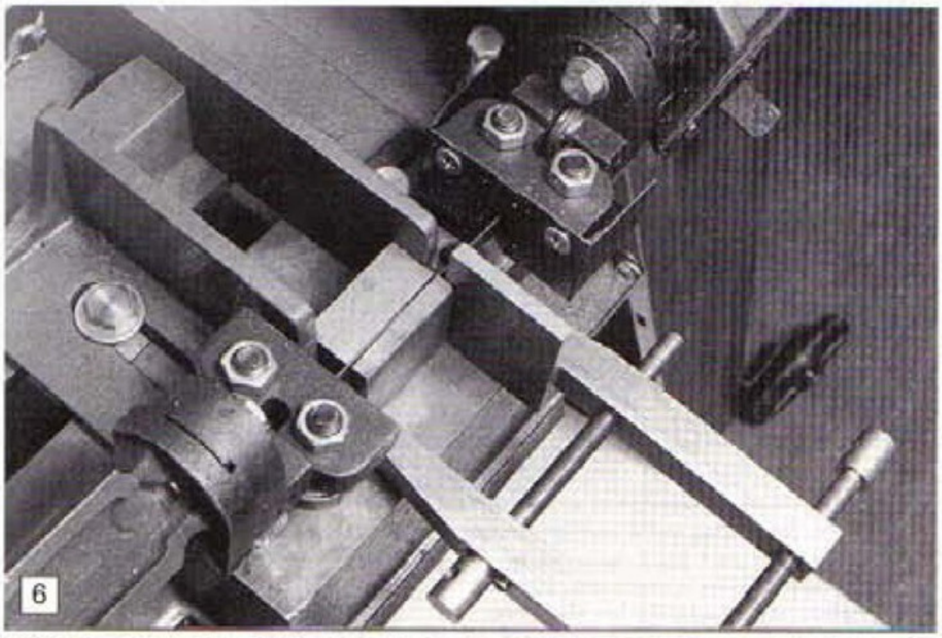
Conclusions

The additional position of the fixed jaw alone helped in enabling shorter items to be held for cutting, but when used with the additional fixed jaw, quite short pieces can be tackled. In some instances, the addition of a clamp of some form, clamping the outer end of the material being cut to the added jaw, would further assist. Of course, when holding very short pieces a suitable packing piece at the other' end of the vice will prevent undue strain on the vice's moving jaw, this simple precaution will add considerably to the security of the part being held.

The success of this modification can be judged urom the work being carried out in **Photo 6,** here we see a very short piece of 1½in. square BMS being sawn quite successfully. I think it probable that the toolmakers clamp, used for added security, could have been omitted.

It can just be seen that there is still a little free slot left in the moving jaw which would permit it to be moved to within a mm or two of the blade. Therefore, had support of the blade been sacrificed somewhat by the blade guide being moved further away from the vice, the moving jaw could have been moved over permitting an even shorter piece, perhaps as short as 10mm; on the vice side to have been cut

This small modification which can be completed in a mater of two to three hours; will further increase the usefulness of an already very useful machine.



6: The success of the modification can be seen in this picture, cutting a very short piece of 1½in. square BMS with ease.

QUICK TIP

Buy an aerosol of belt dressing from engineers' suppliers and spray it on your machine drive belts. It increases friction between belt and pulley, and increases the life of belts.

Alan Jeeves

A METAL BENDER

If bending metal strip, is a vice and hammer job in your workshop, then this strip bender designed by Terry Gould is worth considering. See also the swivel base elsewhere in this issue by the same author.

PULL OUT PLAN

The bender came about, as with most of my tools, through the need to have a tool to do the job. Prior to making the bender, any material that needed to be bent, was done in the vice, tapping it round with a hammer, not only does this leave hammer marks, I am sure that it does not do the vice any good.

There is nothing new in the design of this bender, it has been around for a good many years.

I have seen and used much larger versions similar in design that are capable of bending 3in. x ½in. steel bar. Alright for those who want to keep fit some will say. It does not take as much physical effort as one may think. Providing the bender is well fixed down and the handle is long enough.

All parts for the bender are made from black mild steel, unless stated otherwise. The centre section of the main base, Item "B" may be a problem for some, either in producing the 1½in. dia. hole or in obtaining a block of steel the required size. An alternative method or construction for this centre section has been included.

I tend to put weld preps on most welding jobs, more so with arc welding-with MIG I don't bother so much as better penetration is achieved. Putting preps on will allow for cleaning up of the weld, but these can be left off if so desired.

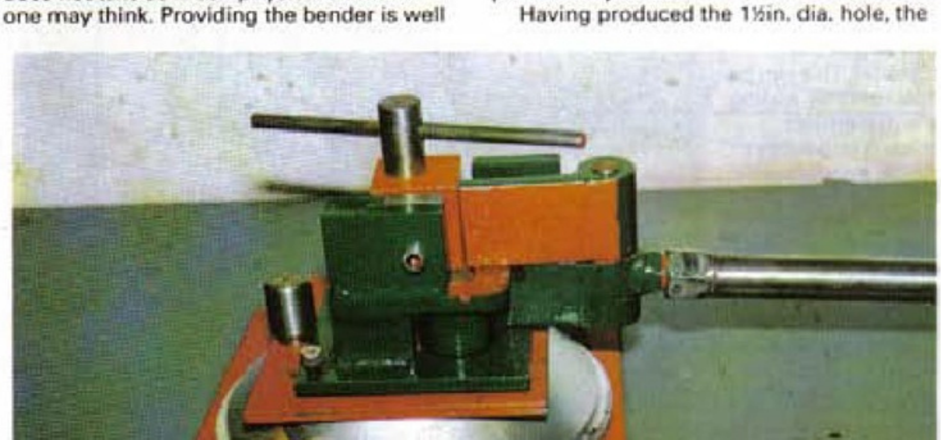
The main base (1)

Items A and C are two 5/16in. thick mild steel plates. No dimensions or size is specified for the 3 base mounting holes in Item "A". These are best made to suit the individual. Item "B," the centre section was made from 2¾in. square mild steel 1in. thick. Before this is welded to Item A and C it will be necessary to produce the 1½ in. dia. hole. As this hole is ¾in. from both edges of the block, if we attempt to drill this hole, then there is a risk that the drill may wander off and break through the edge before the drilling is complete, even with a pilot hole. My first attempt with this hole did precisely that.

If drilling is to be the method adopted, then make the block 3in. square, mark the hole centre in 1in. from both edges. The block can be cut down or machined to size after drilling. Not that many will have a drill this size. The other way is to bore the hole, either by mounting the block in the 4 Jaw if it is big enough or as I have done by clamping the block onto the cross slide using suitable packing to achieve the correct height and a boring tool held in the chuck, collet or mandrel nose.

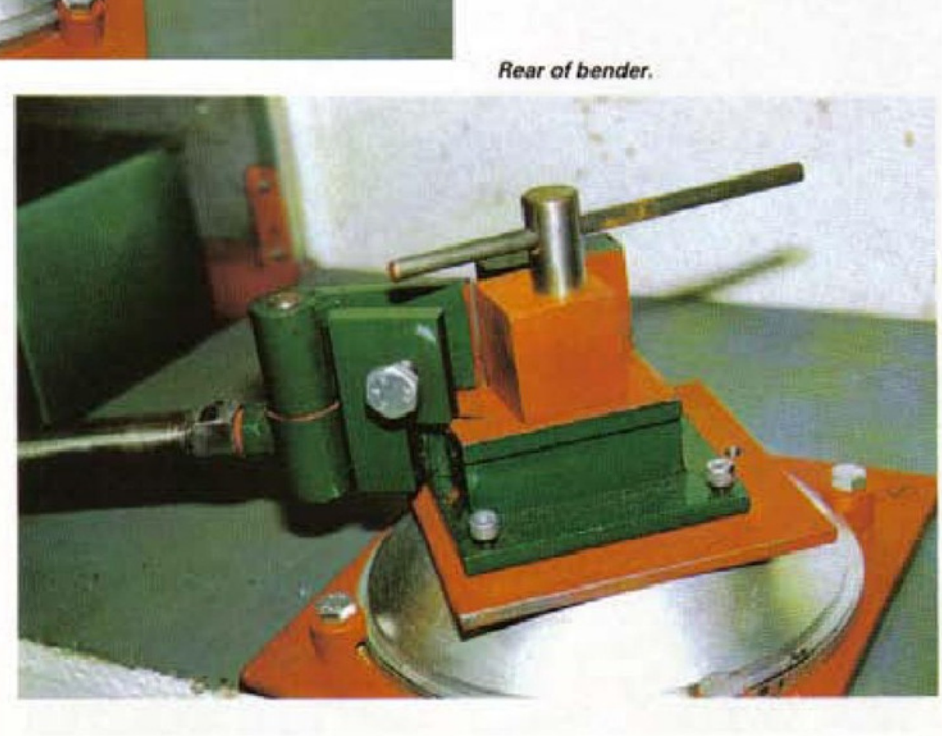
Maybe I'm lucky in having a 1½in. Rota broach, this being set up in the 4 Jaw to produce my hole.

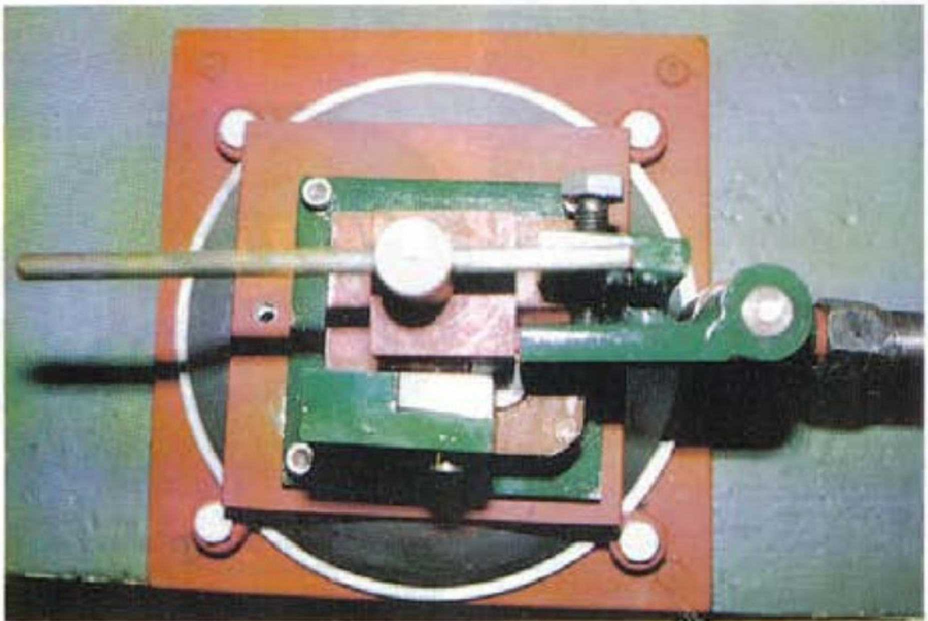
Having produced the 1½in. dia. hole, the block can now be positioned on to Item "A", and welded, followed by Item "C". Having welded and cleaned up the base, the position of the ⅝in. and ¾in. holes can now be marked off, drilled and reamed. These two holes do need to be a good finish in the bore. I must make a confession here, so that any prospective builders will not make the same mistake. When I first wrote to our editor to see if he was interested in the bender, I had only just finished it the week previously and had little time to fully test it out. The mistake was to use a ⅝in. and ¾in. drilled hole. After a few weeks work the high spots in these two drilled holes began to wear. The ¾in. hole is not so important, but the ⅝in. one is-too much free movement in this does effect the clamping of material. When the editor replied that he was interested, I decided to make another base with reamed holes. I actually ended up making a complete new bender and so far I have had no problems. Not everyone will have reamers this size. There are other ways of producing these holes. The main base is small enough to be bolted to the face plate of my 3in. centre height lathe. The ⅝in. hole



The bender fixed on to a single point mounting. The peg on the left of the bender mounting plate is to stop it turning.

Rear of bender.





Top view - it will be seen from the photos that the handle has been made to screw on, the reason for this is, that one handle will fit different tools i.e. plate bender and a round bar/pipe bender.

is easy enough. To get to the ¾in. hole using my lathe I would have to take ⅛in. off the diagonally opposite corner on Item "A" to clear the bottom of the gap. I have not actually done it this way, though I did set it up in the lathe to see if it was possible.

Instead of using a block for the centre section, an alternative method is to use 1in. stock bar, ¼in. thick or more. Once the strips are cut to size, the strips are first welded to the edge of Item "C", which can then be positioned on "A" and welded. One point to bear in mind, with this method of making the base, is that the clamping bar – Item 4 – has a smaller area on which to bear.

The edges of Items "A" and 7 soon wear a groove in this clamping bar, which in time puts the clamping bar out of square; this in turn affects the bending of the material. This can be overcome by adding a ⅞in. diameter boss. A larger boss would interfere with the hinge boss in Item 2. The main problem is getting the ⅞in. boss welded on to Item "C" in the right spot. This can be done by drilling a small hole in Item "C" on the position of ⅝in. hole, say ¼in. clearance hole to take a ¼in. bolt will serve. These two items can then be bolted together and welded. If the bender is only going to be used for light work or not very often, then the boss may not be needed. I am only pointing out what does happen from experience. It will have to be up to the individual builder, whether to fit the boss or not, if this method of construction is adopted.

Item "D" can either be milled from a block 1½in. x ¾in. x 2in. long or made up by welding a 1in. x 1½in. x ¾in. to a 2in. x 1½in. x ¾in. piece of steel. This item requires a 6.5 mm hole for Item 8, which, has been made removable, because this part does wear on the corner. I have shown two of these and (Item 8A), on reflection, the larger radius could have been put on the diagonally opposite corner, providing the bolt hole has been drilled in the correct position, this will save making another.

The reason for this radius is so that it will not cut into or mark the material being bent. The larger 3/16in. radius is for 3/16in. or 5 mm steel. The radius on this edge also makes it easier to bend steel bar.

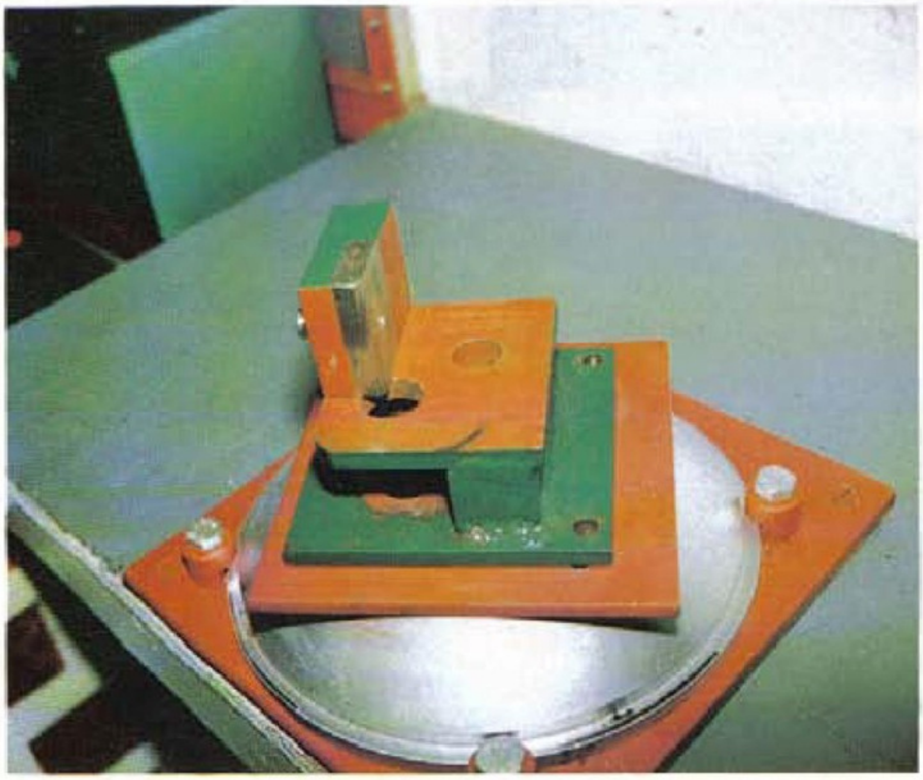
As a guide, the radius on this edge needs to be the same as the thickness you intend to bend in steel, a little less for brass and copper.

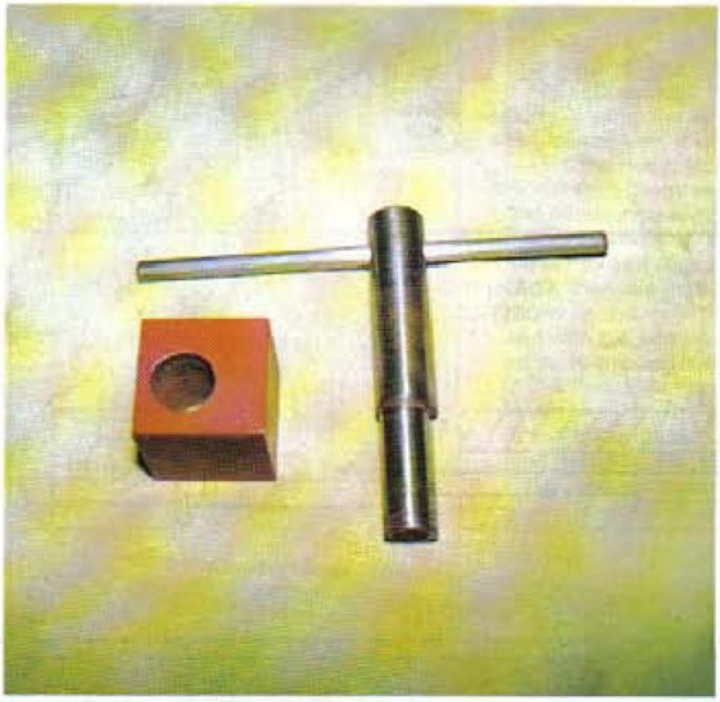
Item "D" takes a lot of pressure and a good weld here is a must. I said earlier that some of the weld preps could be left off, I would not advise doing so in this instance.

Before Item "D" is welded to the main base, Items 4, 5 and 7 will be needed. Item 7 is a clamping block, a 1½in. cube, a straightforward 4 jaw machining job; again the ¾in. hole needs a good finish in the bore, and must be a good fit (not tight) on the clamping bar.

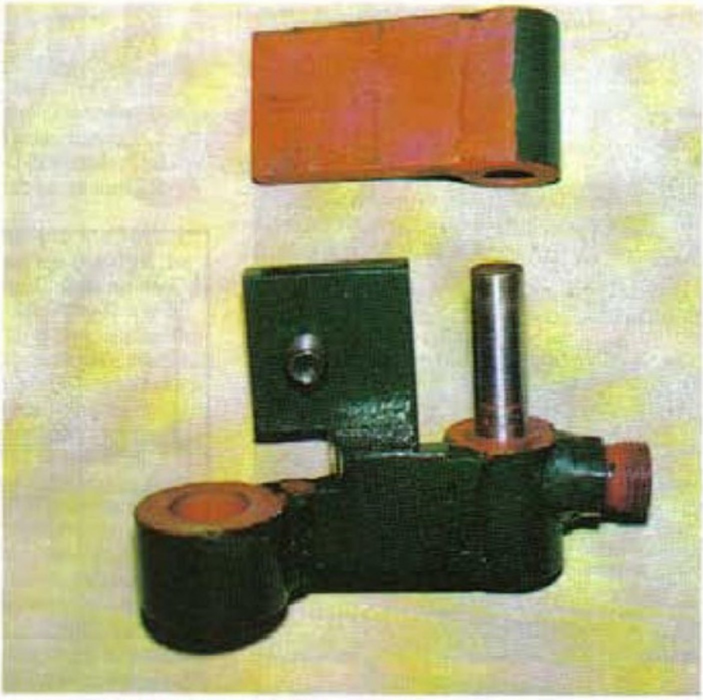
Some items that have been formed on the bender - top is 40 x 2mm, middle 12 x 3mm bar, bottom is 20 x 6mm bar.

Main base of bender.





Clamping block and clamping bar.



The pressure pad (top) and hinge.

The clamping bar, Item 4

I used EN24, ¾in. dia. bar but ¾in. BMS will serve. The ⅝in. dia. section centre is off set 1/16in. from the centre of the ¾in. diameter. The position of the tommy bar hole does not really matter, the position I have shown on the drawing suits me.

Item 5. The tommy bar needs no explanation; this is no more than a 6in. length of BMS.

It will help if Item 6 is made now, leave a very small pip in the centre of one end. This pip will help find the centre when setting up.

Having made the all above it is time to retrace our steps and complete the main base.

Insert 6 into the ¾in. hole, centre pip upwards. The clamping block and bar can now be added to the main base. The 11/16in. dimension of 7 needs to face D, whilst the ¾in. dimension of 7 is best to the right of the clamping bar. Make and fit Item 8 to "D". Do not form the radius yet as the corner edge is needed to line up with the centre pip of 6.

With 8 bolted to "D" place this on to the main base, the corner edge of 8 should be on the centre pip of 6. Clamp "D" to the main base, rotate the clamping bar so that the clamping block moves towards "D". Part 7 should just be touching "D", in other words you should be able to hold a thin piece of paper between 7 and "D". If this is not so, move "D" towards 7 until this is possible.

If you have to move "D" towards 7 the corner edge of 8 must remain on the centre point of 6. This may mean that "D" will not be quite square to the edge of plate "C" on the main base, it will be better to do this than go past the centre point of 6.

"D" will need to be well clamped as there should be no movement at this point. A small amount of weld has a lot of pulling power. The front face of "D" is not the best place to put the first weld, as this could pull "D" away from "G". The left hand end is the best place to start.

Hinge (2)

The hinge boss (2.2) has been given a length of 1inch. The true dimension should be taken from the main base between plates "A" and "C". This boss does not want to be a loose fit. The dimension of 2⅝in. centres for 2.2 and 2.3 is not that important, but should be over rather than under; also the ⅛in. offset centres are not that important thereabouts is good enough.

For welding 2.2 and 2.3 to 2.4 clamp 2.4 to a flat plate or bar, to the same plate clamp 2.2 setting square to 2.4. A small weld will do to start with, to avoid the weld lifting up 2.2 or 2.3. Reverse and let 2.2 overhang the end of the plate. Clamp 2.4 down again, add 2.3 as above.

Before final welding, try the arm in the main base. Once fitted check that 2.3 is in line vertically with D.8.. (see drawing), swing 90 deg. and check again. If all is well this can be welded up.

Fully weld on the opposite side to the first weld then finish off the first weld. Once cool, 2.5 and 2.6 can be added. Clamp to 2.4. The arm should be tried in the main base again. Before welding 2.6 must clear the top of the main base Item "C". If all is well, weld these up.

A general clean up and a handle will finish Item "K". As can be seen in the photo, my handle screws on. The reason I have done this is that one handle will fit several tools. I have used ¾in. x 1/16in. wall tube 13in. long, ¾in. square tube would serve, but is less comfortable on the fingers in use. This I find is really a bit on the short side for 1½in. x ⅛in. steel bar, though is fine for this size in aluminium. I would suggest 18in. long, but having said that, this length may not suit another user, as we don't all have the same physical strength: perhaps it is best left to individual preference.

Whatever is used, pipe or box, for the handle shape one end to fit round the bottom of 3 and weld it on.

A word of warning; while a longer handle will make the bending of material easy, this can be overdone. The bender has the capacity to bend ⅜in. materials while ⅜in. x ⅜in. aluminium is not too bad to bend with a large radius, I would not like to try this size in steel worked cold, at red heat it would not be too much of a problem. While it can be bent with a handle long enough I feel that it would put far too much strain on Item "D". "D" could be strengthened by adding a 3/16in. plate to the front face of the main base and welding or bolting to "D's" front face.

Item 3 is an adjusting plate or flap and is set up and welded as for 2.2 and 2.3.

Fit 3 onto 2.3. Add a 40 x M10 bolt to 2.6. You may wish to make this a wing bolt. Finger tight is all that is required on this bolt.

The bender is now ready to use.

Using the bender is not too complicated. Set 7 to the required position (see diagram) for the thickness to be bent. Insert material to be bent between 7 and "D8". Clamp up by rotating 4. Use the M10 bolt to adjust 3. The face of 3 must be parallel with the material.

If 3 is backed off from material, i.e. not parallel to it, a larger radius will be formed on the bend, due to the material's point of contact with 3 being moved towards the pivot of 3.

There are set rules for the bender or its design. If you want it bigger say by a ½in. then add ½in. to all dimensions. Or if you need the clamping block 7 to hold a special part or thickness then make it so, i.e. metric.

At the moment I am making another one – nearly twice this size of the machine described here, I have every confidence that it will perform satisfactorily.

HOLE ALIGNING CLAMPS

A selection of clamps of differing types and sizes.

Dave Clegg provides us with a simple device for aligning holes in two or more plates the device will, as well as locating, clamp the plates together

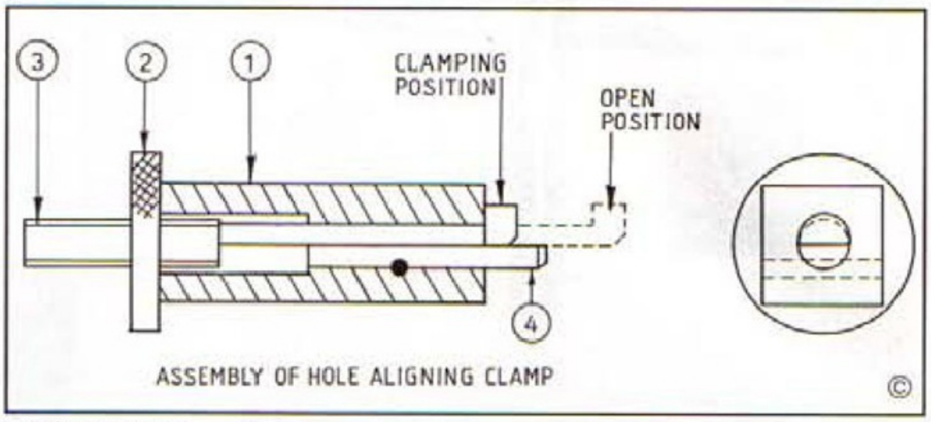
When drilling a series of holes through two pieces of sheet metal you have to either clamp the pieces together and hope they don't move and mis-align the holes or drill the first hole and use a nut and bolt to clamp them, this can be awkward when one side is not easily accessible. Having had this problem when drilling a row of 11/64in. holes I needed to find a solution. In the aircraft industry they use a clamp called "a skin peg". This can be used when only one side of the job is accessible.

The commercial version of this is tool is too complicated to make easily, so the following is my solution (see **Assembly Drawing**). It is a clamp based on an 5x50 Allen cap screw which I had handy at the time. They could just as easily be made from hexagon head screws or even turned from solid, but I feel the high tensile capscrews should make a stronger job.

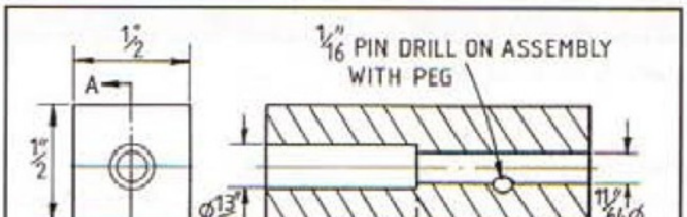
By using different size screws and adjusting the dimensions to suit, larger or smaller clamps can be made. If you decide to make these clamps you will need at least two or three but I find the more you have the better.

The body **(Item 1)** is a piece of ½in. square mild steel bar faced up in the four jaw chuck and drilled as shown. Round bar could be used, but when drilling for the 1/16in. pin, it is easier with square bar.

The nut **(Item 2)** is a straightforward piece of turning but if making a few off, it is easier to knurl and tap a length long enough to part off the required number of nuts at one set-up.

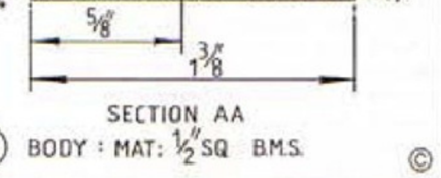


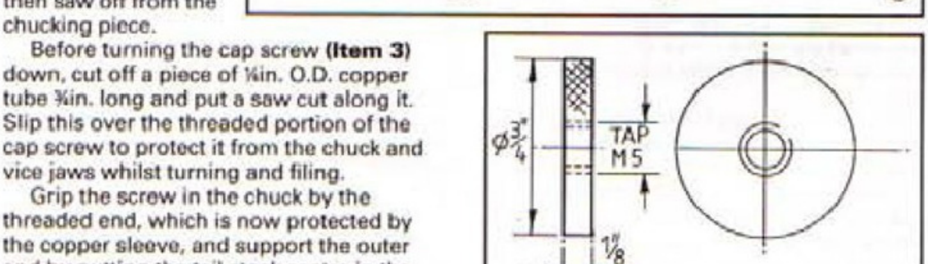
Turn the peg **(Item 4)** from a piece of round mild steel bar 1½in. long to allow for a chucking piece. Turn down to 11/64in. dia. but don't part off the chucking piece yet. Grip the ½in. long section in the vice and file to a semi-circular cross section as shown, then saw off from the chucking piece.



Before turning the cap screw **(Item 3)** down, cut off a piece of ¼in. O.D. copper tube ¾in. long and put a saw cut along it. Slip this over the threaded portion of the cap screw to protect it from the chuck and vice jaws whilst turning and filing.

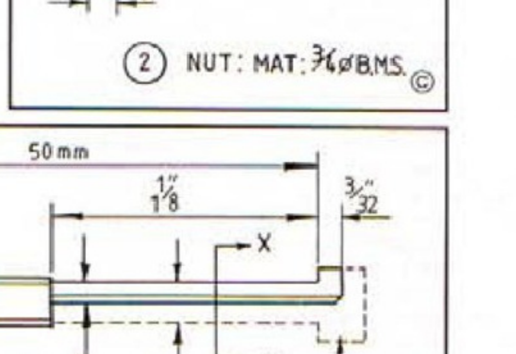
Grip the screw in the chuck by the threaded end, which is now protected by the copper sleeve, and support the outer end by putting the tail stock centre in the hexagon of the head. If using hexagon head screws first lightly centre the head. Turn down the shank between the threads and the head to 11/64 inch.





Using the copper sleeve, grip the screw by the threads in the vice and file off half the head and the shank to 0.085in. and chamfer the corners by 1/32in. x 1/32in. as shown in view "X".

Next file the head to length. Finally



Pegs before and after making flat.

radius the foot as shown in view "X" until it will pass through the 11/64in. hole in the body. If when the lip of the clamping face is reduced to 5/32in. it won't pass through the hole in the body, you will probably find the 1/32in.x 1/32in. chamfer is not large enough and needs increasing.

To assemble the clamp, put the nut on the screw and slide the screw through the body, then slip in the peg. Clamp up the screw as shown in the Assembly Drawing and with the peg protruding 1/4in. clamp the screw to the peg with a toolmakers clamp. Drill a 1/16in. hole through the body to take a 1/16 pin to secure the peg in the body. It doesn't have to hold everything rigid as long as the peg is retained in the body.

To use the clamp, after drilling the first hole through two components, screw back the nut and extend the clamp screw. It will then pass through the drilled holes. When it is now tightened up it will clamp both components together and keep the holes in alignment allowing you to drill the rest of the holes confidently knowing all the holes will line up.

The various stages of making the clamp screw.

QUICK TIP

When making small intricately shaped parts in mild steel, where the scribed lines need to live through the life of the job, a good way of ensuring this is to warm the material up to one of the tempering colours before use - the lines show up well and the marking does not rub off as is often the case with painted on materials.

QUICK TIP

A useful polishing block can be made by sticking a piece of wet and dry paper or emery cloth to an offcut of faced Melamine board using contact adhesive. Similarly a strip of emery etc. wedged into a slot cut across a piece of dowel is excellent for polishing internal radii which may otherwise be difficult to reach.

QUICK TIP

To double the output speed of a worm and wormwheel reduction unit, the worm can be removed and a replacement made with twice the pitch distance. Engagement will then be with every alternate tooth on the wormwheel, thus doubling the speed. If the worm is cut 2-start, every tooth will engage at double speed. **Alan Jones**

SWIVEL BASE

If shortage of bench space is a problem in your establishment, then this swivelling base by Terry Gould may be the answer. Made from a car brake drum it permits the rapid fitting and removal of items of workshop equipment. Even if you have ample room, it would still be worth considering as an additional item for your workshop, as it permits items fitted to swivel

My workshop is a 20 x 10ft. garage which I share with a car, bike and countless other things. What spare space there is, is taken up by the lathe and milling machine, this leaves me with a small workbench, 16 x 30 inches. Add a small vice to this and there is not much room left, even though it is only a 3in. vice.

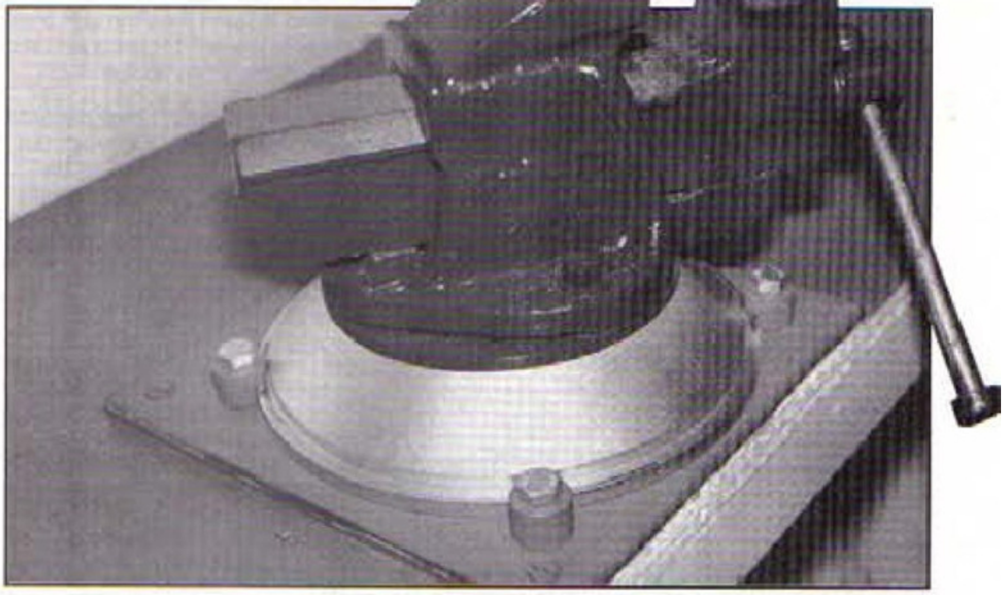
A lot of thought was given to ways and means of either making the vice swing out of the way when not required, or making a quick way of mounting the vice when required. I was also hoping to find a way of making the vice swivel. Many methods of mounting the vice were made and tried, most, if not all, found their resting place in the scrap bin. The time came when I gave up and went back to bolting the vice onto the bench when required.

Many months later, the answer was found. Whilst sorting through my odds and ends I came across an old brake drum, which I had used at one time as a former to bend metal around. I cannot now remember the origin of the drum. It was 185mm dia. and 95mm deep, with 4 x 16mm studs.

At 95mm deep, this would lift the vice up too high. I reasoned that if the drum could be cut down it would make an ideal mounting base for the vice. A test was carried out on the drum with a file, to see if I could machine the material. It was not as hard as I imagined, and so it was placed in the 3 jaw and cut through with a parting off tool with no real problem. After machining top and bottom faces, I got the depth down to 36mm.

A 6mm base is bolted to the bottom of the vice, using the existing vice mounting holes. To this base a 12mm disk is bolted 55mm diameter to match the centre hole in the drum. The centre of this disk is drilled and tapped M10 to take the mounting bolt. The bolt is just long enough to reach through from the under side of the bench to the vice base. Four full turns locks all to the bench top. This set-up is fine for most jobs carried out in the vice, however with any job in the vice requiring a twisting motion, the drum base tended to turn.

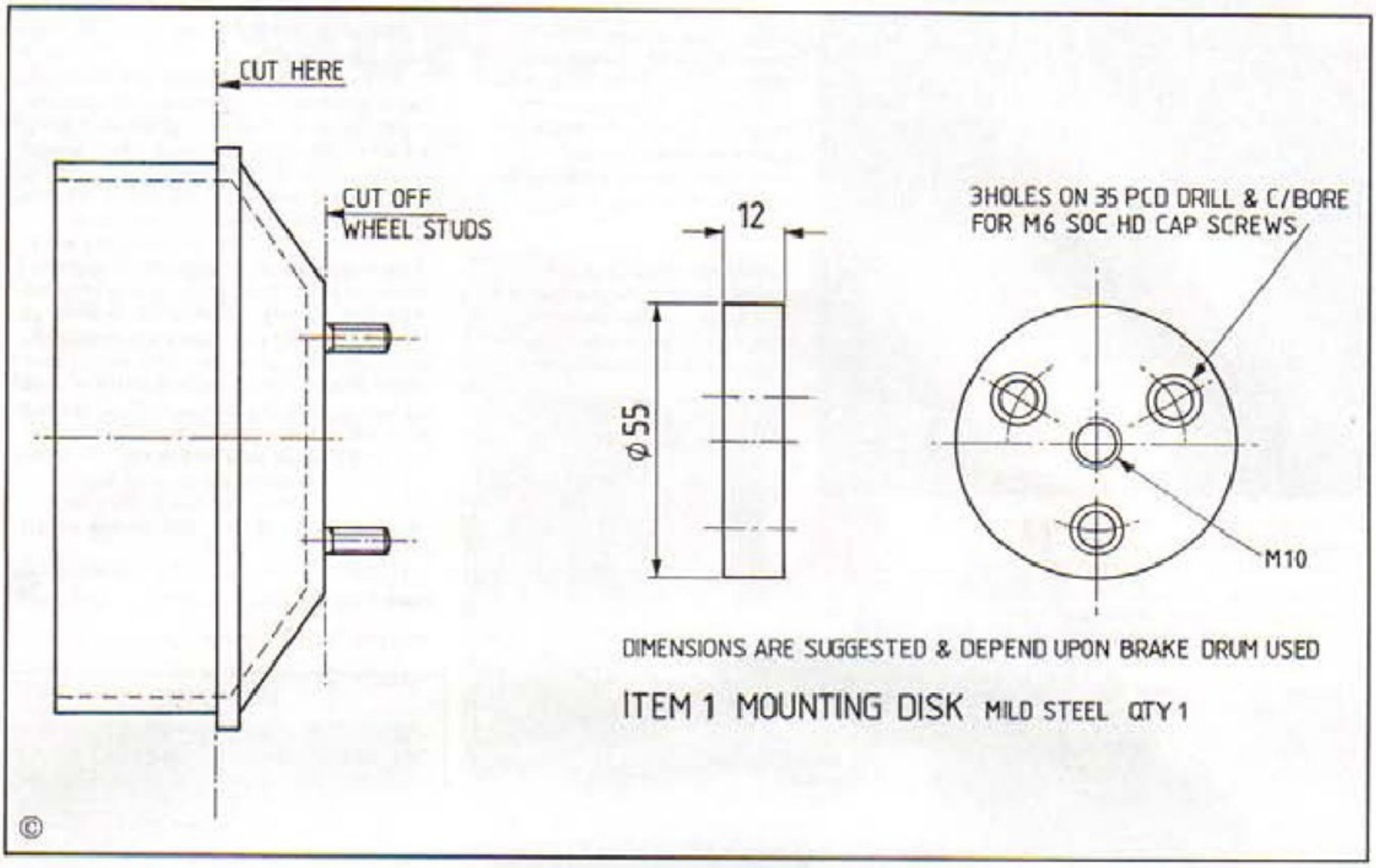
This was overcome by screwing a 200mm square plate 6mm thick to the workbench. The drum base was secured to

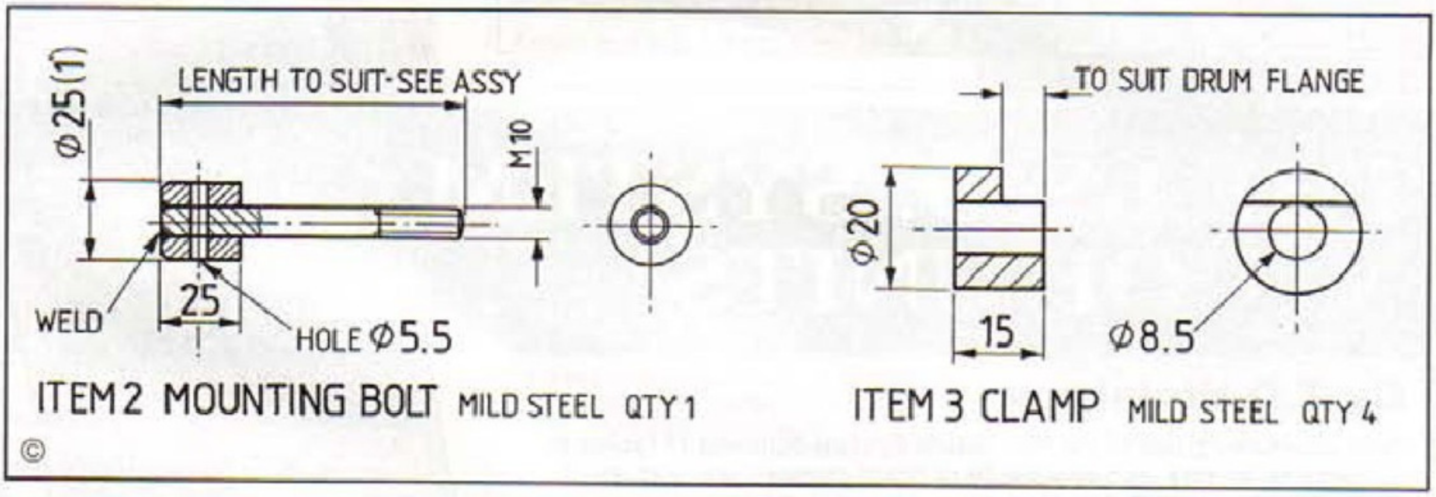


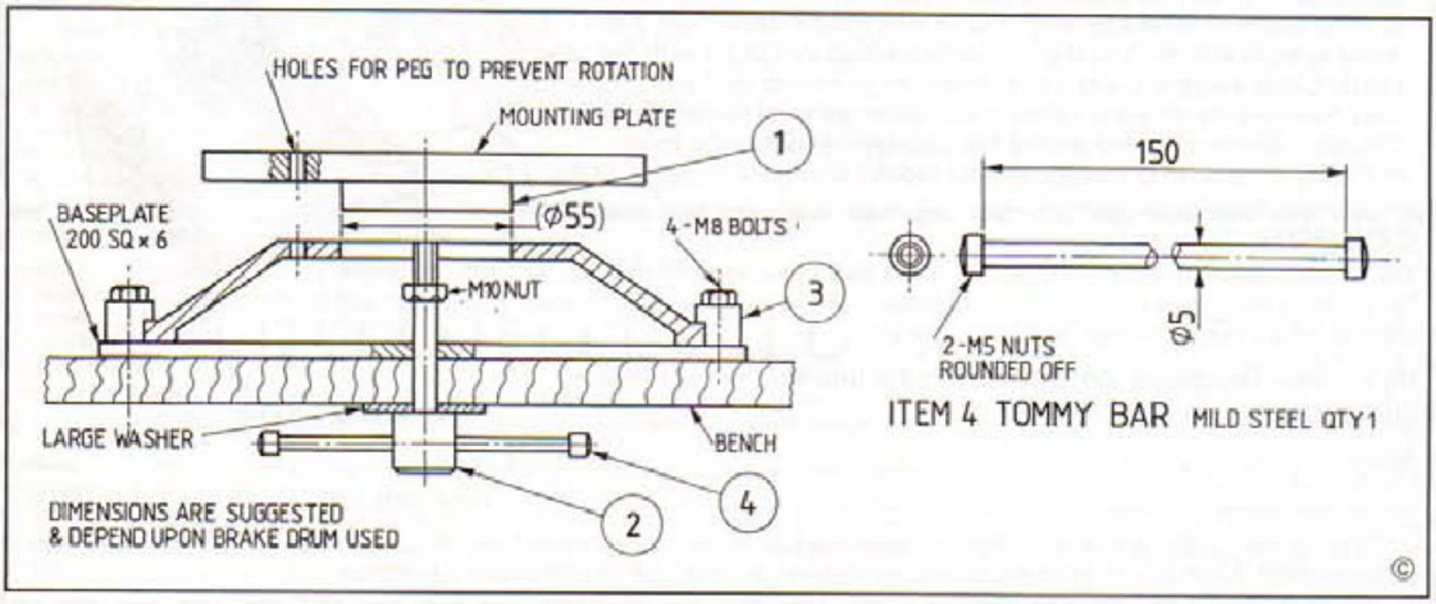
The base being used to mount a 3in. bench vice.

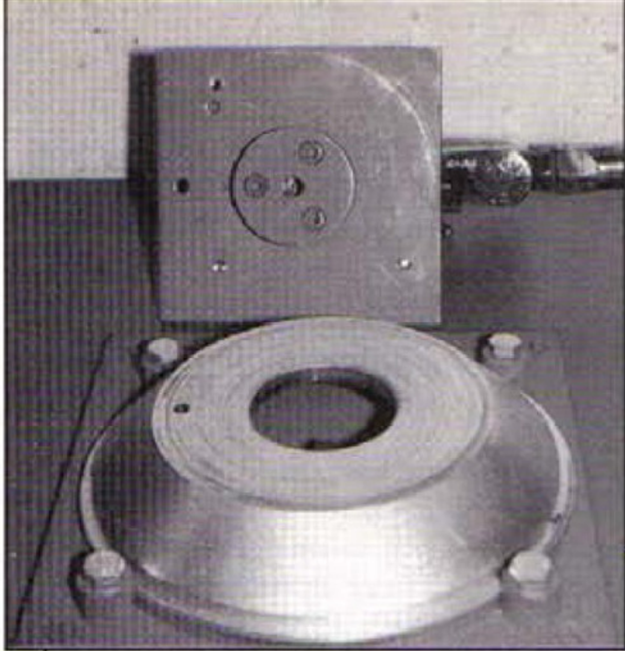
In use fitted with a bench grinder.

The swivel base finished and mounted onto the bench and ready for use.

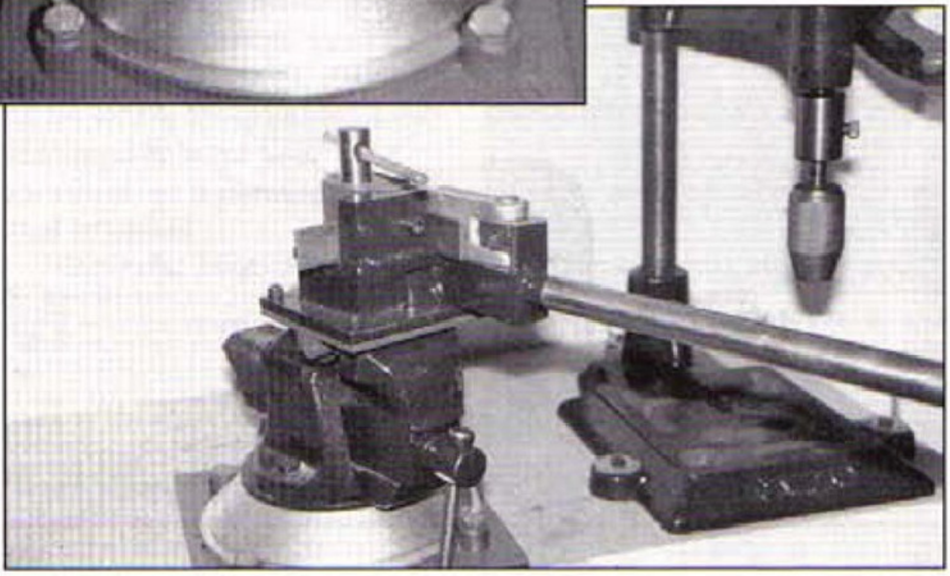

CUT HERE
CUT OFF
WHEEL STUDS
12
Ø55
3HOLES ON 35 PCD DRILL & C/BORE
FOR M6 SOC HD CAP SCREWS
M10
DIMENSIONS ARE SUGGESTED & DEPEND UPON BRAKE DRUM USED
ITEM 1 MOUNTING DISK MILD STEEL QTY 1
©


Ø25(1)
LENGTH TO SUIT-SEE ASSY
M10
WELD
25
HOLE Ø5.5
ITEM 2 MOUNTING BOLT MILD STEEL QTY 1
TO SUIT DRUM FLANGE
Ø20
15
Ø8.5
ITEM 3 CLAMP MILD STEEL QTY 4
©


HOLES FOR PEG TO PREVENT ROTATION
MOUNTING PLATE
1
(Ø55)
BASEPLATE
200 SQ x 6
4-M8 BOLTS
3
M10 NUT
LARGE WASHER
BENCH
4
2
DIMENSIONS ARE SUGGESTED
& DEPEND UPON BRAKE DRUM USED
150
Ø5
2-M5 NUTS
ROUNDED OFF
ITEM 4 TOMMY BAR MILD STEEL QTY 1
©



The base together with a mounting plate seen from below. Note the 55mm disk which locates in the hole in the brake drum. The hole on the left is for a peg to be fitted to stop it rotating, this is particularly useful when being used for mounting a bar bender.



Taking the strain of a bar bender. In this photograph the bender is mounted into the vice, a purpose made mounting plate has since been made.

this plate by four M8 bolts passing through a short length of 20mm dia. bar, with a step cut in one side.

A lot of my tools now get fixed onto this base including the bar bender *(elsewhere in this issue -Ed.)*, guillotine, grinder, even my mini pillar drill, making it into a sort of single point mounting system.

While this method of mounting the vice has solved the problem, a little more thought could have saved me some work. If, for instance, I had used a front wheel drum for a VW, this would have saved me making a separate base for the drum to sit on; here would have been no wheel studs to cut off, VW use wheel bolts, which screw into the drum. Threaded holes in the base are very handy, it also has a larger surface area than mine which would allow for the fitting of a larger vice, neither would I have had to cut the depth down, as it is only about 55mm deep The brake disc portion could be let into the workbench top which would reduce the depth.

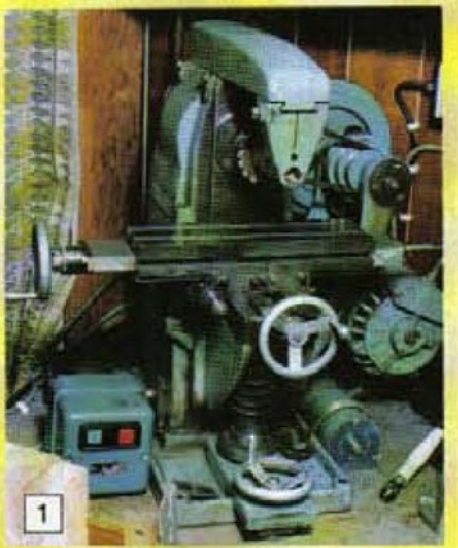
However, I will make do with what I have done for now.

Warning

Brake drums may contain asbestos dust. They should be washed and wire brushed well whilst wet, before any work is carried out.

Workshop Visit
HAROLD NEWMAN

Harold Newman, having read the front cover regarding a recent workshop visit, which read "Meet an Expert", felt that we should meet a beginner in order to give encouragement to other readers in the same position. As he considers himself to be a novice in the hobby, we took him up on the idea and have found some interesting ideas



1: *One of Harold's original purchases, a Centec No. 2 horizontal milling machine.*

Correspondence to *Model Engineers' Workshop* has on many occasions expressed concern regarding the future prospects for the hobby of model engineering. The writers have been concerned that now machine shop activities in industry are in decline, and as a result, similarly those who gain instruction from these activities, new entrants to the hobby will be considerably reduced.

A novice?

Anyone visiting the workshop of Harold Newman will however be somewhat reassured, seeing what he has produced over the last 12 years since becoming involved with the hobby, and coming to it from a non-engineering background. In fact, you will soon find that Harold wishes to encourage those with limited engineering background to have a go. He, without prompting, admits that he is not an expert, and that his creations will not come up to the standards of those magnificent models seen at many exhibitions around the country. However, he makes it clear that he considers the joy is largely in the making, and only slightly in achieving perfection, so encourages all those who are unsure to give it a go.

2: *A much later buy, a Warco Major milling machine.*

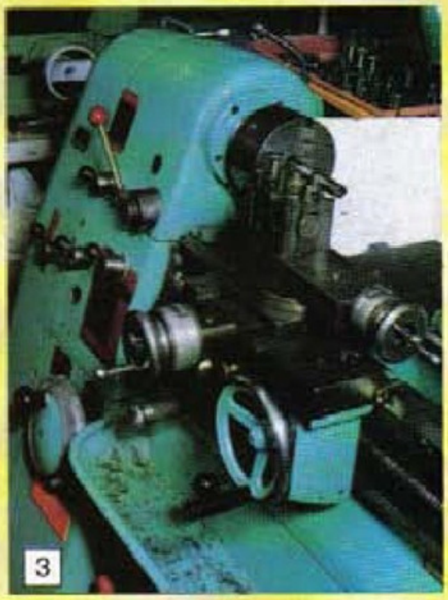
Harold's first desire to become involved with lathe work, was whilst working in an engineering firm for a short while when waiting to serve in the RAF after the last war. Finding himself in a situation where machine shop activity was taking place, he made a request to be permitted to become involved, the request was turned down in view of it being a temporary position.

It was not until 15 years ago that he decided to purchase his own lathe, a Myford ML7, even then the lathe was stored away and not brought into use for a further three years whilst a workshop was being built. Since then Harold has become largely self taught, gaining what knowledge he now has from reading appropriate books and the experience of putting this into practice. During these initial years his other main item of equipment was his Centec No.2 horizontal milling machine, seen in **Photo 1**, also with a vertical attachment.

Recent expansion

He limited himself to these machines until about three years ago, when, having built up his experience, he decided to expand his available workshop equipment. His first purchase was a vertical milling machine, he bought the Warco Major seen in **Photo 2**. With this installed he turned his attention to a larger lathe, in this case a second hand Colchester Chipmaster was purchased, **Photo 3**. Harold makes the point that with the changes in industry, these, once popular, lathes are easily available second hand and at very advantageous prices. They are rather large, but some simple modifications he has made have helped in this direction, more about that later.

Being industrial they of course have a 3 phase motor, but a converter was purchased and has been found to function very satisfactorily. These days a variable frequency inverter would normally be worth considering in such circumstances, but is not appropriate in the case of the Chipmaster as this has its own in built mechanical variable speed system. The control for this is the large handwheel seen in the lower left hand corner of the photograph.

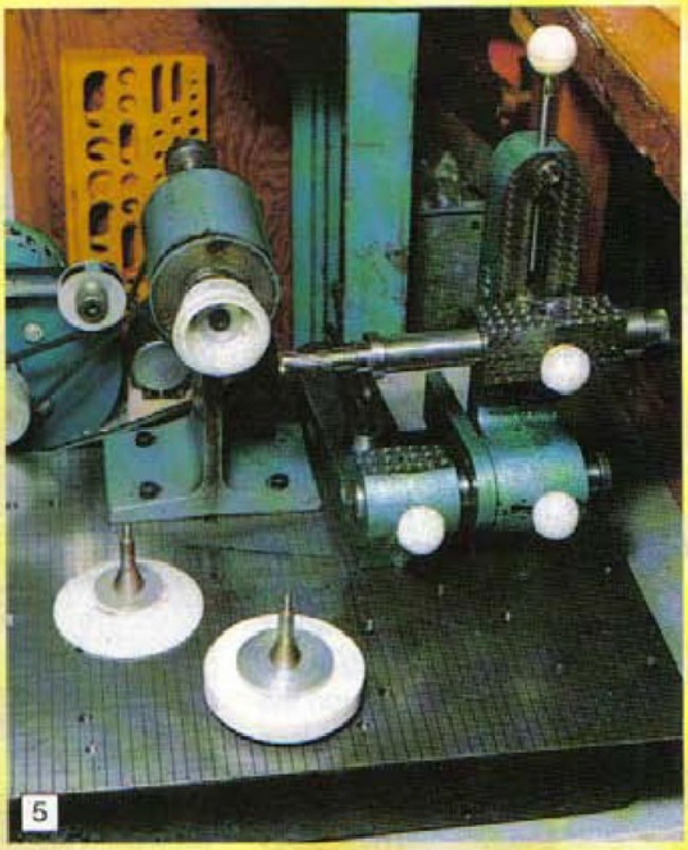


3: *The Colchester Chipmaster which replaced the Myford ML7.*

Harold firmly believes that if the space is available, and with a strong enough floor and adequate access for its installation, such machines as the Chipmaster should be seriously considered. He stresses that they have very beneficial advantages over the smaller machines frequently found in the home workshop.

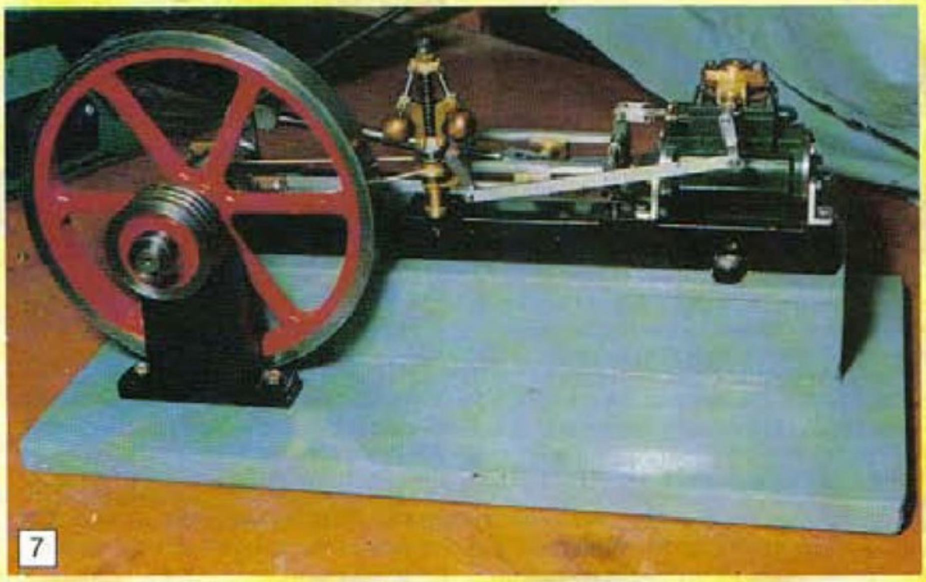
QUICK TIP

When working in sheet metal, do not be in too much of a hurry to scrap the odd pieces trimmed off when cutting an edge to size. Cut them to convenient sizes and their uses are multitude. For example as packing under a project on the milling machine table, or folded to an L shape and interposed between workpiece and vice jaw when filing to a line, they save the top of the jaw from being marked and having achieved their purpose can be scrapped afterwards.



4: *The welding corner.*

5: *A Tinker tool and cutter sharpening accessory.*



7: *Harold's first completed model, a* Victoria *stationary steam engine.*

6: *The grinding and belt sanding corner.*

Other items to be seen are a MIG welder and a blown air/gas torch, **Photo 4**, both skills which he has acquired without outside help. MIG welding he has found very useful and very easy to achieve an adequate skill, albeit not that of a coded welder. To complete the picture as far as machines available are concerned, there are a bench drill, a Tinker tool and cutter grinding accessory, **Photo 5**, a belt sander and a bench grinder, **Photo 6**.

Modelling his main interest

Harold's workshop activities, during the 12 years since starting in earnest, have been divided between modelling and making and adapting workshop equipment. He makes the point that, for him, the workshop equipment side is very much as an aid to his model engineering activities. As a result, the aim is to produce a piece of equipment adequate for the task and in the shortest possible time, niceties of design and finish taking a low priority.

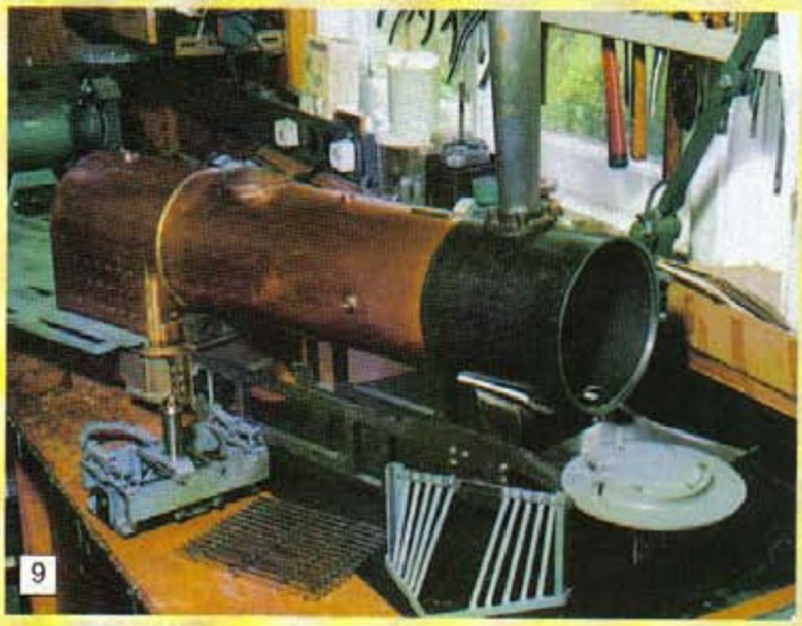
Most of the work evident to date would have been undertaken in the days of the ML7 (which has been sold) and the Centec mill (which has been retained). The first modelling project was a Stuart *Victoria* steam engine, made as a starter to see how well he took to such activities. Having completed the engine, seen in **Photo 7**, he turned to a much more ambitious project, Don Young's *Lucky Seven* locomotive, seen in course of construction in **Photos 8, 9 and 10**.

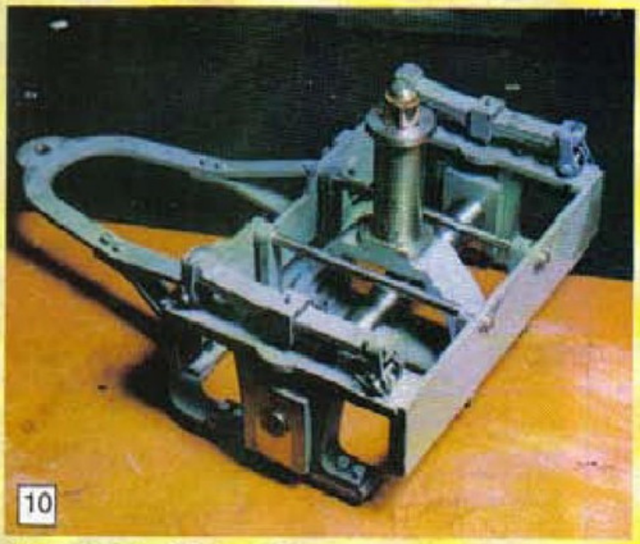
His workshop equipment is varied and often made by adapting items of equipment purchased at car boot sales and the like. He, like many readers of *M.E.W.*, appears to find such sales a mine of useful and cheap equipment, unfortunately I never have the time to attend and find out for myself.

When using the Centec mill he found the

knee raise and lower arrangement inconvenient, also the table left/right travel was rather limited. To overcome these problems a new leadscrew was fitted below the knee as seen in close up in **Photo 11.** To operate this, the handwheel at the front drives the leadscrew via a bicycle type chain. The dial to indicate table movement is fitted to the lower end of the leadscrew to avoid any errors that may result, because of the chain. Table travel was increased by adding longer leadscrew support brackets at each end of the table and making and fitting an extended leadscrew, the brackets can be seen in **Photo 1.**

The Tinker Tool and Cutter sharpening accessory, no longer available, came either complete or in kit form. It did require to be used in conjunction with some form of bench grinder and Harold has made one, again from a small surplus spindle mechanism and a small blower motor. These have been mounted on a surface





8, 9 and 10: ***Harold's* Lucky Seven *locomotive, in course of construction.***

11: *The modified Centec milling machine vertical traverse mechanism.*

plate by drilling and tapping holes on its surface, this may appear rather extravagant but he was able to acquire some when the company he was working for in a non-engineering capacity was being closed down. I know many who would be pleased to have just one surface plate. Harold considers himself fortunate to have been able at that time, to acquire a number of small items and also raw material.

An interesting aspect of the plate used is that it is marked with a grid of squares, seen in **Photo 5,** probably ¼in. pitch, this enables him to more accurately set up the device for use. The motor is a little short of starting torque, so it is allowed to start off load by lifting the jockey pulley that controls belt tension, then, when up to speed, belt tension is applied by lowering the jockey pulley.

Small geared motors

Whilst on the subject of small motors, Harold had used a motor/gearbox unit, intended to drive the spit of a barbecue, to provide a power feed to his Centec mill. Readers will know that such small motors when fitted to high reduction gearboxes can provide a substantial output torque, this was more that adequate for the table drive. However, is was far too slow for the application, still, as a readily available source of relatively cheap motor and gearbox they are worth keeping in mind.

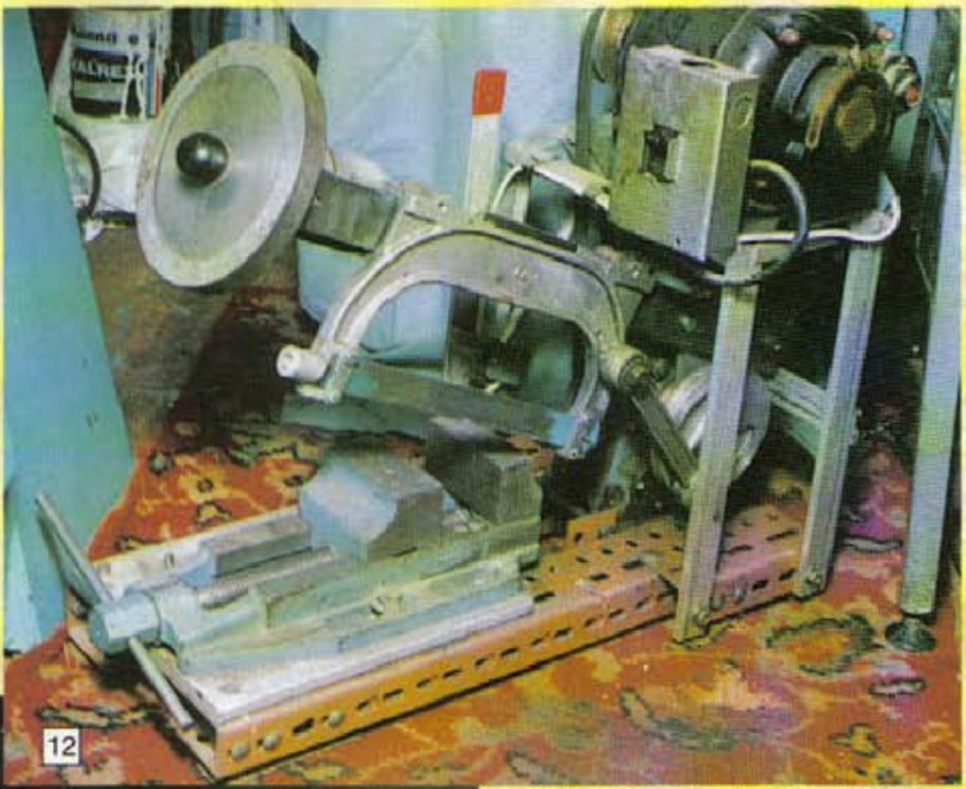
Returning briefly to the cutter grinder accessory, this is mounted in an interesting manner to make maximum use of space available. As bench space could not justifiably be used for an item having infrequent use, it has been mounted under the bench on a slide out platform. Two legs on the front edge support its weight when pulled out but still permit access to the bench space below when stored away. This arrangement makes it rather low, but in view of its limited use is considered acceptable, in any case a small stool would make it perfectly satisfactory and is an idea worth considering for other such situations.

A universal grinding rest

Another item adapted for a specific purpose is the large grinding rest seen in **Photo 6.** This is fitted to an assembly which permits the table to be angled, and which can be set using a normal desk type protractor which Harold has fitted. The table has included in it, dovetail slides which enables it easily to be set close to the grinding surface. This easy adjustment is a requirement due to the distance varying depending on the angle set. Closer examination of the photograph will reveal a number of important details.

First the table top includes grooves both parallel, and at right angles, to the table edge, these permit the fences, some seen loose bottom right, to be slid along ensuring an accurate result. One fence, seen on the table, is available with protractor, again a desk type, that enables it to be set rapidly with a good degree of accuracy. Other fences, as seen in the photograph, have rigidly fixed guide pieces that enable them to be immediately available for the commonly used angles for tool grinding.

The grinding rest, being intended for use with both the bench grinder and the vertical sander, a modified Picador horizontal sander, requires to be easily moved from one to the other. This requirement is meet very simply by the addition of two strips of wood at each position, between which the base of the rest is a close fit. The closeness of the fit is sufficient to make it fit securely, but not too tight making it difficult to remove and replace. These strips of wood can be seen in the photograph.



12: *A motorised hack saw made largely from scrap.*

13: *Another item from scrap, a simple dividing device.*

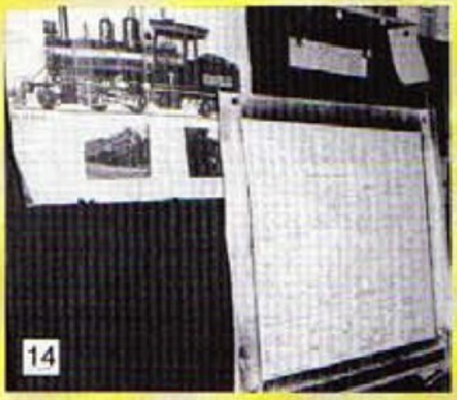
Also made from a redundant spindle, from some unknown item of workshop equipment, is the dividing unit seen in **Photo 13**. There is a substantial bracket which makes mounting the unit easy, this is not visible in the photograph. One other item of workshop equipment, simple but very helpful, is his movable notice board on which he pins the drawing relevant to the operation taking place at the time. This can be seen in **Photo 14** and it can be seen that a picture of *Lucky Seven* is permanently placed as a reminder of the main project in hand.

Recent equipment projects

More recently, when purchasing the Warco Major milling machine, Harold, like most owners of this type of machine, became unhappy with the loss of registration when raising or lowering the head during a machining sequence. He gave this much thought, considering such ideas as adding an additional bar running parallel with the main column. Eventually he decided to fix the raise and lower rack, semi-permanently, as the need to rotate the head appeared likely to be a very infrequent requirement. With this fixed a clamp screw is fitted to ensure the head takes up the correct position, this modification will be the subject of an article in a future issue.

The last major purchase, the Colchester Chipmaster lathe, required some modifications to make it suit its location in Harold's workshop. Whilst enthusiastic regarding the machine, he admits that its size and requirement for all round access will be a problem in many home workshops. The machine, having been designed for use in industry, assumes that all round access will be available, most important being the very large and deep swarf collecting tray at the rear. First this was modified such that the projection at the rear was considerably reduced and its method of fitting made such that it can be removed sideways, this of course requires a space at the side for its removal. To avoid this making a sizable area at the side of the machine redundant, this space is used to store items of workshop equipment which are on trolleys. Examples of this are a polisher and his motorised hack saw, another item which he has made himself, seen in **Photo 12.**

Two other simple changes to the Chipmaster were to add a horizontal mesh behind the lathe to avoid items, if dropped, falling down into the swarf tray, which goes almost to floor level. Also the very large door on the outer headstock end of the lathe was made lift off, rather than hinged, again to reduce space required.



14: *A movable notice board complete with a picture of the project in hand,* Lucky Seven *to the Don Young design.*

Harold hopes that these comments, and in particular the photographs of his modeling endeavours, will encourage less experienced readers of *M.E.W.* to become more adventurous in their approach to workshop projects, a view heartily endorsed by your Editor and his staff.

SHAPES AND TYPES OF LATHE TOOLS

1: *A mixed bag of types of turning tools. Left to right, a throwaway tipped tool, a brazed on tipped tool, a butt welded form tool, a butt-welded boring tool and two specials forged from K.E.10. grade HSS.*

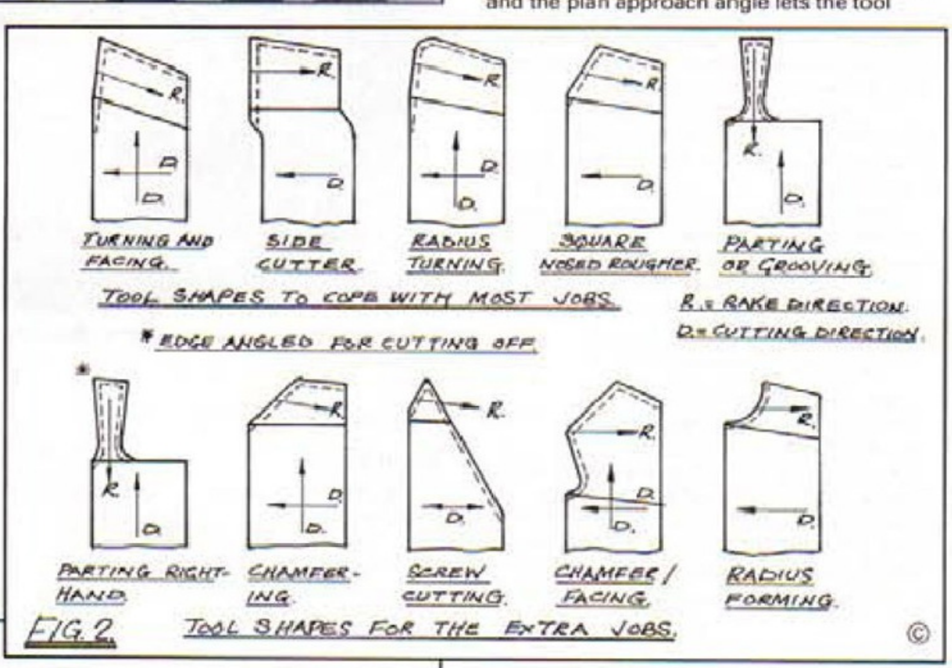
This is another workshop practice article from the pen of Mr. Loader. This time he concentrates on lathe tools, their shapes and applications to various materials

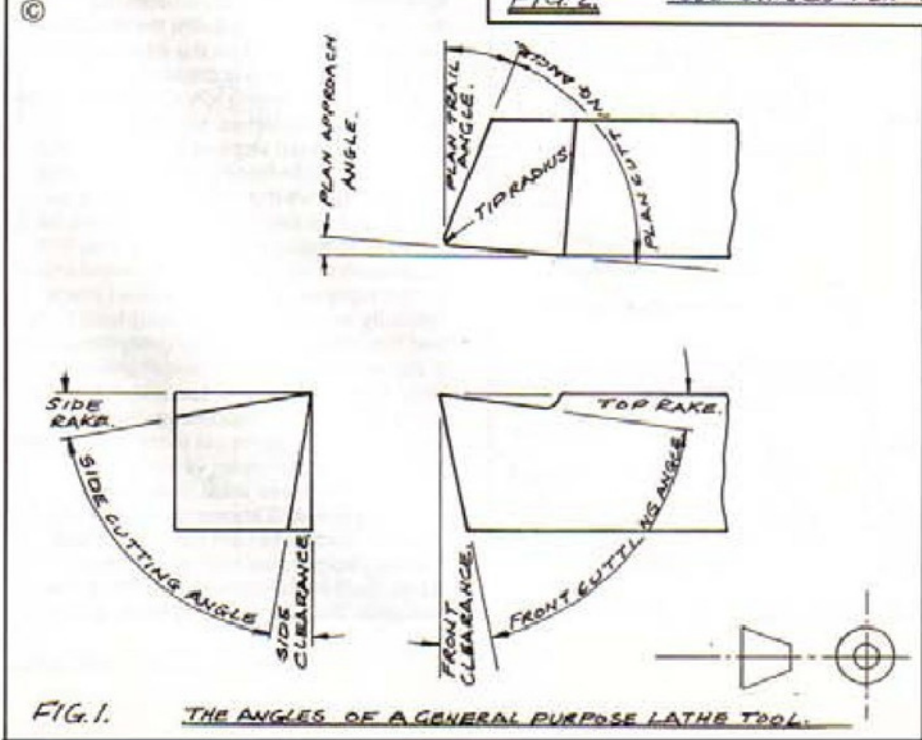
Turning is the most important of the activities in the home workshop, so it is as well to know a bit about lathe tools. Even those which are bought ready to use will need sharpening or perhaps a little reshaping. There is an almost infinite variety of shapes, sides and materials for lathe tools, **Photo I** shows a few of the common types.

For turning and facing work, **Fig. 1.** shows the essential angles. The vital ones are the clearances, because without these a tool won't cut at all, merely rub. Clearance should be enough to do the job and no more, because the bigger it gets, the smaller the cutting angle gets and this will weaken the tool profile. About 5 deg. is normal, but there are some exceptions which will be mentioned later.

Rake angles vary with the material to be cut. The rule is, small rake for hard and brittle materials, large rake for soft and ductile ones. At the extremes; alloy tool steels need about 5 deg., aluminium about 30 degrees. See the table for some details.

Looking down on the tool at the plan angles, the plan trail angle prevents rubbing and the plan approach angle lets the tool cut with all its edge, sharing the strain of the cut, not taking it all on the point, which is the weakest part of the tool. The tool can be angled round for the finishing cut or cuts, when it will have to turn and face on the same setting, but for roughing an approach angle will give much longer tool life between re-grinds. It also makes the sharpening easier, just a trim over the front and side clearance faces does the job. The tip radius depends on the sort of work, a large one for a radius turning tool, a small one made with a stone for a finishing tool which has to turn and face.





As a Unimat 3 user, the tools I use most are ¼in. and 5/16in. tool bits, the sort I used to use in holders on larger lathes. I also use the smallest size of throw-away tips in a 5/16in. square holder.

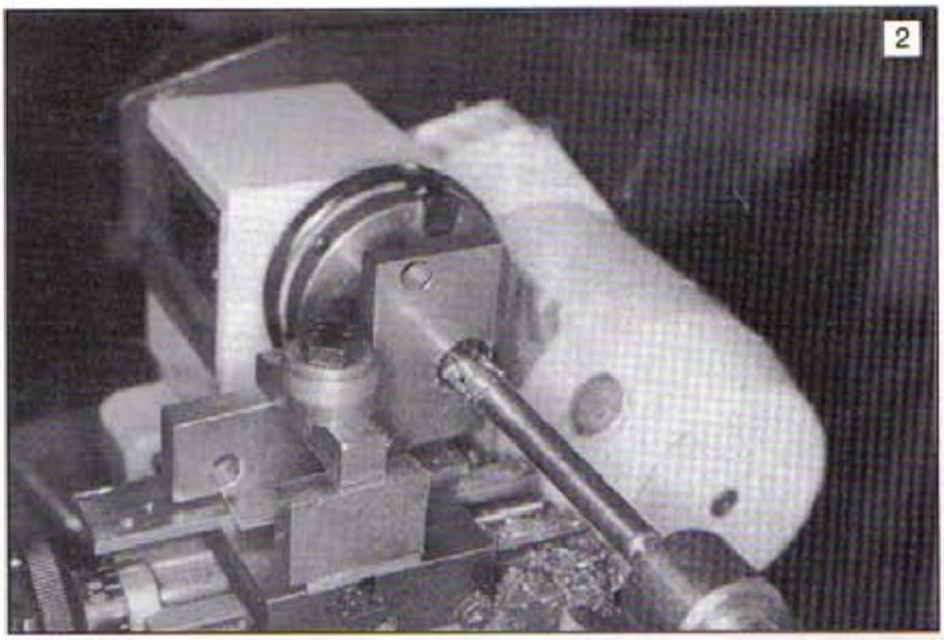
For those who use larger lathes there is a much wider choice, solid tool bits up to ½in. square and many different shapes in the butt-welded types. These are made by flash butt welding a high speed steel (HSS) end to a mild steel shank. The business end is pre-ground and the base ground flat; they only need a touch up to make them usable. The smallest sizes have ⅛in. shanks and are painted in various colours. The colours are different for different makers and sometimes different grades of HSS. Copper, red, blue, green, yellow and silver are some of the colours. Parting and boring tools are included in the wide range of shapes. They are tough and strong in the shank and hard on the end; I have broken a few by overloading them, but they have never broken at the joint. Don't confuse then, with tipped tools, a tipped tool is a different thing altogether.

Standard shapes

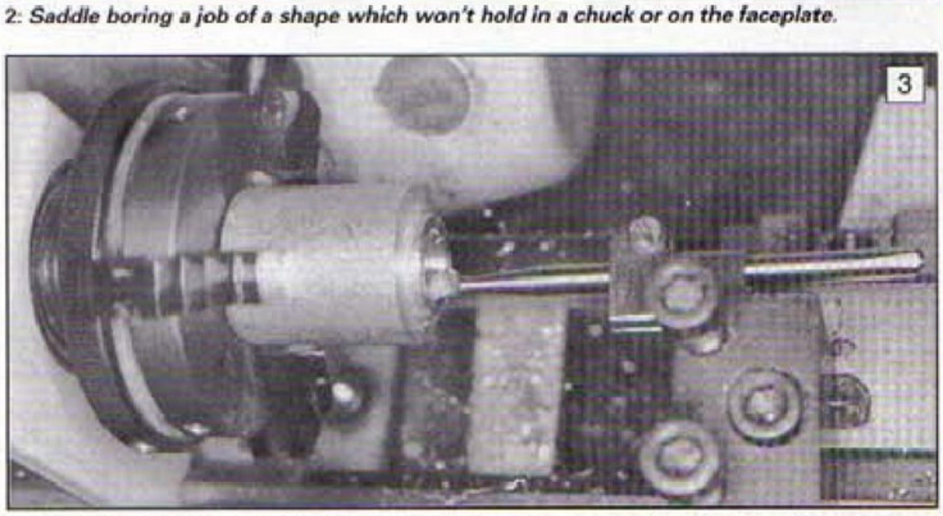
Fig.2 shows a selection of shapes which would cope with most lathe work. The top row are the essential ones and the bottom row the extra ones for the special jobs. I've used the plan view because it shows the shape better, the dotted lines are the clearance. Notice that on all the tools the rake angle slopes away from the cutting direction. Most of them are easy to visualise, but there are one or two which need a word of explanation. The side cutter is a tool designed to take large cuts at slowish speeds and fine feeds, it can do this because, having no top rake means that the cutting edge is always on centre height, and the tool cannot try to lift the work.

The screwcutting tool will have the appropriate angle ground on it and is shaped odd-legged so that it will get into tight undercuts.

The chamfer/facing tool is a favourite of mine because it will chamfer with the edge, face with the corner where the rake arrow is and rough turn as well, if I need it to: a very versatile tool indeed.



2: Saddle boring a job of a shape which won't hold in a chuck or on the faceplate.



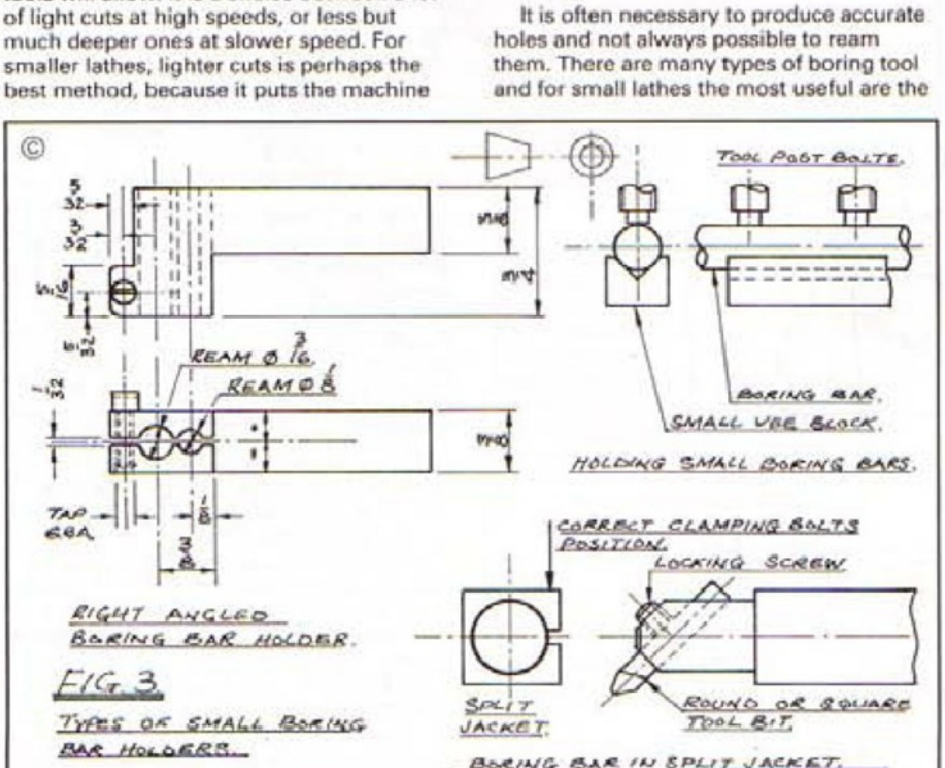
3: The angled boring tool holder in use with a ³⁄₁₆in. bit. Note the unobstructed view of the work.

The choice of tooling

Most turning operations are a compromise between what the turner would like to do and what the machine and tools will allow. It is a choice between a lot of light cuts at high speeds, or less but much deeper ones at slower speed. For smaller lathes, lighter cuts is perhaps the best method, because it puts the machine under less stress and strain.

Boring tools

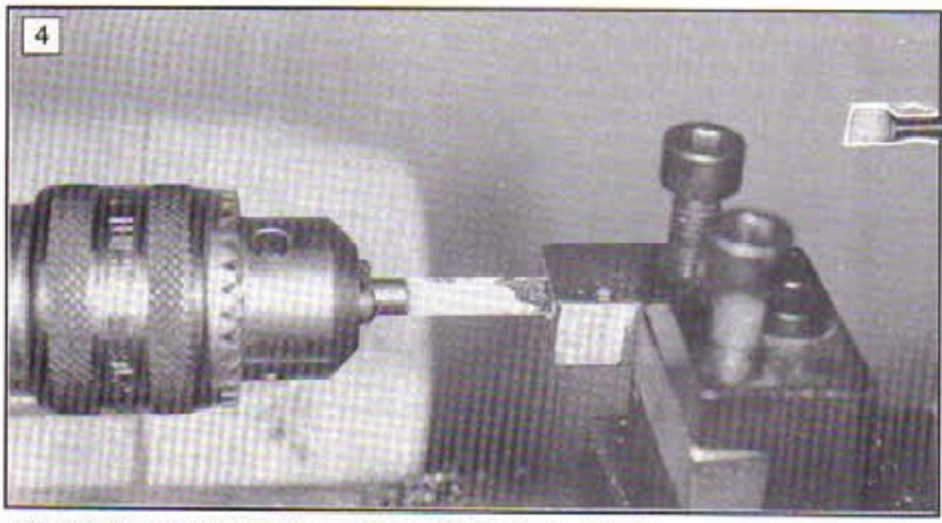
It is often necessary to produce accurate holes and not always possible to ream them. There are many types of boring tool and for small lathes the most useful are the ones shown in **Fig. 3**. Those held on the small vee blocks are the simplest and can be made by grinding a neck on a round tool bit and leaving a boss at the end. The boss can be ground into the shape required. The other type is the bar which holds a small tool bit and is clamped into the toolpost by a square jacket. It is very difficult to cope with very small holes with this latter type of tool, and they are often damaged by thoughtless clamping down the middle of the jacket, instead of on the edge to close the split, as shown the drawing.



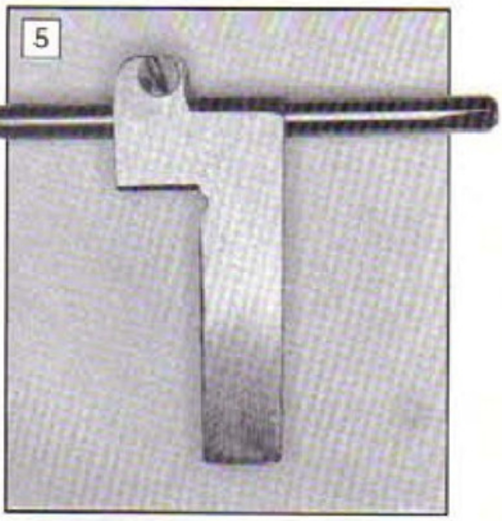
Butt welded boring tools are ideal for the larger holes and lathes. Where it is impossible to get work in a chuck or on a faceplate, saddle boring is an option and **Photo 2** shows this operation being carried out on the Unimat. The boring bars are easy to make; without using one, the job shown would have been a non-starter.

The right angled holder is one I made specially for the Unimat to hold both ³⁄₁₆in. and ⅛in. tools. It is a useful gadget because it allows adjustment for length and centre height and being the shape it is, it lets the turner see what is happening; too many boring bars and tools get in the way so that you have to peer round various obstructions to see what is happening.

Photograph 3 shows the tool in use. It is easily made and I did the drilling and reaming for the tool bits with the tool holder held in the cutting position in the tool post, this is shown in **Photo 4**. The



4: One of the operations in the making of the boring tool holder.



5: The completed boring tool holder.

tool being used is a "D" bit because I have no 3/16in. reamer; it does exactly the same job. **Photograph 5** is of the completed tool holder and the main dimensions are on **Fig.3.** The shape and size of the holder was worked out to suit the Unimat; it could be easily scaled up or modified to suit other machines.

Figure 4 shows one of the problems when boring small holes and how the clearance angle has to be different. It also shows how the centre height can be adjusted slightly by rotating the bars, in or on the supports. Avoid too much movement because it could alter both rake and clearance angles.

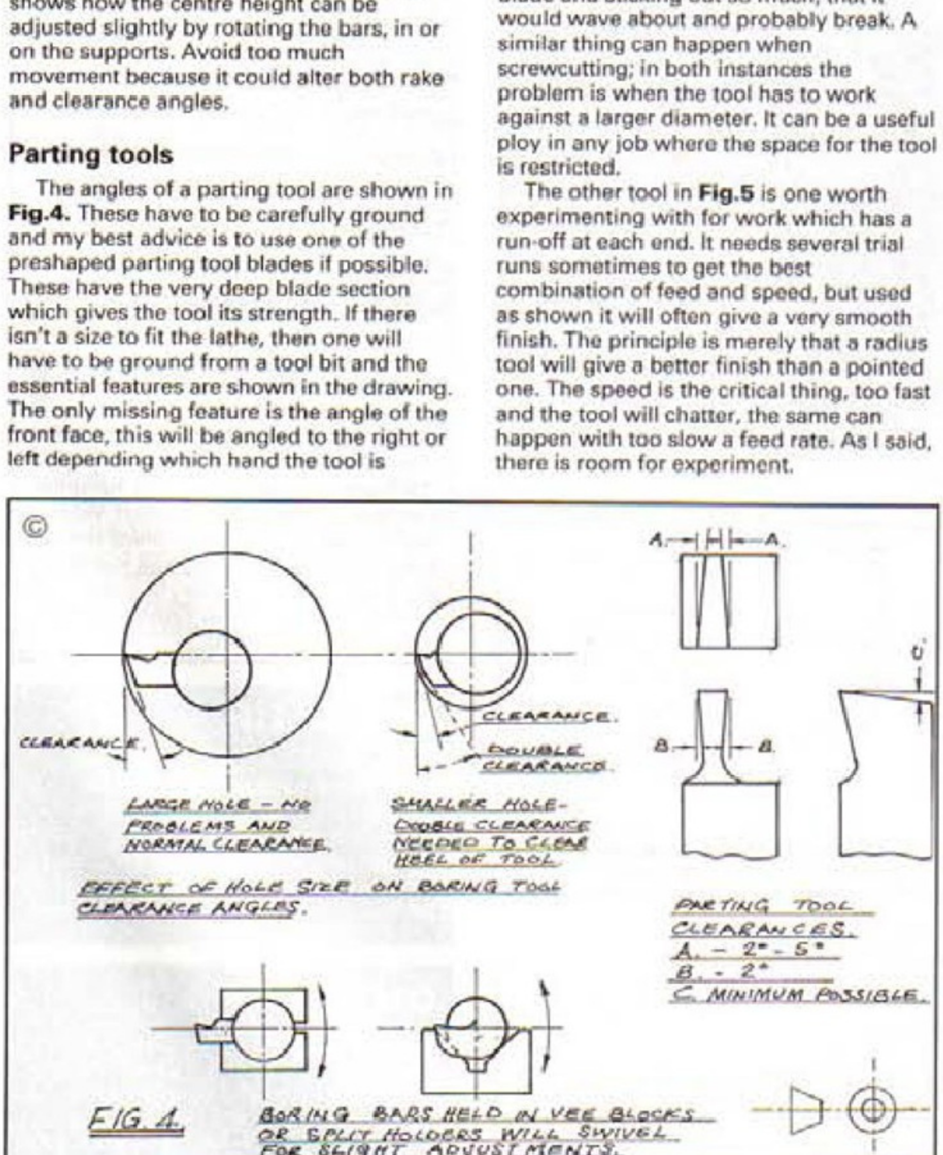
Parting tools

The angles of a parting tool are shown in **Fig.4.** These have to be carefully ground and my best advice is to use one of the preshaped parting tool blades if possible. These have the very deep blade section which gives the tool its strength. If there isn't a size to fit the lathe, then one will have to be ground from a tool bit and the essential features are shown in the drawing. The only missing feature is the angle of the front face, this will be angled to the right or left depending which hand the tool is cutting. The parting tool is one which I never stone any of the faces on, it seems to aggravate the tendency to rub for several revs, then dig in, then rub and so on.

Cranked tools

Sometimes it is difficult to get a tool into the cutting position and there are two examples in **Figure 5**. The parting tool, if straight, would have to be so long in the blade and sticking out so much, that it would wave about and probably break. A similar thing can happen when screwcutting; in both instances the problem is when the tool has to work against a larger diameter. It can be a useful ploy in any job where the space for the tool is restricted.

The other tool in **Fig.5** is one worth experimenting with for work which has a run-off at each end. It needs several trial runs sometimes to get the best combination of feed and speed, but used as shown it will often give a very smooth finish. The principle is merely that a radius tool will give a better finish than a pointed one. The speed is the critical thing, too fast and the tool will chatter, the same can happen with too slow a feed rate. As I said, there is room for experiment.



Special tools

These are mostly form tools designed to do one particular job and those for which there isn't a normal shape. Some are easy to make by grinding and some are not so easy where the shape is complex and difficult to make by grinding. For the awkward ones, silver steel, gauge plate or old files are a good bet. All three sources can be filed or machined to shape and hardened after the form is settled. Old files must, of course, be softened first. Because form tools are used carefully and often at slower speeds than frequently used ones, the problem of them breaking down with over-heating does not happen. It is worth remembering though, that at above 300 - 400 deg.C tools made from carbon tool steel will begin to lose their edge.

Not all special tools are form tools. When I was a youth, in the bad(?) old days when apprentices used to do a 5 year apprenticeship, we often had to have special tools made. One sort was a small boring tool, like the two on the right in **Photo 1.** The stores hadn't any small enough and the choice was to grind one out of solid HSS, an extremely long-winded job, or to have one forged and heat treated out of HSS, "in the raw". The stores had unhardened HSS in ½in. and ⅜in. square, the reference was H.E. 10 or K.E.672, perhaps long forgotten by now, but it used to make lovely tools. The man who did the forging and heat treatment was the blacksmith, known to everyone as Steamboat. His forge was the only heat source hot enough. Steamboat's forge had a steady stream of customers, from those who needed a welded framework straightened, to those who wanted their favourite chisel drawn out and re-hardened. Winter time especially, drew many genuine and not so genuine customers. Whatever the time of year, Steamboat would rough shape and harden the tool, leaving us to finish off. I have quite a few of them left, too large to fit the Unimat, unfortunately.

Carbide tooling

During my apprentice days carbide tools must have been around but we knew little about them and had no chance of using them. Our tool stores had none in stock and I was never in a situation where they were in everyday use. This is probably why I used to think that there was no place for

6: The cutting end of a large throwaway tool holder, showing the chip breaker.

them on small lathes like the Unimat. Since trying the throwaway tips in the smallest holder, the ¼in. square one, I am a convert to using tips for general purpose work. The only thing I didn't like was the price of the holders, so I made my own and in the making, made it to fit the tool post so that it needed no packing for centre height, it is only a matter of filing a bit off the bottom of the holder, as long as the holder is made with the final adjustment in mind.

The term throwaway doesn't mean that the tip has to be literally thrown away when it stops cutting effectively; they can be ground. It is true that a different grinding wheel, a silicon carbide one, must be used, but they can be ground. The finishing touch given to HSS or carbon tool steels by an India stone is different too. For carbides a diamond hone is the touch up tool.

The larger carbide tools with throwaway tips often have chip breakers built into the clamp or as a separate piece under the clamp; **Photo 6** shows this on a left handed tool.

Carbide tools usually have no rake angle and cut quite happily without one. They are especially good for cutting the difficult metals like stainless and alloy steels and some bronzes.

A lot of the fun in turning is the control the turner has over the tool, unlike other machining methods where the shape is fixed and nothing much can be changed. There is a great sense of achievement when a diameter or face is not only accurate, but smooth and gleaming and the turner has done everything, from shaping the tool to setting and using it. On a personal note, it takes me back to when I left the first year training shop and did my first stint on a man-sized lathe, a Southbend 13in. swing. A bit different from the Unimat which I use today. The tools don't change much though.

I expect, like most home workshop enthusiasts, I have many more lathe tools than I need, **Photo 7** shows just a few. The first two on the left are throwaway tips in home made holders and the three on the right are form tools. I think that there is a Parkinson's law for tools; the number of them increases to fill the space available in the drawer.

However many you have, remember the basics of shapes and angles and you cannot go far wrong.

Table of rake angles for common materials

Material (degrees)	Rake angle
Aluminium and wrought aluminium alloys	30
Cast Aluminium	15
Wrought Bronze	15
Cast Bronze	10
Machining Brass*	0
Cartridge Brass**	20
Cast Iron	0-5
Copper	20
Mild Steel	20
Alloy Steels	5
Thermo-Plastics e.g. Nylon	15
Thermo-setting Plastics e.g. Tufnol	30

* Brass of the sort used for turned parts. It has a brittle nature, making small broken chips. Pale straw colour. Sometimes called 60/40 Brass, meaning an alloy of 60% copper and 40% zinc. Lead can be added to make free-cutting Brass which is 58% copper, 39% zinc and 3% lead.

**A Brass suitable for drawing, turns like mild steel producing coiled swarf. Yellower than the free cutting or machining brasses.

These values assume average conditions, sharp tools and machinery in good condition. As with other processes there is room for experiment.

7: A selection from the author's lathe tool drawer.

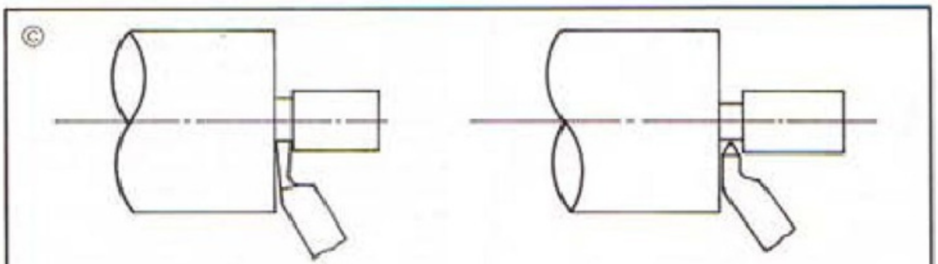


FIG. 5.

QUICK TIP

Those who encounter screw threads of the progress system of horological threads when working on old clocks, can define the gauge number by multiplying the thread diameter in mm by 10. e.g.: Thread dia. of No. 4 gauge = 0.4mm. **Alan Jones**

QUICK TIP

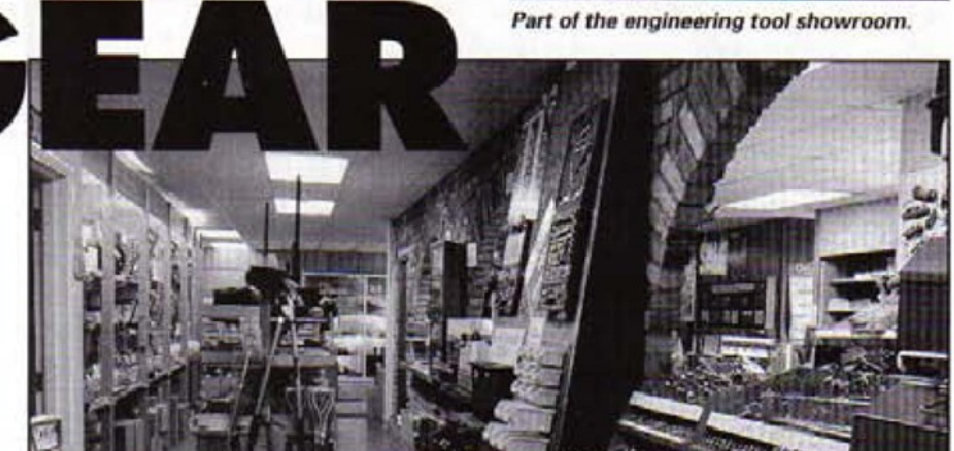
When making small grub screws, the normal junior hacksaw makes for a very wide screwdriver slot. So if the blade thickness is reduced on the grinding wheel for an inch or two, it makes a very neat slot to whatever width is required. **A. T. Cambridge.**

The large premises are prominent and easy to find.


Part of the engineering tool showroom.

A VISIT TO TILGEAR

Tilgear is a supplier of mainly tools, but also some materials, to industry, local authorities, education and the home workshop enthusiast. They have therefore a very wide range on offer, including very many items for the woodworker. A copy of their catalogue is a must, a visit, even better.


Further view of the engineering tool showroom. Service counter is on the right. Obtaining requirements is part self service, part assisted.

The majority of visitors to Tilgear will, I am sure, soon become impressed by the amount of tools and materials on offer, and in particular, the methods employed far its display and storage. Tilgear first started to trade in tools and materials in the early 60's, but its origins go hack to the 1930's when it traded as an engineering sub-contracting business. It has changed its location a number of times, but has always been located in the north east fringe of London, moving to its present site at Cuffley in 1987.

A long established company

The original business was started in the '30's by a Mr. Tilbrook, who had previously served his apprenticeship with Crawford Collets, who are still trading in Witney Oxfordshire. The company has remained since that day, very much a family business, and the name Tilbrook is still very much in evidence. In total around 25 people are employed, with some part time additions to cope with seasonal variations.

Originally the products supplied were engineering based, but from the mid '8O's the company diversified into woodworking, the split is now about 45% woodwork, 55% engineering. The premises is a small industrial style building of about 8000 sq. ft. Into this area a considerable amount of mechanized display and storage is used to extract the maximum usage from the space available. For maximum convenience to callers, the two areas of trade are kept largely separate in two showrooms. However in an endeavour not to waste any space, the entrance and interconnecting areas are full of items on display, many on carousels, including many special offers available to callers.

Mechanised storage

Many readers will have seen in advertisements, and a few no doubt in the flesh, the very large and mechanized warehouses. In these, automatic forklift trucks travel up and down rows of racking collecting items from the shelving, some times at a considerable height. At Tilgear they have a smaller version of this, here some 500 bins, about 300mm x 200mm x 1000mm in size, are arranged on two sides of a gangway and are collected by the equivalent of a small automatic fork lift truck. There are also quite a few storage systems where rows of small bins travel up and down on a continuous conveyor.

Not surprisingly these mechanized storage systems are operated by the staff, and whilst much of what is on sale is available self service, or at least on display in cabinets, staff will always be prepared to obtain other items from the storage system for viewing if required. Very well illustrated catalogues are available, which of course includes the items available that are not on display.

Access is easy

Tilgear have their own small car park, but should this be full there is plenty of parking in the area. Cuffley being only a small town, finding Tilgear presents no problem being on the main through road. Being opposite to Cuffley British Rail station, on the Moorgate to Hertford North line, also makes it easy to find and very convenient for those who wish to come by public transport. By road Cuffley is easy to get to being just a few miles from the M25, leave at junction 24 if coming from the west and junction 25 if coming from the east.

Opening times for callers and telephone sales are 8-30am to 5-00pm, Monday to Friday, but they are closed on Saturday. However Tilgear do have open days,

A small range of engineering machine tools are available, the two lathes seen here are fully reconditioned machines.

A view of the woodworking showroom.

Seen in this photograph are a range of non-catalogue items at advantageous prices, these are available to visitors only.

particularly at some bank holidays, and also extended opening hours prior to Christmas. These will be published through the press and also their very wide mailing list. Any one requesting a catalogue, or placing an order, will go on the mailing list, and continue to receive mailshots, for up to two years if an order is placed. Two mailing lists are established, one for woodworking has some 8000 names and that for engineering around 6000 names. It is surprising that whilst storage is so mechanized, and almost ahead of its time, documentation is done manually, and computers are not in evidence.

Large mail order business

Whilst so much has been done for the benefit of the caller, these lists serve to show that Tilgear has a large mail order turnover with about ⅔rds of business coming from that direction. Mail order includes export, so orders from overseas present no problems. Business is not confined to the home enthusiast, in fact this is the smaller part, a considerable amount comes from such organizations as schools, hospitals, prisons and of course many firms large and small.

Being mail order orientated a good catalogue is highly desirable and Tilgear, I would say, excel in this. The reason for Tilgear's success in this area is no doubt due to what is probably unique for a relatively small organization, that is, that they produce their own catalogues right up to and including some of the printing. They have their own artwork department that does all the photography and layout, and a printing machine on which the catalogues are produced. They have in the past produced a range of catalogues for differing types of equipment, Hand tools, Cutting tools, inspection equipment etc.

Catalogues

It is now heir intention to produce only two composite catalogues, woodworking and engineering. These being larger will have to be printed by a specialist printer. They will continue to produce the artwork, also retain the printing equipment for the production of leaflets, detailing such items as special offers, latest prices, new lines, details of open days and many other things. These they send out to those on the mailing list three to four times per year. New catalogues are produced about every two years.

All items sold are chosen to be of good quality much of which is of European or United States manufacture, this includes well known items from eastern European countries, which are both of good quality and very economically priced. Tilgear do sell items of East Asian manufacture, but these are carefully evaluated to ensure they are of adequate quality. The toolmakers cabinets made by Gerstner, of the USA, have solid oak frames and are considered to be the finest available.

Woodworking tools

The range of wood working tools is particularly impressive, with apparently some rather specialized tools not easily available elsewhere in this country. Also the quality of some is outstanding, many of these originate from the U.S.A.; it is perhaps inevitable that the level of quality is reflected in the price. It should be stated however that the prices quoted for the majority of items, both woodworking and engineering, would appear very competitive.

Also supplied to the woodworker are a range of veneers and wood blanks for turning and carving, many are rare woods and some, as a result, expensive.

Visitors to Tilgear are likely to see a small range of fully reconditioned machine tools, this area of their business is not actively pursued but some machines are normally available.

Tilgear try to have most items available from stock and orders are despatched within 1 to 3 days of being placed, except for peak periods. Special arrangements can be made for overnight or COD deliveries. All catalogue items are supplied with a fourteen day from receipt money back guarantee should they not be to the customers satisfaction for any reason.

Other interests

Visitors to Tilgear may be interested to learn that the local area of Crews Hill is well known for its extensive garden centres, aquatic centres and animal/pet supply companies. This is but a few miles away, no doubt someone at Tilgear could point you in the general direction if asked.

For further information and your free copy of the Tilgear catalogue contact: Tilgear, Bridge House, 69 Station Road, Cuffley, Herts, EN6 4TG. Tel: Engineering Sales 0707 873434, Woodworking Sales 0707 873545.

BACKLASH

Following a brief mention of some older, now defunct magazines which tried to serve the needs of the practical person, your Editor was inundated with letters, offers of help and memories of these publications. With so much interest apparent we are publishing a selection of the letters received

Harold Hall says:-

With the exception of the Digital Readout article, no other article, or comment of mine, has generated so much correspondence from readers of *M.E.W.*, than the comment I made in *On the Editor's Bench* in the April/May '93 issue regarding magazines of the past.

The magazines in question were *English Mechanics* and World of Science and a more recent publication, *Practical Mechanics*.

A number of readers assumed from my comments that I was interested in obtaining copies far myself, whereas I was just interested to find out whether readers had found these to be collectable. If space were available perhaps I would be interested, but working from home, much of my available space is taken up by items more directly connected with *M.E.W.*, such as files of correspondence, articles and catalogues etc.

I would like to take this opportunity to thank all those who have devoted the time to write, the letters that follow are a representative sample. I apologize, at the moment I am unable to answer all letters individually.

Ron Hough (Secretary of the S.M. & E.E.) offers this fascinating insight into some of the subjects covered in Practical Mechanics magazine

I write in reply to your query regarding *Practical Mechanics*, in issue No. 16 of *Model Engineers' Workshop*. This magazine was published by George Newnes Ltd. and I have four bound volumes: 1936 to 1939, with some copies missing. These are calendar years, but January 1936 is shown as Vol.3 No.28 indicating a start date for Vol.1 No.1 of October 1933.

At 13 I was just a little too young, and probably not financially able to subscribe to the magazine. I was mechanically minded, and knew of the magazine through my friends, but my interests then were in Meccano constructions for which I won several prizes, for a Ewbank carpet sweeper, a vintage motor car and a coke oven door extractor and coke pusher, in competitions organised by the *Meccano Magazine*, bound volumes of which, dating back to 1929, are still in my possession.

To revert to *Practical Mechanics*, start date October 1933, my copies date to December 1939, I don't think it survived the war.

January 1936 contains the last instalment of the series describing the construction of the *Flying Flea*, a single seater biplane, which I seem to remember had no ailerons but controlled its lateral attitude by warping the flexible wings. February '36 had details of the *Flying Squirrel* engine manufactured by the Scott Motor Cycle Co. and recommended for installation in the *Flying Flea*. There was also a note regarding proposed *Flying Flea* clubs, whose members would be entitled to fly the machines for payment of 2 shillings (the cost of the fuel and oil). Sadly for their high hopes, I believe the machine lasted only a very short time after several tragically fatal accidents.

Unfortunately the March and April issues are missing, but in May and June we are into parts 3 & 4, the final instructions for building the £20 car. This was a single seater, one rear wheel, built on a wooden chassis and using largely motor cycle parts. July has photos of the completed car on display in Gamages. Another photo shows it on the road allegedly doing 45 mph. F.J.Camm says he has put the car through some rigorous tests and been unable to discover any snags or defects, but I notice a photo here showing, and drawing attention to, angle iron cross bracing to the front axle which had not appeared in any of the previous instructions or drawings. The August issue had details of the braking system, - somewhat belated I would have thought.

There were series of articles on working model steam engines, on metal lathe work for amateurs, wood turning, wireless set construction, and model aircraft.

In November we were told how to make a home cine projector without the aid of a lathe and without the use of toothed wheels. It must have given a really bright picture, as it was illuminated by a bicycle lamp!

My son, while still at school, was also interested in these magazines and started making an index, only getting as far as 1936 before other things took over. I found it, rather tattered, in the 1936 volume when I started looking them up before writing to you.

1937 continued in much the same vein, with articles on television now beginning to be more prominent.

Of particular interest to me now, is a long drawn out series of articles by E.W.Twining on building a scale model of a G.W.R. broad gauge locomotive. This series had parts 1 and 2 in January and February 1937, parts 3 and 4 in May and June, part 5 in November, and part 6, the final part not until September 1939.

He gives the history of all the locos built between 1847 and 1888 and shows three different frame arrangements;- for *Iron Duke* and *Sultan* 1847, for *Courier* and *Sebastopol* 1848-55 and for all rebuilds and new engines 1878-88, and six different chimney shapes.

He chose to base his model on *Hirondelle* of 1848 rather than on the original *Iron Duke* as he preferred the sandwich framed tenders of the later engines.

In May, apparently not discouraged by the demise of the *Flying Flea*, we return to the subject of light aeroplanes with an article on the *Luton Minor*, a high wing monoplane, or as the author calls it, a parasol monoplane, kits of materials and parts available for £40 and £75 respectively. A series on its construction started in October.

May also sees the start of a further series on car construction, this time a two seater version, now with four wheels, the three wheeled version being considered not stable enough for the wider body, but even so, in view of the comparatively narrow wheel track not needing a differential!

There was mention in September that a barrage across the Thames at Woolwich was again being closely considered by the Port of London Authority. It was envisaged that this would carry road and rail facilities and would be started in the following decade.

November carried an illustration of a large wind generator installed on the farm of Mr. F. Atkin, the then Irish Free State Minister for Defence, all the farm machinery being powered by this machine. No output figures are given, but the machine appears to be about 70ft. high with four blades, each about 20ft. long, a size approaching that of the machines we are only now beginning to get enthusiastic about.

There was a series on building a 1cc petrol engine.

Throughout the years there were continuing series on Star Gazing for Amateurs, on Masters of Mechanics, on Model Aero Topics, The Month in the World of Science and Invention , and on model railways by Edward Beal 1938/39 featured a series on Toolmaking and Tool Design.

March 1939 had Practical use of the sine bar, and continued a series on Watch Repairing and Adjusting.

The adverts, as always in old publications, make interesting reading; to pick out the old familiar names and note those who have survived and those who have not. One set of adverts I found particularly interesting was for a 3in. lathe, manufactured perhaps by The Winfield Manufacturing Co. I am only going by their address of College St. Works, Long Eaton. They offered the lathe as The Winfield, but, going by the illustrations, the identical lathe was offered by Gamages as The Gamage, by Dennis and Smith of Goswell Rd. as The London, and by E. Gray and Son of Clerkenwell Rd. as The Grayson, all at around £7.10s.

There were, of course, all the usual offers to increase your height, to cure your red nose or protruding ears, to stop you blushing, or banish your inferiority complex (this latter by Pelmanism, often with a picture of Baden-Powell). International Correspondence Schools were there, as were Myfords and Fluxite; even Charles Atlas put in an appearance in October 1939.

Advertisers were, as now, not above hyping up their addresses. L Wilkinson, who sold small electrical and radio components, showed their address as Wilkinson House, an exact description, as they operated from the front room of a terrace house in Addiscombe, opposite the telephone exchange where I was employed as a Youth in Training.

I have limited my comments to the articles of most interest to myself, and probably to you too, as model engineers, leaving out quite lengthy series on chemistry and a new method of learning to play the piano. I hope you find my comments interesting.

Don Unwin who provides our articles on the history of machines adds these comments:-

I've just received the April/May issue of *M.E.W.*

Of particular interest in your column is the reference to magazines of the past.

I have two bound copies of *The English Mechanic*, 1875 and 1878. and working backwards it seems that it was first published in March 1865. Incidentally Fig. 24 of *Lathes* was taken from the 1878 volume and I believe one of the illustrations I have included in the Planers article also comes from one of them. I started taking it at the beginning of 1940 and continued until 1951 when I believe it ceased publication; by which time it had dropped the English part of the title. During its life it had several secondary titles, as did *Model Engineer*. I've still got copies together with the *M.E.* 1934 to 1970.

My Father took *Practical Mechanics* from when it started in 1934 - he used to call it Unpractical Mechanics- until 1948 when I believe it was discontinued. It had some quite interesting bits in it and I've still got tear-outs of the *Masters of Mechanics* series some material from which I have used in my current series. Also retained are some articles about clock and watch repairing and a series by E. W. Twining on modelling historic locomotives.

E. Mitchell of Waterlooville suggests another magazine from the past which may be of interest

I refer to your item Magazines of the past in the April/May issue. I can confirm that there was a magazine called *Practical Mechanics.*

There was also a companion magazine called *Practical Engineering.* This was published weekly and cost 4d in 1944 but later issues in 1951-53 were 6d. Volumes changed at six monthly intervals, my earliest copy, September 22nd 1944 is Vol.I0. this would suggest that it started in 1940. I have a collection of odd copies from 1944 to 1953 but only one volume is complete, Vol.25 Jan.- June 1952

The magazine was aimed at the professional engineer rather than the amateur or model engineer, although the later could glean many useful ideas which could be adapted for our use. Among the contents of my earliest copy were - Cutting worm wheels, Non ferrous metals, Quenching in oil, Device for marking out radii. Although these items were fully illustrated the sketches were rarely dimensioned, nor was any information given on 'how to do it'. It would have been like 'teaching grandma how to suck eggs'.

I trust this information will be of interest to you, all I have to do now is find time to read the magazines myself!

***Fred Bawden of Paignton provides us with a copy of the front cover of the 21st birthday issue of* Practical Mechanics**

Herewith a copy of the 21st birthday number of Newnes *Practical Mechanics* magazine. The front cover was in colour. Note the price 1s. (5p).

Michael Gilkes, Editor of the S.M. & E.E. Journal provides some details regarding early days of English Mechanics magazine

I am prompted to reply to your enquiry about the *English Mechanic* and *Practical Mechanics* in the April/May *M.E.W.*

English Mechanic started as the The *Mechanics Magazine* on August 30th,1823 and one cannot do better than reproduce the words of its original Prospectus. *(See below. Ed).*

The first issue also carried an article on aerostation. It concerned itself with all these matters and in its later volumes published detailed accounts of the Rainhill Trials and accounts of the participating engines.

In 1865 it became *The English Mechanic* and with the absorption of various periodicals persisted through two Series until its final demise, as *Home Mechanics* under the aegis of *The Model Engineer* in April, 1959. The last issue apart from containing a review of the magazine's history (from before the days of travel by railway) contained a

To the Mechanics of the British Empire.

FELLOW COUNTRYMEN;

Almost every class of people in this enlightened country has now a Journal or Magazine, which attends to its peculiar interests, as affected by the passing events and discoveries of the day, and supplies it with the sort of intellectual food in which it takes pleasure. The Gentleman, the Philosopher, the Divine, the Physician, the Lawyer, the Farmer, the Sportsman, have all their favourite works, to which they can weekly, or monthly, turn, with the certainty of obtaining some new information connected with their particular pursuits. The very Cottager has his magazine. As yet, however, there is no periodical Publication, of which that numerous and important portion of the community, the Mechanics or Artisans, including all who are operatively employed in our Arts and Manufactures, can say, " This is ours, and for us."

Every one of you who can read, and has a taste for reading; every one who has a just sense of his own importance in the scale of society, must wish to see this want supplied. In the confidence, that the attempt to do so will meet with your general and cordial support, we now commence, under the title of the " Mechanic's Magazine," a Weekly Publication, which shall be so cheap that all may buy, and of such value, that no one ought to be without it.

The Mechanic's Magazine will comprehend a digested selection from all the periodical publications of the day, both British and Foreign, and from all new works, however costly, of whatever may be more immediately interesting to the British artisan; such as Accounts of all New Discoveries, Inventions, and Improvements, with illustrative Drawings, Explanations of Secret Processes, Economical Receipts, Practical Applications of Mineralogy and Chemistry; Plans and Suggestions for the Abridgment of Labour; Reports of the State of the Arts in this and other Countries; Memoirs, and occasionally Portraits, of eminent Mechanics, &c. &c.

The Mechanic's Magazine will contain also a due portion of that lighter matter, which those who toil most stand in need of, to relieve and exhilarate their minds—as, Essays on Men and Manners, Tales, Adventures, Anecdotes, Poetry, &c.

Each Number will contain Sixteen closely printed pages, with numerous Wood-cuts, price 3*d*. only.

The Work will be published every Saturday, and may be had on the day of publication, in all towns within 150 miles of the metropolis.

No. I. may be now had by application to the Publishers (KNIGHT and LACEY, 24, Paternoster-row, London) or to any Bookseller or Newsman in the United Kingdom.

No. II. will be published on the 6th of September, and the following Numbers in regular succession. In No. II. there will be an interesting article on the case of the Spitalfields' Weavers, drawn up for this Work by an eminent Economist.

Communications from intelligent Mechanics, and from all others who may take an interest in the diffusion of useful information on any of the subjects embraced by this work (addressed to the Editor, and post-paid, to the care of the Publishers) will be thankfully received, and have every attention paid to them. It was well remarked by the great philosopher, Boyle, that if every artist would but communicate what new observations occurred to him in the exercise of his trade, the advantages gained to philosophy, would be incalculable.

Printed by T. C. Hansard, Peterborough-court, Fleet-street, London.

continuing instalment from LBSC on *Evening Star* the 3½in. gauge locomotive.

Over the years the magazine had printed details of such diverse items as important astronomical discoveries and the first description of the cholera bacillus.

Practical Mechanics was the brain-child of F.J.Camm who, apart from constructing a Kew Class 'A' watch and winning a model aeroplane endurance trophy, had been associated with Bassett-Lowke, Twining and Greenly in, firstly, Greenly's Magazine Models,Railways and Locomotives in the Period 1900-1920, and later in the long-standing magazine *Hobbies* in the early 1930's (he is also reputed to have brought about the later rift between Bassett-Lowke and Greenly).

The first issue appeared in October 1933 and, amongst other very practical concerns, was looking at space travel.

In later years *Practical Mechanics* described how to build cars, aeroplanes (the *Luton Minor*) and a host of other practical ventures. To many, such as myself, it was considerably more accessible and practical than the slightly esoteric and, dare one say it, pompous *M.E.* which dealt with things for which one knew one was not good enough. 'Plus ca change'! But hopefully we can be more enlightened now and while admiring excellence respect endeavour.

Practical Mechanics experienced the same publishing blizzard of the early 1960's as did *English Mechanics* and many other worthy journals. It too, over the *Evening Star* series and in its last issue of October 1963 there were also features on space flight and the *Luton Major*.

Being in the fortunate position of having built up complete sets of these journals I am fully aware of their value and the fact that there is hardly anything new under the sun. They form a wonderful archive of the history of practical interests. Sadly people do not always take good care of club copies but there is no doubt that a cumulative index of either or both, comparable to that which Guy Lautard prepared for *M.E.* would be a work of great value.

Any computer literate volunteers (the writer is not!)?

H. White of Newcastle, Staffs, is a collector of Practical Mechanics magazines, partly for their practical content and partly for nostalgic reasons

With reference to your recent comments re magazines of the past, I can give you a bit of information on the old Newnes publication *Practical Mechanics*, I have been collecting them for about 8 years. As you know, F.J. Camm was the editor of *Practical Mechanics* and many other i.e. *Practical Wireless, Television, Householder, Practical Engineering* and the author of many other technical publications.

The first publication of *Practical Mechanics* was Vol. 1 No.1 October 1933, I have the second issue, November 1933, in this issue Camm states that 100,000 copies were printed and sold out within two days of publication, a large reprint was called for! It was printed monthly.

F.J. Camm died suddenly in February 1959. The editor after April 1959 (the March issue had already been completed by Camm), was an unknown, only referred to as "The Editor".

In October 1960 the magazine was reduced in size from 11 x 8½in. to 9 x 6¼in. this being at Vol. 28 No. 318 in Sept 1962, (Vol 29 No. 341) the title of the magazine was changed to Practical Mechanics and Science. By now the magazine was getting into trouble, i.e. reduced sales and not much advertising etc. The final edition was August 1963 Vol. 30 No. 352.

That is a brief outline of its history. I have a good collection of the issues, although by no means complete, they are hard to locate, the bulk of my copies came from an advert in *M.E.* these were being sold off by a son as part of his father's estate. I was fortunate in locating several copies from a local secondhand bookshop. The pre-war copies are very rare, but their quality is better than all the later issues, by 1942 they were of a poor quality, due to the paper shortage, (although *M.E.* of a similar date was printed on better quality paper).

I don't know of anywhere where one can inspect back issues of the magazine (i.e. libraries etc.), they are not collectable as such, their content is very mixed i.e. product reviews, science articles, instructions on the construction of items for the home, not a great deal on engineering.

In the post war period the magazine incorporated *The Cyclist* and *Home Movies*. Cycling had a section on its own, but home movies were hardly mentioned. Some time in 1960 *The Cyclist* was dropped without explanation one month - it was there one month, next month gone!

The reason I like the magazine is, I think, nostalgia. I am in my mid-fifties, and these magazines were around in my youth and young manhood.

IN OUR NEXT ISSUE!

Coming up in the OCTOBER/NOVEMBER issue No. 19 will be:

Micrometers with a difference. Details of some rather special micrometers.

A small sensitive drilling machine.

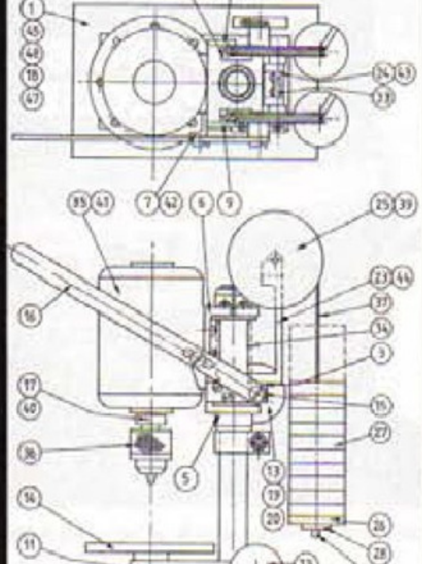
Using a bench press. The first part of a series describing the use of a bench press in the home workshop.

Some more history of machines, this time the planer.

A lathe filling rest, useful for making those flats, squares or hexagons on parts turned in the lathe.

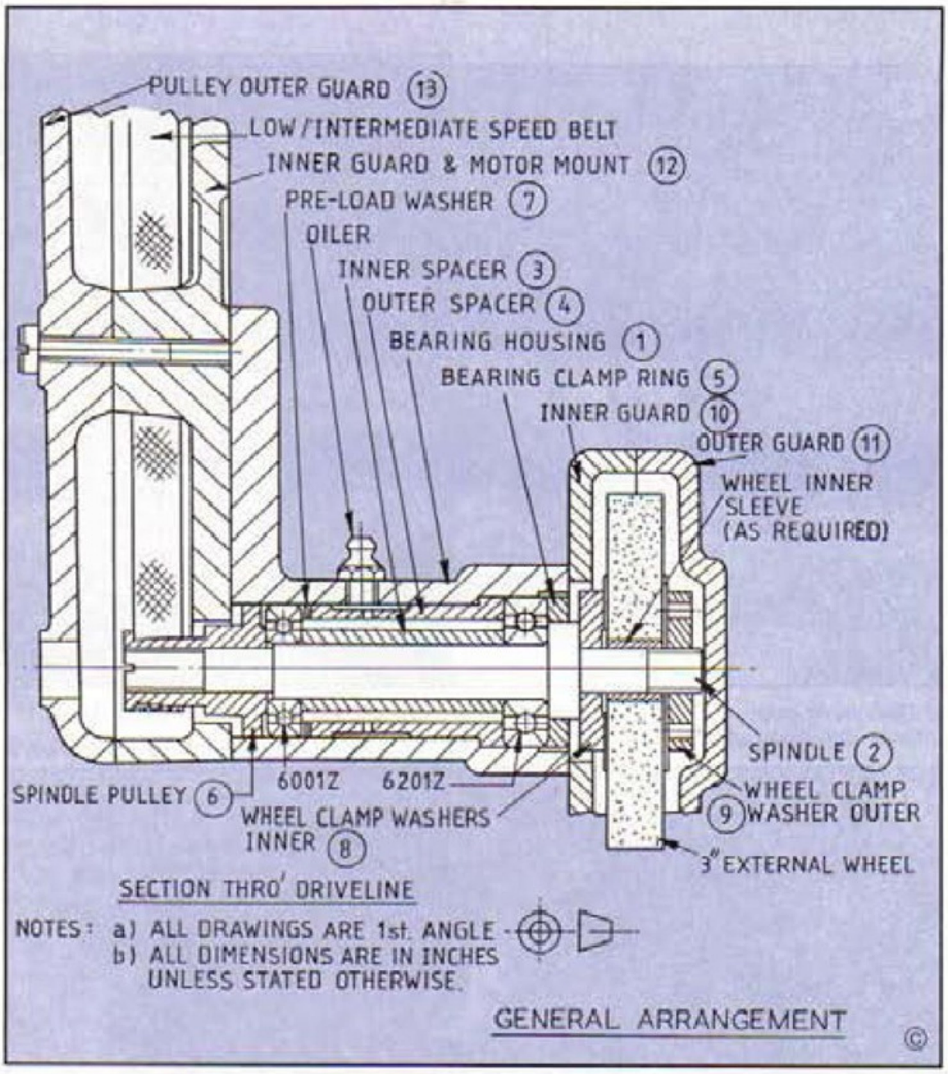
AND MUCH MORE
Issue on sale
10th Sept 1993

Contents may be changed



PART 1

Gordon Cornell has designed this excellent toolpost grinder, in this, the first of a two part article, he deals with the considerations which influenced the design described. Part two will deal with the actual manufacture of the unit



A TOOL POST GRINDER

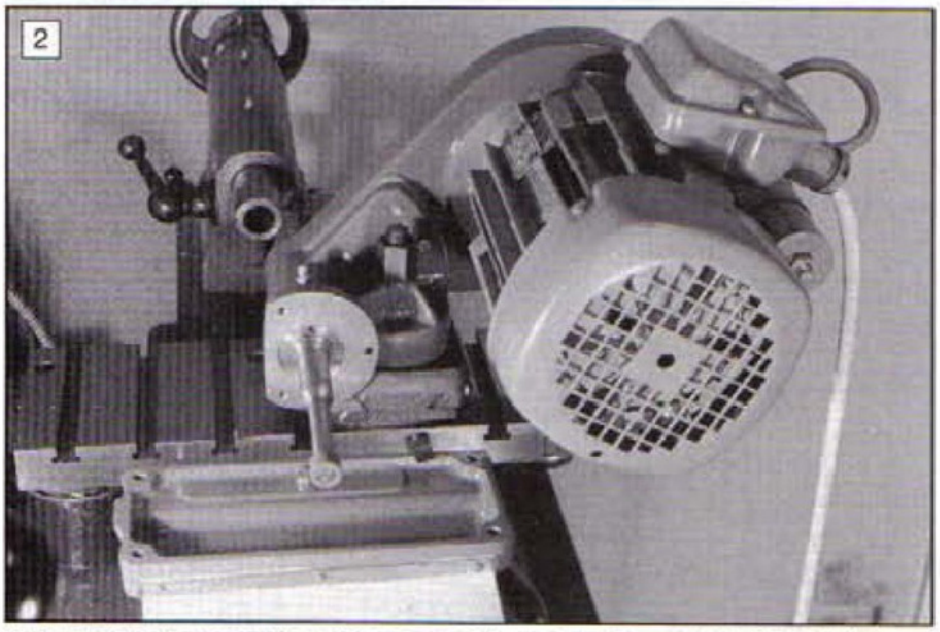
In late 1989 I decided that all my future model aero engine designs would incorporate hardened and ground components. This implied that external and internal grinding of bearing and cylinder bores was the minimum requirement. After many enquiries it appeared that the Myford/Duplex D26 Toolpost Grinder was the only potentially suitable device. At the time an outlay of just under £300 was required, a substantial sum for what appears to be such a basic device. However I decided to purchase one, having been advised by Duplex it would have to be adapted to meet my specific requirements. This article describes my experience and application of the unit which has led to the design and construction of the Dynamic grinder.

Duplex specify a 2.5in. dia. wheel at 8000 RPM for external grinding with a 0.75in. dia. wheel at 18000 RPM for internal work. The instruction plate implied that 5000ft./min. would be achieved at these speeds. As I required to grind internal bores smaller than that specified the wheel surface speeds were checked and found to be less than indicated. Machinery's Handbook implies that optimum peripheral grinding speeds are between 5000-7000ft./minute. A study of the design requirement indicated that 5000ft./min. is not possible in an economically priced unit using small dia. wheels with a single spindle for both internal and external operations. For speeds in excess of 30000 RPM an additional spindle would be required as the smaller bearings required to satisfy the higher RPM would have insufficient capacity to meet the external grinding wheel loadings. A more complex multi-stage pulley system would be necessary to produce the required ratio absorbing more power unless a suitable high speed motor could be fitted.

1: *The parts of the Dynamic grinder seen here ready for assembly.*

External grinding

The 2.5in. dia. wheel had limited application as the difference in dia. between the wheel and its mounting flanges was insufficient, making it impossible to grind up to any significant shoulder. A further problem was encountered when trying to grind a 5mm dia. shaft between centres, the spindle body fouling the centre/tailstock. The wear rate on this size wheel is such that a sharp corner or lead cannot be fitted with an appropriate guard. This sets a maximum speed limit of just over 7000 RPM and by pulley modification is run at 6240 RPM. The diameters which can be face ground are restricted by the available cross slide travel or the drive motor fouling the item being ground. Satisfactory results have been achieved; however heavy cuts must be avoided as there are no specific thrust bearings in the D26.



2: The saddle extension chip tray is an essential extra. Here the grinder is fitted with an internal extension spindle.

3: The external 3in. dia. wheel and guard assembly.

Internal grinding

The 0.75in. dia. wheel for internal use was far too large in my case since the smallest bore envisaged is around 0.375in. dia. After much searching around I obtained a series of different wheels of 0.5 and 0.375in. dia. at sensible prices (purchased from Graham Engineering at between 15 to 20p each). These can be dressed to size without consideration of life and expenditure. Whilst points could have been used a more complex chucking system is required restricting the bore depth and they are more costly. These considerations exclude the difficulty of obtaining the required accuracy and balance. Whilst dentists use this system there is little precision required in their application. Hence the revised internal adaptor extensions shown in the photographs and drawings which will be included with the constructional notes in the next issue.

To obtain a satisfactory performance level with such small wheels an increase in RPM would be required. The pulley ratios were 6:1 and 2.89:1 as the Brook motor speed is specified at 2800 RPM the spindle

QUICK TIP

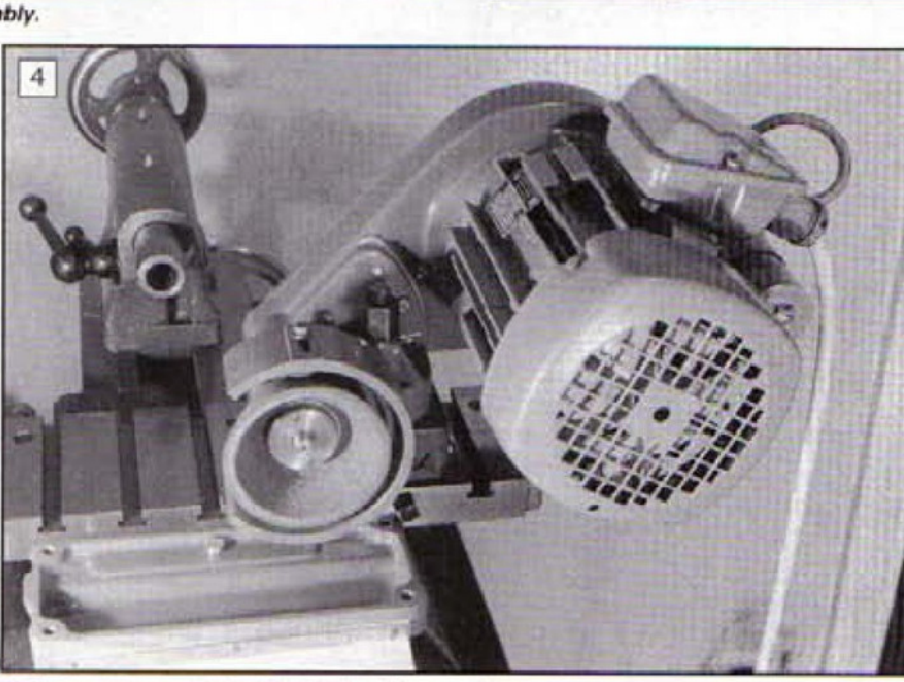
When you are out walking on a main road keep a weather eye out for bolts, nuts and other useful metal objects which drop from vehicles and find their way to the kerb. Bolts can be a useful source of raw material for small jobs, and nuts are always useful as spacers - you may even find them useful for their original purpose.

maintained. In order to grind parallel up to a shoulder an undercut is essential. Dressing the side of the wheel although recommended was impractical due to the limited difference in dia. between the wheel and mounting flanges. The standard diamond dressing stick being too large to traverse up to the flange.

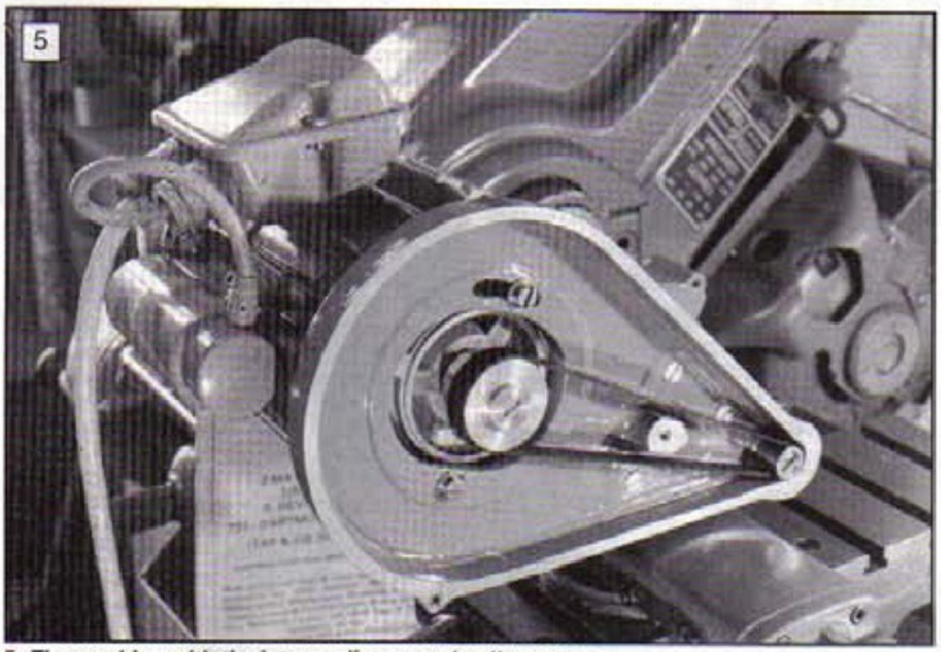
These problems meant that I could not grind the crankshafts to an adequate standard. To improve on this I fitted a 3in. dia. wheel (maximum safe speed 8160 RPM) together with a specially made guard. This gives a much improved wheel life and superior finish. An alternative would be to fit a recessed type wheel which would also provide face grinding, apparently not considered in the D26 design.

Face grinding

Whilst on the subject of face grinding this is best achieved using a cup type wheel. This wheel type is also used for cutter grinding which can be carried out on the Myford with suitable fixtures. A component 80mm x 50mm dia. has been



4: The cup/recessed wheel and adjstable guard.



5: ***The machine with the intermediate speed pulley set up.***

speeds available were 16800 RPM and 8092 RPM. The main problem being the 6:1 ratio. During use the spindle, which as supplied is lubricated by prepacked grease, indicated signs of bearing failure. Consequently I dismantled the spindle. Two 12mm ball bearings are fitted; No. 6201 at the wheel end and No. 6001 at the pulley end. Neither of these was fitted with any form of seal or shield. A study of an SKF catalogue revealed that the larger 6201 was suitable for 22000 RPM with grease lubrication and 28000 RPM with oil. I decided that an oil/grease nipple should be fitted and an annular chamber was machined around the bearing spacing tube and appropriate holes drilled through it to allow oil access. The bearings were replaced with shielded type bearings to retain the maximum amount of lubricant and prevent the ingress of grinding dust etc. A means of pumping out the ingress of foreign matter is essential if accurate work is to be produced. Potentially the spindle should now be reliable up to 28000 RPM. Could the speed be increased within the existing design and belts?

Examination revealed that the spindle pulley could be reduced from 0.562in. dia. to 0.475in. dia.(12mm), providing 19894 RPM without belt problems. This change would cause an excess speed on the 3in. external wheel now fitted. Another driving pulley modification would thus be required for external wheels. If the existing belt was to be used an additional pulley to fit on to the spindle for speeds lower than 8000 RPM would also be needed. Calculations indicated that a driving pulley of 3.625in. dia. (giving 21368 RPM) could be fitted inside the guard and that the low speed pulley should be reduced from 1.625 to 1.5in. dia., it was hoped that a longer belt could be obtained to suit the larger pulley dia. so a test pulley was made up. Assembly showed that the existing belt could be used with a pulley of 3.56in. dia., giving 20985 RPM as the absolute maximum for the D26 design. The pulley guard system restricted the drive line design.

At this point it became obvious that my requirements could not be met with the Duplex D26 Grinder. An upgraded design was required which could be made on the Myford lathe.

The Dynamic design

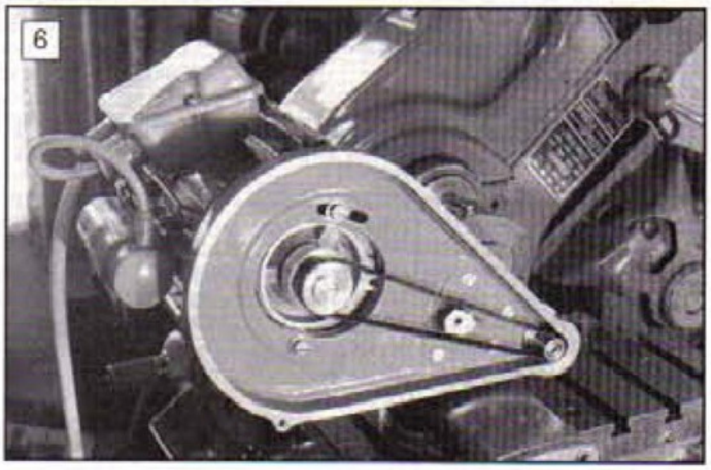
Development experience had shown that whilst parts could be made from offcuts this is not the best method for such large complex components. To ensure a professional appearance my new design would be based on cast components. In all 7 patterns were required to produce 11 items, one pattern producing 3 parts. These are cast in Aluminium Alloy and only require minimal machining.

The performance/specification of the Dynamic Toolpost grinder is as follows:
Performance
3 speed 28000 RPM Internal
7700 RPM External
6300 RPM Face Cup Wheel
According to pulley size fitted.
External Wheel:3in.x 0.5in.x 0.75in. or 0.5in.
Cup Wheel: 3in. x 1.5in. x 0.75in. or 0.5in.
Internal Wheel 0.511 x 0.5in. x 0.186in. or 0.125in.
Motor: 180/250 Watt, 2800 RPM, Single or 3 Phase, D63
Frame - "C" Mount/T.E.F.C.
Permanent Capacitor.
Spindle Bearings: Inner No.60012
Outer No. 62012
These are pre-loaded by a Special Wave type washer to provide the correct running conditions. The bearings are grade 6 noise tested.

I investigated the possibility of alternative drive motors in the hope that the pulley ratio could be reduced. Both AC and DC types with controllers were considered. For safety reasons the motor must run at a fixed speed to avoid exceeding grinding wheel safe limits. Some types have no effective speed control so if you consider fitting a motor of different type check with the supplier before doing so. The Brook motor from the D26 was taken to a local specialist who advised me that it was a cheap throw away type not normally repaired. They demonstrated a number of alternatives suggesting that a standard commercial motor was a better proposition. A decision was made to fit the highest available HP in what is known as a D63 frame. Experience had shown that a totally enclosed fan cooled motor is essential. This left me only to make a decision on the starting system to be used (see the section, Problem resolution, at the end of this part of the article). Alternative motors can be fitted within the latest castings.

The design as illustrated could be simplified, however the method of construction employed provides for easy manufacture and alternative features. Constructors can therefore readily adapt the design to suit their specific requirements.

Readers should appreciate that both motor and spindle assembly must be vibration free to ensure best performance, this feature must also apply to the lathe toolpost to which it will be attached. Whilst readers may have suitable motors and the kit of parts can be supplied without, it should be appreciated that any rogue motor can be specially balanced or replaced when purchased as a new item.

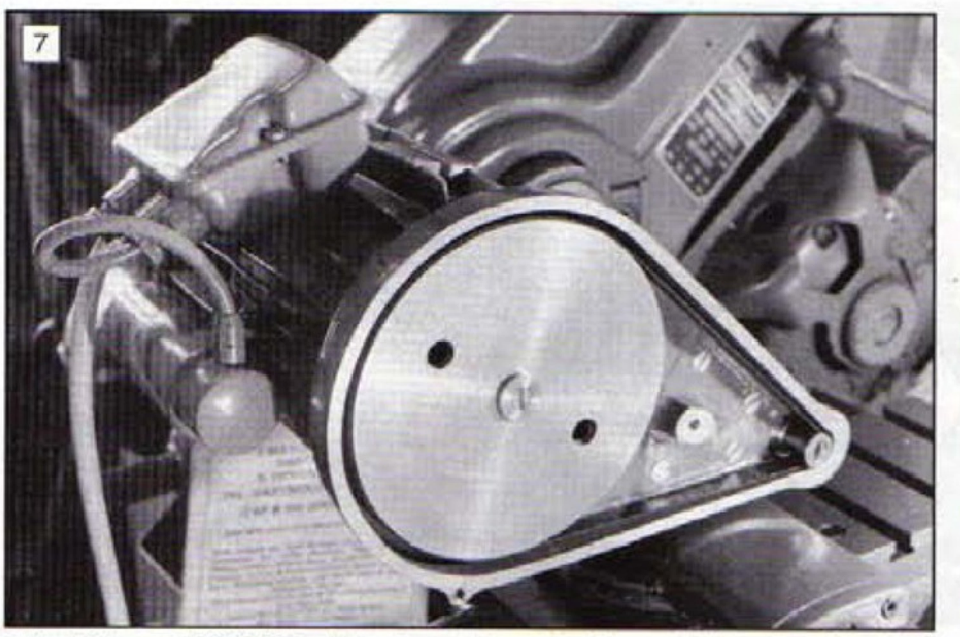


6: ***This is the set up used for the low speed pulley.***

Those who own a D26 can upgrade this using the Dynamic castings. Either by simply changing the grinding wheel sizes, or as a complete rebuild using the motor etc.

Accessories

The chip tray included in the casting kit has proved to be an essential item in protecting the lathe bed-ways. The use of rags, plastic sheets, newspaper, etc. is extremely dangerous. All of the above can catch fire when subject to hot grinding particles. When filled with either water or cutting fluid, the tray collects and limits the spread of airborne particles. Additional travelling deflectors/guards can be fitted to this, thus limiting overspray. It is also extremely useful when machining brass or cast iron in other than grinding operations and for most purposes can be left


7: *The high speed 28000RPM pulley set-up. This must only be used when operating with wheels of less than ¾in. diameter.*

permanently fitted. This casting is also available as a separate item.

Peg spanners will be required for the bearing clamp ring and the wheel clamp washers. These should be made to your own design.

A diamond dressing stick and holder will be required to true the wheel in use. A list of suppliers will be appended at the end of the article. The stick itself is fitted to a centred bar and assembled in place of the workpiece as required. A better arrangement is to make an attachment fitted to the rear of the lathe bed and swung in or out as required.

Finishing, assembly and operation

An attempt was made to evaluate a natural finish product as most components are alloy castings. The prototypes were shot blasted. I concluded this was expensive and not completely satisfactory with sand castings. It is most likely that some additional fettling will be required to provide the best appearance of the finished item. Thus these were finally given two coats of primer followed by 3 coats of grey enamel to match the Myford.

The simplest electrical wiring solution is to fit a fused industrial 13 amp socket next to the normal control switch on the lathe stand. Both can then be operated by the left hand, the cable hanging in a simple loop clear of obstacles and one's feet for maximum safety.

The spindle assembly bearings are pre-tensioned by a wave type washer. When assembled there should be no shake or free play however the shaft must rotate freely without roughness at operating temperature. The precise loading can be adjusted by modifying either the internal or external sleeve length as required.

It should be appreciated that all heat generated by the motor and grinding spindle is cooled by combined radiation and convection. The guards and covers are all part of the cooling system, these are made of alloy and should always be fitted as they assist in providing a stable temperature. It would be foolish in the extreme not to use the accessories in the interests of operator safety.

When grinding wheels are assembled to spindles paper/card washers must be fitted between the wheel and the clamping faces. Where the wheel bore is larger than the spindle a suitable plastic sleeve should be fitted to ensure concentricity. Finally the wheel is dressed using a diamond tipped tool before grinding is commenced. These diamond dressing sticks can cost between £20 to £40 so treat them with care. If any wheel vibrates do not attempt to use it. A variety of wheels are available to suit the different materials requiring grinding.

The spindle speeds suggested are basic, test experience has shown that optimum cutting speeds vary with the work in hand. All rotating systems have critical vibration periods.

The Dynamic grinder is more robust than the Duplex, superior results can be achieved at lower RPM. Users should adjust the pulley ratios to obtain the best results. Use the lowest speed possible to obtain a smooth cutting action. Excessive speed causes the grinding wheel to operate in a hard condition. Alternative belt sizes can be obtained from the supplier listed at the end of this article.

For cylindrical grinding the workpiece needs to rotate at modest speeds probably less than 500 RPM depending on the diameter. The rotation is against the cutting action of the wheel; this means that the normal screwed on head attachment of the chuck to the headstock is not suitable for many grinding operations if accidents are to be avoided. If it comes unscrewed and runs into the wheel a burst wheel is likely. Similarly the standard screwed on catchplate should not be used when grinding between centres. Make up driving fixtures on Morse tapers which are pulled into the headstock with driving plates/mounts positively pinned to prevent rotation. Needless to say it will be a waste of time trying to grind any object which when mounted is not dynamically balanced.

Flat or rectangular surfaces can be ground using a faceplate with headstock locked. This is used either as a direct mount or with an angle plate/vertical slide. For this type of operation a cup or recessed wheel is usually required.

When grinding, only very small cuts should be taken consider 0.002in. as a maximum with 0.25 HP. The original D26 grinder is fitted with a 180 Watt/0.25 HP motor, the larger external wheels can be stalled, due in part to the flat belt drive acting as a safety device. To improve cutting rates a 250 Watt/0.33 HP motor is fitted to the Dynamic grinder.

If the cutting action is poor, due to an unsuitable wheel or speed very high pressures are generated between the wheel and the workpiece. Never stop/start the grinder with the wheel touching the workpiece. The type of motor fitted has low starting torque. Very little force should be necessary for the wheel to traverse the surface being ground using a reciprocating action, coarse feed, light cut. This minimises the wear rate on the leading edge of the wheel. In order to facilitate taking such small cuts the topslide can be set at an angle and used for small increments, this may also be required when a tailstock supporting centre is being used.

Problem resolution

A number of problems were encountered with the first prototypes shown in the photographs. I had not allowed sufficient clearance inside the pulley guard casings for belt stretch and throw. The outer cover was flat and could be easily distorted. Due to differences between my original ML7 and the current Super 7 topslide there was too little spindle offset to allow this to be angled for small increments. Fresh patterns have been produced to eliminate these faults.

Plain flat pulleys were originally fitted, following the style of the Duplex. These proved unsatisfactory with the higher pulley ratios. In order to obtain satisfactory operation these must be crowned as shown in the drawings.

Considerable power is required to accelerate the spindle to 28000 RPM from cold. A Capacitor Start/Induction Run type motor has better starting torque than that fitted to the prototypes, the switch gear is less reliable and may not be quite as well balanced. It is also slightly longer due to the internal switch gear. Do not initially overtighten the belt, as this varies with temperature; a small amount of slip is acceptable when starting from cold. Use light machine oil for lubrication. Note that the shaft may take up to a minute to reach maximum RPM. Standard commercial ballraces can be quite noisy over 20000 RPM. Plastic cage types will give less noisy operation.

The original D26 design internal spindle extension gave inconsistent performance at the higher speeds required. Run out as little as 0.005in. can cause problems. The overhang being too great with the reduced diameter, up to 50% of the spindles made vibrated like a tuning fork. The drawings show a more compact spindle extension than those in the photographs.

To be concluded

QUICK TIP

Coat your file teeth with ordinary chalk when filing metal at the bench. This will help prevent filings from clogging the teeth as the metal is removed from the work.

Alan Jeeves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DC MOTOR SPEED CONTROL METHODS

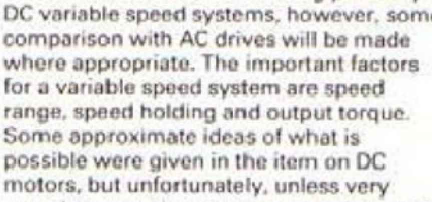
PART 4

In this part of our series on electric motors and their speed control, DC motor speed control is considered. The numerous methods of achieving this are considered, together with how some methods will improve their performance; other means having the opposite effect. The series will conclude in the next issue with some details for the construction of controllers for low voltage electric motors

The parts of this series published in issues 15 and 16 related to AC and DC motors; statements were made regarding their capabilities. However, these statements were made relating mainly to the motors in isolation from the remainder of the parts which make up a complete system. Whilst the statements made were true, at least within the limitations of the scope of the article, the ability or otherwise of the motor to achieve the stated parameters of speed holding etc, would also be dependent to a greater or lesser extent on the other elements which make up the system, in particular the control equipment. This aspect is the main subject of this fourth part of the series.

The drive block diagram

We are this time, considering primarily DC variable speed systems, however, some comparison with AC drives will be made where appropriate. The important factors for a variable speed system are speed range, speed holding and output torque. Some approximate ideas of what is possible were given in the item on DC motors, but unfortunately, unless very complex control systems are employed the stated values are unlikely to be met. This will be due to the effects of other elements in the total system. More about that later, but first let us look at each element in a little more detail. **Sketch 1** shows a very simplified block diagram of a complete drive system.



ELEMENTS OF A COMPLETE DRIVE SYSTEM. SK 1

Power supply

The source of power for any drive system will be derived, in almost all cases from one of two possibilities, either the AC mains supply or alternatively a battery. In the case of a battery supply, this is likely to be a car type battery for all but the smallest of powers.

Control equipment

The control equipment is the most variable aspect, having many alternatives, both in terms of method and finer detail.

Considering very briefly, as this was covered in detail in the last issue, the question of control equipment for an AC variable speed system, it should be understood that there is no simple approach to this requirement.

In the case of DC systems the possibilities are numerous, also wide ranging in terms of complexity. At the simplest it can be just a resistor to give a fixed speed change. Alternatively a range of fixed resistors with a suitable rotary switch, maybe of the tried and tested stud switch type to give a range of set speeds. If sufficient steps are provided this system can approximate to a continuously variable control.

Another method would be the use of a tapped transformer with rotary switch, and a rectifier bridge. The tapped transformer will, like the fixed resistors method, only give a range of fixed speeds, however this will be adequate for many applications.

For a continuously variable speed control a variable resistor can be used, but this method is practical only for low powers; more about these problems later. Without doubt the most suitable method of providing continuously variable speed control, is by electronic means. These systems can range from the simple, containing perhaps no more than ten components, to the complex with many hundreds of components. Complex systems are capable of precise control over a wide range of speed and load conditions.

The motor

Very little requires to be said regarding this, as it has been fairly well covered in the previous issues.

Transmission

There are a very wide range of possibilities for conveying the motor power to the actual load, but these can no doubt be divided into two types. These types can be considered as rigid, that is direct coupling or a gear train, or alternatively belt driven, in this case, some belt slip and/or stretching, gives a degree of isolation between motor and load. In any case, the transmission is probable only of academic interest for the calibre of drives found in the home workshop.

Load

Again there are many variables and each one must be considered on it's own merits, but for readers of this magazine they are most likely to be divided between, machine spindle drives, table feeds and drives for models, in particular larger passenger carrying locomotives. Little will be said regarding the latter other than to discuss how its requirements differ from machine drives. In any case, controllers for locomotives have been extensively covered in *Model Engineer* quite recently.

Drive system requirements

Before finally proceeding with purchase of motor and control equipment, it really is necessary to decide what is required from these and what factors are special to the application. For example, it would be easy to fall into the trap of considering that, assuming they both required the same speed range and output power, a drive for a machine spindle could be the same as that for a locomotive, there is however an important difference.

Anyone who drives a motor car will understand, even though after much driving it will have become second nature, that when arriving at an incline on an otherwise straight road the accelerator will be depressed so as to maintain speed. The driver of the small locomotive will be able to make similar adjustments as load on the system changes.

In the case of a machine spindle, such adjustments are impractical in most situations. This will be particularly so if the load fluctuates frequently as a result of intermittent cuts, say when machining an irregular shape on the faceplate of the lathe, or with a fly cutter on the milling machine. Regular readers to this magazine may remember in, *On The Editors Bench*, issue No. 13, mention was made of fitting a flywheel to a mill/drill spindle, the result of which was to improve finish of the machined surface.

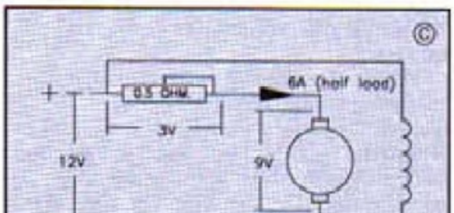
Subsequent correspondence to this, soon to be published, states that the improved finish is due to a more steady spindle speed. The correspondence further indicated, that even some lathes produced for industrial use had flywheels fitted for this very purpose. On this basis, a steady speed being desirable, the motor type and its control equipment require to be chosen carefully.

Effect of control equipment

In the article on DC motors it was indicated that the speed variation of a shunt wound motor, or its equivalent permanent magnet motor, for a given load change was a constant in terms of rpm, irrespective of set speed. The result of this is to make the motor characteristic less acceptable at lower speeds. As an example, a motor which drops in speed by 50 rpm when load increases from 50% to 100%, will fall, from say 1800 to 1750 rpm, quite acceptable, but also from 100 to 50 rpm, almost certainly unacceptable.

These statements, as already mentioned, consider the motor in isolation. Unfortunately the type of control system most likely to be found in the home workshop will be of the simpler type, and will further increase the speed change, in some cases considerably.

Let us consider the simplest system, that of a variable resistor being used to control the armature voltage as seen in **Sketch 2.**



EFFECT ON MOTOR VOLTAGE WHEN CHANGING FROM HALF TO FULL LOAD. SK.2.

In the top example the motor is seen running at half load (6A) and at nominally ¾ of top speed, that is 9v applied to a 12v motor. If now the load on the motor is increased to full load (12A) the volt drop across the resistor will increase to 6V and the voltage across the motor reduces to 6v. From this it can be seen that there will be a reduction in speed of about 25% of top speed, this due to the change in voltage drop across the resistor. This speed change, has also to be added to the change due to the motor's own characteristic, making the situation even worse.

The resistor method is a worst case situation, however, with the exception of the most complex of systems all methods will suffer from this to a certain extent, thought mostly to a much smaller extent.

Effect of power supply

Unfortunately, there are other factors which will further increase the effect of load on speed, they do however, normally have only a small effect and as a result are worth mentioning mainly for technical completeness.

The circuits shown in **Sk. 2** indicate a 12v supply but not how this is derived, this is likely to be either a battery or transformer rectifier unit fed from the mains supply. Any car driver will have at some time noticed that, with the engine stopped and the head lights on, the lights will dim if some other relatively large current item is switched on, typically windscreen wipers. Here we see that the output voltage of a battery will reduce as the load placed on it increases, this again will have detrimental effects, albeit small, on the speed holding of a motor being powered in this way.

In a similar manner, even the output voltage of a transformer is reduced with increasing load. Typically, the specification for a transformer will require the output voltage to vary by no more than 5%, with load changes of, from no-load to full-load.

Even the mains supply is not totally immune from changes in voltage due to changes in load. Most workshop owners will have experienced the momentary reduction in light output, due to the large starting current when a motor is switched on. This of course, does not mean that the voltage at the local sub-station has been reduced, it is a result of an increase in the volt drop along the cable supplying the premises, and the workshop in particular. This effect will be most marked if the workshop is some distance from the main house supply and the connection is made by using cables that are perhaps on the small side.

Possible systems

Methods for achieving speed control of DC motors are numerous, especially if one considers the many variations to a particular method. Therefore going into great detail is certainly not appropriate to this article.

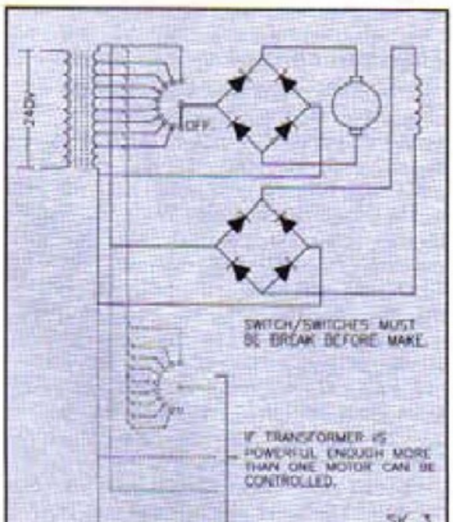
Voltage droppers

The use of resistors in series with the motor armature, as shown in **Sk. 2,** was for many years, even in industry, one of the main methods of providing speed control. One reason for this was that DC mains supplies were provided in factories, making it possible to control quite large motors in this way. It does though have another disadvantage in addition to the increase speed change due to load, that is it is also very wasteful in terms of energy. The resistors as a result can be very large and get very hot. A similar system can be used by replacing the resistor with a power transistor to provide the voltage variation. This approach is only marginally better than using resistors, as it still has to dissipate as much energy. For this reason, the transistor(s) will require mounting on a substantial heat sink. This must not be confused with the electronic methods described later. Its probable only real use is with very small motors, say up to 20 watts.

Stepped voltages

For the reader who is unhappy at the thought of getting involved with electronics, an alternative is the use of a stepped transformer as shown in **Sk 3**. In any case, it is worth considering whether the continuously variable characteristic of an electronic system offers much advantage over this system. Even so, for this method to compete with an electronic system, the number of tappings would have to be reasonably generous. It would also be preferable for the voltages to increase by a constant percentage rather than a constant voltage difference.

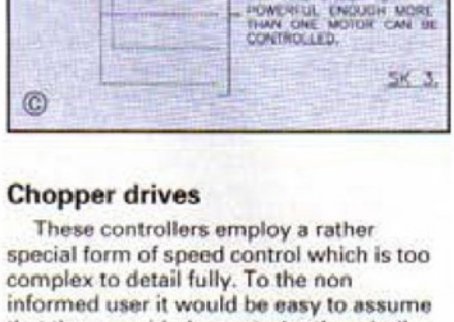
The transformer would however be quite expensive, typically £75.00 plus for a 500va transformer which would suit the popular Sinclair C5 motor. The other advantage, in addition to it not being electronic, is that it would not vary its output voltage greatly with change in current drawn, and would not therefore dramatically effect the motor's speed holding. Do make sure that the switch is break before make, this would necessitate a non connected stud between each working position should a stud switch be employed.



Chopper drives

These controllers employ a rather special form of speed control which is too complex to detail fully. To the non informed user it would be easy to assume that they provided a control rather similar to the variable resistor method. That is, taking a given supply voltage and then, by the application of electronics, to vary the output voltage to the motor.

However, whilst testing the system using a digital or analogue voltmeter would indicate that the voltage was being varied, the use of an oscilloscope would soon show this not to be the case. What is happening is that the supply voltage is being rapidly switched on and off. To change speed, the ratio between the on and off periods is varied as seen in **Sk 4.**



CHOPPER (PULSE WIDTH MODULATION) OUTPUT WAVE FORMS. SK 4.

©

The frequency is a constant and preferably in the order of KHz rather than Hz.

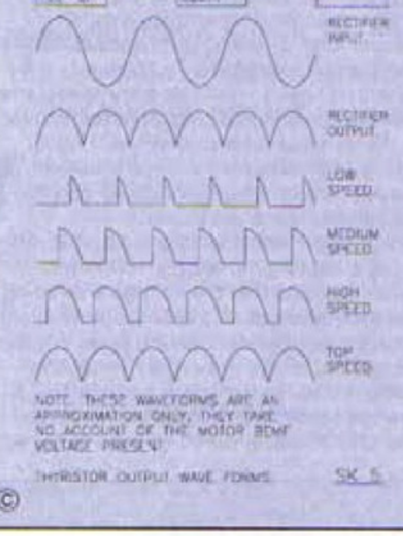
The distinct advantage of this system is that, as the transistors are fully switched on whilst carrying current, very little power is dissipated by them, and therefore very little power wasted. Even so, this type of component requires to be kept within certain temperature limits and will require, in all but the lowest power applications, to be mounted on a heat sink. The power dissipated will only be a fraction of that in the case of the series resistor method of control.

This method requires a pure DC supply, necessitating it being battery fed. This is unfortunate as the cost of a car type battery and the need to keep it charged, say during a long machining session, makes it far from ideal for a machine spindle application.

Thyristor control

This method has similarities with the chopper drive, in that it operates by switching the current on and off, and varying speed by changing the off to on ratio. An advantage is that it is powered from the AC mains supply, either direct for high voltage motors, or via a step down transformer in the case of lower voltage motors.

The characteristic of a thyristor is such that it is switched on by the application of a given value of current to its control terminal, known as the gate terminal. This current is in the order of milliamps and is therefore fed from electronic circuits. With the thyristor switched on it can then only be switched off by the removal, or reversal, of the supply to the power connections. The output from the controller therefore conforms to that shown in **Sk 5.** As the output of a full wave rectifier



THYRISTOR OUTPUT WAVE FORMS SK 5

will have 100 positive pulses per second, the output frequency of a thyristor controller will be 100Hz.

This controller, like the chopper, will require the thyristor to be placed on a heatsink to maintain a low working temperature, but similarly, will dissipate only a small amount of heat.

Precision control

In the part of this series dealing with DC motors, it was stated that the DC motor was the more able in terms of speed range and speed holding, than an AC motor. Whilst this statement is true, it is misleading as far as its use in the home workshop is concerned. Let us briefly recap regarding the comparative characteristics of AC and DC motors.

With regard to speed holding the AC motor wins hands down as it is essentially a fixed speed motor, running as it does at just below synchronous speed, varying only slightly with changes in load. The speed of the DC motor however is much more affected by changes in load. On the other hand the speed range available from an AC motor is limited to around 10:1 maybe a little more with motors designed with this in mind. This is much less than is achievable with a DC motor providing the poor speed holding characteristic at low speeds can be tolerated or, by the use of complex control systems, overcome. It should come as no surprise that, in common with many things these days, the application of electronics to DC variable speed drives provides the possibility of considerable performance improvements. What is required is some means of detecting changes due to load, that is speed, or current. With this done, it is possible to compensate by varying the voltage applied to the motor to minimise the change.

There are two common ways of achieving this. Let us try to explain the most effective and most expensive method first, as this is the easiest to understand. The non drive end of the motor, or some other part of the machine, is fitted with a small tacho generator; this will generate a voltage which is proportional to machine speed, this is compared with the voltage from the wiper of the speed setting potentiometer. The speed of the machine will rise until the voltage from the tacho generator almost balances that from the speed setting potentiometer. This error voltage is very small and just sufficient to control the motor at that speed via the power electronics. If now the load on the motor is increased and as a result starts to slow down, the out of balance will increase, resulting in an increased voltage to the motor preventing it slowing down further.

This method of control is extremely effective and speed ranges in excess of 100:1 with speed holding better than 0.1% of top speed are possible. Unfortunately the cost of the tacho generator and the additional electronics, would in most cases, rule this out as viable for the home workshop. There is a series of articles being run in *Model Engineer* at the present time, dealing with this method of control and giving some ideas for construction. In my opinion this is a subject for the electronic enthusiast.

The second system is less expensive, primarily because of the absence of a tacho generator, but also less effective. Even so, it will give far superior control than a system that makes no attempt to compensate for changes in load. The system depends of a facility which is called IR compensation, "I" representing the motor current and "R" the motor armature resistance. The controller will make adjustments to the voltage applied to the motor as it sees variations in the current taken. As the armature resistance is fixed (ignoring changes due to changes in motor temperature) the compensation for this is set during the initial commissioning of the system.

These facilities are found on commercially produced controllers which are, together with the costly DC motor, outside the price range for most home workshops.

Regeneration

If the voltage applied to a motor is reduced, such that it is lower in value than the back emf, the motor will attempt to become a generator and pass current back into the controller. If the controller is designed to permit this, the effect will be to brake the load thus reducing its stopping time. Many controllers will not pass reverse current, and as a result the motor will just idle down until the energy stored in the form of inertia is dissipated in the machine friction. This is likely to be acceptable for most home workshop drives, but as manufacturers literature will probably list this facility, it is best to understand the terminology.

Drives that will motor in one direction only are frequently known as single ended, whilst controllers that will motor and generate in a single direction are known as double ended. Controllers that can motor and generate in both directions are called four quadrant. Single and double ended are also known sometimes as one and two quadrant.

Whilst of academic interest only, the following should make the situation clearer. Consider a very large wood planer where the large block of wood is traversed back and forth whilst at the same time being surfaced. The method of moving the table back and forth is by a reversing motor rather than some mechanical means. The table is motored forward as the cut is being taken, but rather than let the table idle to rest at the end of its travel the current is reversed to brake the motor. This is achieved by reducing the output voltage of the controller to just below the back emf, and brings the table to rest rapidly over the last metre or so of movement.

The voltage to the motor is then reversed and the table returned to the start, this time at a higher speed as no cut is being taken, it is again brought to a rapid stop by reducing the voltage to below the back emf value. This is an example of a four quadrant drive where it is possible to both reverse the output voltage and the direction of current of the controller either together or individually. Any reader who would like a copy of the speed, voltage and current curves for this please send a stamped addressed envelope marked *Four Quadrant* to the *M.E.W.* office.

AC versus DC

The cost of a drive system will consist of motor, controller and maybe a tacho generator. The question of the cost of the motor has been covered in the previous articles but in a nutshell, the DC motor is likely to be in the order of three times that of the AC motor and will also be less reliable, or at least require more maintenance. In the case of the controller the differences are much less but with the AC controller likely to be slightly the more expensive.

If therefore the limited speed range of the AC system can be accepted, this is certainly the most economic approach. A good compromise in this respect would be, in the case of a drive for a lathe, to use the 10:1 range to cover the top speeds, say typically from 2000 to 200 rpm. The lower speeds could then be achieved by bringing in the back gear and again using the 10:1 speed range of the motor to give probably 250 to 25 rpm.

High versus low voltage

Here we are considering only DC motors, as motors for AC supplies are invariably made for mains voltages. It has already been stated that motors for DC are very expensive, particularly so in the larger sizes say 200w plus. The main difference however is the availability of good second hand motors, these are almost non existent in the case of high voltage motors, having the effect of keeping up their price up for the few that do exist. There are though many low voltage DC motors to be had, mainly taken from motor vehicles. Here they will have been used for such tasks as cooling fans, windscreen wipers and electric windows.

It is worth mentioning here a point to consider when using surplus motors, be it from motor cars, washing machines or some other source, and that is whether they are continuously rated. Take for example the three motors mentioned above. The wiper motor will certainly be required to be used for long periods and, due to its location, at a high ambient temperature. The engine cooling fan is less likely to run continuously, but even that may, on a long journey and a hot day, be called to operate for lengthy periods and repetitively, again in a high ambient temperature. On the other hand the window motor will only be used for a few seconds at a time and invarably be starting from cold having not been used for some time. Of course it will have a good safety margin to cover such things as repeated use for testing should the window require a repair. But in such a cut throat business no car manufacturer is going to use motors that are larger than required, especially as in this case the car may be fitted with as many as four such motors.

Make versus buy

Many readers will, in true *M.E.W.* tradition, first consider the possibility of making their own controllers. Whilst, with sufficient space in the magazine and time to develop an article, detailing a design for an AC inverter is not impossible, in practical terms it is really not acceptable. Inspection of the photograph on the front cover of issue 17, should make this obvious. It is therefore a case of purchase if an AC system is the route taken.

When we consider DC controllers an answer is much more difficult to arrive at, as there are a much wider range of possibilities. Considering first controllers for high voltage motors, these in their simplest form are much simpler than their AC counterpart and would be much more practical for an article in *M.E.W.* at some latter stage. However the cost of new motors and the minimal supply of second hand motors makes this a low priority.

When low voltage motors are considered there is much more scope for making this in the home workshop. First one needs to decide the type of power supply to be used, that is mains or battery. In the case of mains fed controllers the answer would appear to be make it oneself, as to date I have not found a supplier for such units. I must confess that I have not scoured the market that closely so may have missed some. Should any reader know of such a supplier I will be pleased to learn of same, in which case details will be published later.

In the case of battery fed controllers the situation is much less clear cut. In fact there are a number of manufactures who make these items in relatively large numbers, being used in such items as golf buggies and electric wheel chairs. In view of the areas of use and the quantities made, these are both high quality and reasonably priced. However, if one still wishes to make one oneself, either for the interest therein or for saving that £10 to £20, then there are some kits on the market that will make this a possibility.

For those wishing to make their own low voltage controllers, mains or battery fed, some thoughts on the subject will be published in the concluding part of this series in the next issue.

Bibliography

The following are suppliers of control equipment.

AC inverters. The following company is an addition to the list published in the last issue. Jeno-Tech Ltd. Little Miel Builgh, Powys, LD2 1TN. Tel. 0982 553565.

DC controllers, high voltage. Most, if not all, of the names listed as supplying invertors, will also manufacture DC controllers.

DC controllers, low voltage. 4QD, 30 Reach Road, Burwell, Cambridgeshire, CB5 0AH Tel. 0638 741930.

Nautilus Systems Ltd, 8 Avoca Road, Tooting, London, SW17 8SQ. Tel. 081 767 4184.

DC controllers, low voltage in kit form. Nautilus Systems Ltd, as above.

Argus Publications, Reader Offer, Elco Controller Kit. See order form in this issue. Copies of the following issues of *Model Engineer* will be required to complete this kit, Nos. 3886, 3888, 3890, 3892 and 3894.

Postscript

Jim Cox, author of the Argus Books, Workshop Practice Series No. 16, entitled *Electric Motors* (£6.95 plus 70p. p&p), has pointed out a mathematical error in the article on DC motors issue 16, making an error in the magnitude of the speed change of a series motors at lower speeds. The following is an extract from his letter:-

"The article on page 66 of April/May *M.E.W.* continues the good work of explaining motor operation, but a gremlin has crept into the speed calculations for series wound motors.

Under the heading Intentional Speed Variation page 70 the findings regarding the motor at 2% of top speed and 50% load are incorrect. The figures for 2% at 100% full load are correct, but when the torque load is halved the current drops to 70% of full load and only 14v is lost in the resistance of the windings. This allows the back emf to rise to 10% which, allowing for the fact that field strength is now reduced to 70% due to reduced armature current, gives a speed of 7.1% of top speed. This is a lot less than the 49% figure but still pretty dreadful. The speed is more than trebled when the load is halved so the general conclusion that the shunt wound or permanent magnet motors are still a better bet for controlled speed applications is still correct".

It will be clear from the above comments that conclusion SS4 on page 71 needs revision. "Change in speed due to torque demand is large and this effect is more noticeable at low speeds"

A characteristic of series wound motors that is not mentioned in the text is their no load behaviour.

In a perfect series wound motor speed is proportional to $1/\sqrt{\text{Torque}}$ which gives rise to the interesting conclusion that, if there is no load on the output shaft, the speed rises without limit (or until something bursts!). With real motors, rapidly increasing windage and iron losses limit the no load speed to a safe value but some of the larger more efficient motors can overspeed to the point that conductors break loose from the armature with spectacular and permanent results. Some high spin speed washing machine motors come in this category and should be treated with respect, if used for a purpose other than that for which they were built, they should never be run up off load.