No.301

THE MAGAZINE FOR HOBBY ENGINEERS, MAKERS AND MODELLERS

MODEL ENGINEERS' WORKSHOP

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MARCH 2021

INSIDE

Making a Lathe Clutch

Caring for Super 7 Lathes

COVER STORY

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On the Editor's Bench

MEW Online Archive Upgraded

I've been contacted by a number of readers and forum members regarding the future of the Online Archive that goes back to the very first issue of MEW. Access to the archive is a 'bonus' feature available to digital subscribers who purchase their subs direct from MyTimeMedia. Until about two years ago, all issues on the archive were in Adobe Flash format, but as many will be aware Flash Player is being aggressively purged from our computers and browsers due to security concerns.

After a period of uncertainty, I'm please to say that the entire MEW archive is in the process of being converted to a new format that works without Flash. It is progressing well and provides another good reason to consider joining our rapidly expanding digital readership.

Pocketmags Reader Settings

This is probably also a good time to explain an issue one subscriber found with the Pocketmags App, which is the ideal and portable way for digital readers to access their subscription issues. The reader allows you to download all your subscription issues and keep them on your device so you can access them anywhere without an internet connection. In this case our subscriber was horrified to get a screen telling them their downloaded issues older than three months would be deleted automatically.

The good news is that you can avoid this by changing your 'auto Archive settings' in Pocketmags to 'never delete'. If your issues get deleted by accident or you change device, you can still download them again as long as you have your Pocketmags account.

Model Engineers' Workshop Data Book

Starting in Issue 22 of Model Engineers' Workshop, a series of pull-out sheets was included in the magazine, compiled by then editor, Harold Hall. Following a number of requests we are republishing the most useful of these across our centre pages.

Some of the pages, such as tangents and exact conversions between metric and imperial sizes are rather less useful now that computers and smartphones are almost ubiquitous. Instead we will be focusing on those cards which are most useful, possibly to be pinned on the workshop wall or maybe laminated and kept in a drawer. We are starting with data on Metric thread forms -this might be handy to keep with a set of taps and dies or near your lathe changewheels.

I hope you find these useful.
Neil Wyatt

With darker days approaching, it is a good time to review lighting in the workshop.

Good lighting will avoid eye strain. Warco's new range of LED lighting complements the existing range and offers new features, sizes and prices. Lights have an inbuilt transformer and low energy consumption

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At this time, we would usually be announcing our next Warco Open Day. With the current Covid-19 restrictions it is not possible to hold this popular event. In the meantime, please view our Used Machine list on our website. Our showroom is now closed to the public.

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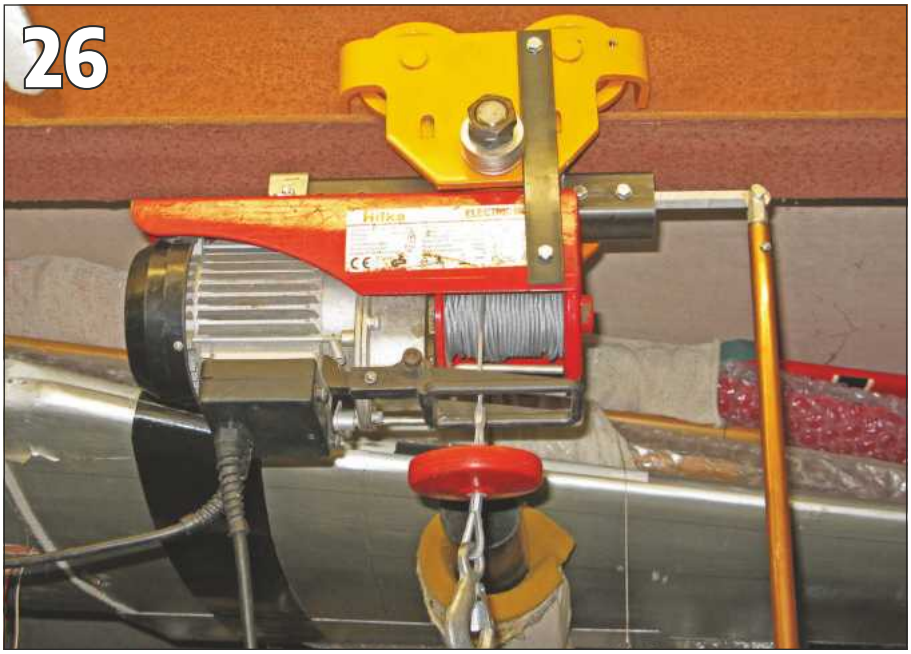
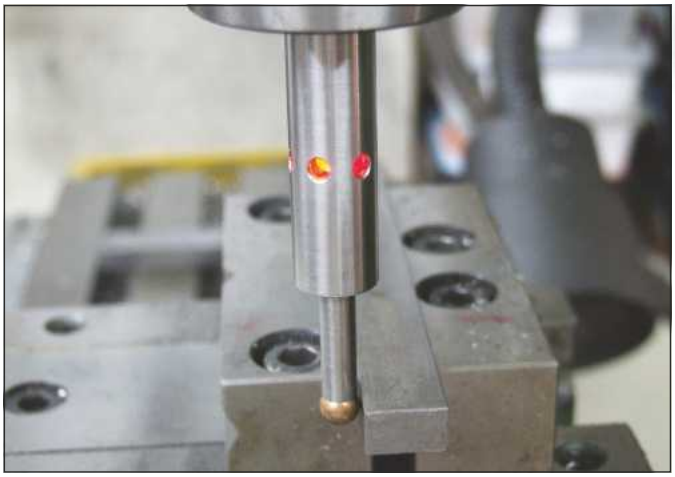


Coming up...

in our next issue

As we look forward to the spring and some warmer weather, for your next we plan more fascinating content including how to get the most from a spin indexer, an adjustable tailstock and making an electronic edge finder.



Regulars

ON THE COVER

This month's cover was taken during the restoration of a 1:8 scale Big Boy locomotive at the Rahmi M. Koç Museum in Turkey, with Mr Koç (to the right) and Bulent Bulgurlu.

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THIS MONTH'S BONUS CONTENT

Log on to the website for extra content

Visit our website to access extra downloads, tutorials, examples and links.
www.model-engineer.co.uk/extracontent

Drilling and Tapping Size Chart
Following a request from reader Michael Belfer and the help of several readers, including Nick Farr, we have been able to produce a good quality downloadable and printable version of the Model Engineers' Workshop Drill Size Chart originally given away as a pull-out in MEW.

- **Mc Donald Model tractor**
Further progress with what promises to be an outstanding model.

- **ML7 left to run for 72hrs accidentally - what to check?**
Useful lessons learnt when a machine was left running.

- **How big Are Your Chips?**
How does your workshop's swarf measure up to this?

Come and have a Chat!
As well as plenty of engineering and hobby related discussion, we are happy for forum members to use it to share advice and support. If you feel isolated by the lockdown do join us and be assured of a warm welcome.

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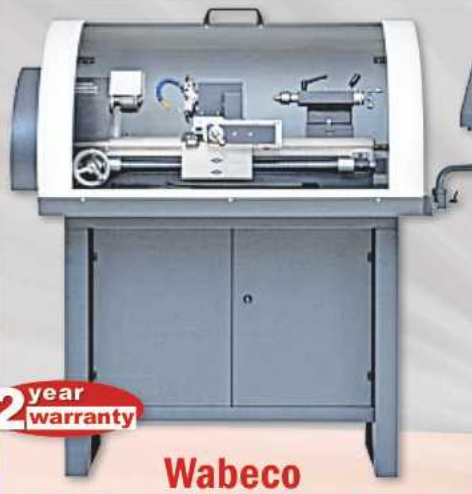

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- Size – 900 x 610 x 960mm
- Weight – 101Kg

Wabeco Lathe D6000

- Centre Distance – 600 mm
- Centre Height – 135mm
- Speed – 30 to 2300rpm
- Power – 1.4 KW
- Size – 1230 x 500 x 470mm
- Weight – 150kg

5 year warranty

Wabeco Lathe D4000

- Centre Distance – 350mm
- Centre Height – 100mm
- Speed – 30 to 2300rpm
- Power – 1.4 KW
- Size – 860 x 400 x 380mm
- Weight – 71kg

5 year warranty

Wabeco CNC Mill CC-F1410

- Table – 700 x 180mm
- Z axis – 280 mm
- Speed – 140 to 3000rpm
- Power – 1.4 KW

- Size – 950 x 600 x 950mm
- Weight – 122Kg
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Looking after your Myford Super 7

Press Parts oil gun.

Eric Clark offers sound advice to owners of the 'classic' model engineering lathe, still much lauded sixty-seven years after it was first introduced

Quite often members of the Model Engineer Forum, having just acquired a used Myford Super 7 ask some basic questions about its design, functions, capabilities and maintenance. The objective of this article is to offer some help and advice to someone new to Myford Super 7 and ML7R lathes, however much of it can be applied to the older ML7 and indeed, generally, to lathes from other manufacturers. I do not claim originality for all the contents. The help offered has been gained from my own experience and my desire to look after my lathe to preserve its accuracy and usefulness. This is not a comprehensive guide to the Super 7, just some key messages for owners. Actions that are considered to be essential are printed in bold italics.

Any reference to Myford in this article relates to the original Beeston manufacturer. "new Myford" relates to the current company who continues to supply a range of spare parts, accessories and useful information as well as small numbers of new Super 7 Connoisseur machines.

So if you have acquired a Super 7, congratulations and I hope this article will be of help.

Get yourself a handbook

The official Myford handbook is very comprehensive and answers most questions that arise concerning its feature, use, adjustment and maintenance. It also contains a comprehensive illustrated parts list. If you are lucky enough to have a lathe fitted with the quick change gear box there is a similar handbook available. Official handbooks are available from new Myford, second-hand or can be downloaded as pdfs.

A copy of the handbook is essential if you need to make any adjustment to the lathe headstock. Do not attempt to work on the headstock without first reading and understanding the relevant pages of the handbook.

Two other books are also very useful:

Myford Series 7 Manual by Ian Brady which is readily available new.

The Amateur's Lathe by Lawrence Sparey which covers early ML7 lathes.

Lubrication

Get a suitable oil gun. In the handbook there is a comprehensive lubrication chart which I suggest should be copied, laminated and put up near the lathe.

Many oiling points require the use of

an oil gun to be applied to the rather strange nipples originally fitted. The original Myford oil gun is notorious for leaking and for putting oil everywhere other than through the nipple. A much better Waner oil gun is offered by new Myford - at a price, other cheaper alternatives are available but usually also leak.

Hand oiler PP632 from Press Parts works well and puts oil only where it should go and only costs £15. I have had one for some time and I am very pleased with it, photo 1. It might be an idea to replace the original slim oil nipples with the more conventional bulbous type that accepts a modern collet type oil gun.

Do not use grease anywhere on your Super 7, however sometimes it is found that previous owners have used grease instead of oil. This is a consequence of confusion caused by the presence of an oil nipple mistakenly assumed to be a grease nipple. Do not use grease anywhere on your Super 7. If you find that grease has been used it is best to flush it all out with H32 oil.

Get yourself a supply of H32 & K64 oils and some straight SAE 30 motor oil. Myford specify Esso Nuto H32 oil for the headstock and for most other lubrication points. Now this is just good

2

Underside of chuck board

quality hydraulic oil to ISO viscosity specification 32 and there is nothing magical about it – other than the exotic prices charged for by some specialist suppliers. Any reputable manufacturer's oil to the same ISO 32 specification is acceptable. Search the web for ISO H32 hydraulic oil and then buy a 5 litre can that will last a lifetime. No need to pay fancy prices for this very common standard lubricant.

I lubricate the top and sides of the lathe bed, and rack with SAE 30 motor oil (available as 4 stroke mower oil) as it "stays put" longer than H32. Some authors have recommended slide way oil (ISO K64 grade) for this application, but in my opinion, it is too sticky and encourages swarf and metal debris to cling to the working surfaces and may do more harm than good.

Do not over lubricate the headstock rear bearings as the oil level will rise too high within the bearings making them noisy at high speed due to the oil churning. I found this out after fitting a new matched pair of SKF bearings and enthusiastically pumping oil whilst the lathe was running however the increase in noise was worrying until the excess oil had found its way out. It is very difficult to assess how much oil is pumped into the bearings, so I have fitted a flip top type oiler which allows me to put a few drops into these bearings at the start of the day and occasionally as the work progresses.

The clearance in the front headstock tapered plain bronze bearing is very, very small when adjusted correctly according to the handbook. Very little if any oil should show escaping at the ends of this bearing. Keep the angled oil pot topped up but do not expect oil consumption to be very much at all. Excessive oil consumption at this point indicates a leak from below the bearing or that the front headstock bearing is not correctly adjusted.

When using the back gear ensure that you lubricate the headstock cone pulley and the back gear spindle (Items 4 and 18 on the lubrication chart). There is a cut-out in the casting to allow the oil gun to be used on the nipple (4) situated on the hub of the pulley. The back gear spindle (18) is best lubricated without the chuck on the spindle.

When acquiring a Myford lathe it is best to replace the felt wiper attached to the front of the saddle as it may well be contaminated with metal particles or worse. The felt wiper should be changed periodically. Currently Home and Workshop Machinery who advertise in MEW are selling them at a reasonable price. For the Super 7 the ones shaped like a wide" U" are correct, the ones with the narrow "U" are for the ML7.

3

Chuck board in position

Swarf tray

Gearbox lubrication

Myford have confused the issue concerning the lubrication of the gear box. Originally SAE 30 was specified however the handbook that came with my gearbox (one of the last to come out of the Beeston factory) specifies Esso Febris K68 oil presumably because it is sticky and clings to the gears that are only partially immersed in the sump. As the gear box should never be loaded too highly due to the use of a low power fractional HP motor and the presence of the Tufnol tumbler gears (that will strip their teeth long before any serious damage can be caused through crash-ups) it does not matter which of the two specified oils are used – just stick to one or the other and check the level periodically.

The teeth of the gears between the tumblers and the wide gearbox input gear should be lubricated with K68 from a small oil can. This is of course a total loss system and excess oil will drop off and collect in the main drip tray. I position a redundant small loaf tin (donated by Management) below the gear case to collect the excess oil and periodically use it to impregnate an oily

Magnetic swarf catcher

Swarf tray and catcher in use

rag, avoiding any swarf, which everyone should possess for general wiping things over to prevent rust on non-moving machine parts and tools. When the oily rag gets too dirty for use on your treasured machinery keep it to wipe over garden tools!

Whilst on the subject of the gear box never alter the front pitch selector whilst the lathe is running, as to do so would cause damage to the internal gears. However, the top mounted 3-position lever can be altered whilst the machine is running in "fine feed" mode to change the fine feed rate – but never whilst screw cutting. This lever can be set to an intermediate position between the set positons to unlock the leadscrew from the powertrain to enable it to be turned by using the end hand wheel.

Protect the lathe bed

It is all too easy to damage a lathe bed particularly at the end nearest the chuck, so make a chuck board.

This is simply made from scrap wood and is easy to use and will protect the bed whilst changing chucks in case of mishaps. **Photograph 2** shows the underside of one I made from 10mm ply and is approximately 160 x 180mm with 25mm square side pieces. In the centre of one end is a 40mm high "foot" to steady the board in the bed gap.

None of the dimensions are critical – just make it to fit the job. Photograph 3 shows it in use. Ensure the mandrel nose is perfectly clean and smeared with anti-seize compound such as Rocol or similar. When removing a tight chuck never engage the back gear to lock the spindle – always use the spindle lock provided on a Super 7 lathe, more about this below.

Make a swarf catcher for the front of the cross slide

Catching the swarf in this simple device greatly helps to prevent wear to the lathe bed and prolongs the life of the felt wiper pad. You can buy a fancy cast aluminium one as a casting for machining, but I advise against such an item as it is expensive, too rigid and could cause damage in the event of a crash up. I made mine from 1mm aluminium, **photo 4** gives the general idea with suggested dimensions.

Features of the design are:

- Ease and low cost of making.
- No damage caused to the lathe during a crash up.
- Ease of fitting to the ¼" BSF screw at the front of the saddle intended for securing the travelling steady.
- 10mm joggle positions the tray close to the top surface of the lathe bed without touching it.
- Non-magnetic allowing a magnetic pick-up to be used for ferrous swarf.

Get a good one-inch paintbrush and keep it solely for brushing swarf off the vital lathe parts onto the above swarf tray or down onto the main under tray. Do not use an airline to remove swarf as it can blow swarf into other parts of the lathe or your eyes!

Make a magnetic swarf pick-up tool.

This can be purchased but it is easy to make one using non-ferrous materials. The one shown stripped down in **photo 5** is made from a length of ordinary 22mm copper water pipe with a thin disc of brass soft soldered on to close off the lower end. A neodymium high strength magnet was purchased from eBay and is secured to a brass rod which passes through a brass bush at the top end and is fitted with a suitable handle. The length of the rod is made to stop the magnet just short of the bottom to prevent it hitting the thin brass end plate. The rubber disc is there to shed the swarf from the tube when withdrawing the magnet. I found this disc in the gutter near my house and it has the word "Valio" on it so I suppose it came from a vehicle lamp unit. **Photograph 6** shows the swarf catcher tray and the magnetic pickup tool in use.

●To be continued

Scribe a line

YOUR CHANCE TO TALK TO US!

Drop us a line and share your advice, questions and opinions with other readers.

300th Issue

Dear Neil, Just a few lines to say how much I enjoyed reading the articles about the history of MEW in the 300th issue. It made me think back to when my own interest in model engineering started and I have to say that I thought that MEW started before 1990.

I'd always enjoyed woodwork and metalwork at school and as a teenager enjoyed making and repairing this in the garage at home and in my granddads shed. In 1976 I started an engineering apprenticeship and spent the first year at college learning general engineering skills – fitting, machining etc. Around this time, it would have been around 1976 or 77 I purchased a model engineering special magazine. I thought that it was from MEW but the date obviously means that it wasn't. But I do remember it was written or edited by Tubal Cain and was about setting up a model engineers workshop. The Unimat lathe featured largely (I think this was a Model Engineer special- Ed.)

Armed with the skills that I'd learned at college and with my enthusiasm fired by Tubal Cains publication I embarked upon a hobby that I still pursue today working with both wood and metal.

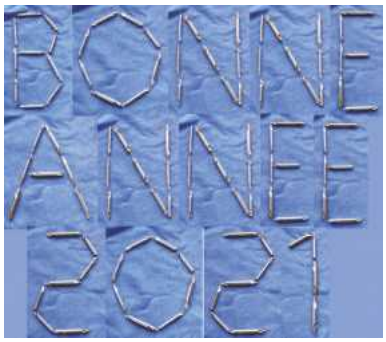
Sadly I no longer have the publication that I had back in the 1970's so if any reader has one that is surplus to requirements, I would happily buy it off them – or even a photocopy would do. It would be nice to revisit the articles that set me out on the road to model engineering again.

Chris Murphy, Derby

Tip Appreciation

Dear Neil, I'm writing today to give especial thanks to Philip Hurst for his "Tip of the Month," which you published in #289 (January, 2020). I built a parallel rack per his idea. A friend saw it and called it a "Xylophone," which I thought was quite appropriate. Please pass my thanks on to Mr. Hurst.

John Herrmann, Chandler, Arizona, USA.



Happy New Year to all Readers

Happy new year and best machining wishes for 2021, with centre drills this year.

Jacques Maurel, France

Air Compressor Warning

Hello Neil, I was quite shocked to see [a split open air receiver caused by corrosion] on You-tube. There are so many of these "hobby" compressors in peoples workshops.

I am sure many owners are unaware of the dangers of now ageing air tanks, which should be drained after use. In this example the weld is at the bottom and had been submerged under residual water for some time.

Brian Howett, by email

Thanks to Brian and others who got in touch as a result of a discussion on the forum, www.model-engineer.co.uk where this video and other incidents were discussed. The thread Air Compressor Safety now includes a link to best practice for testing compressors – Neil.

Archive Articles

Dear Neil, you asked for ideas on older articles that may repay reprinting. I would like to suggest a short series of articles from ME by Dr Robert Rose, I think, a Canadian dentist and who wrote on "Simple Toolholders", ME Vol 138 (1972). These are easy to make, cheap, require no castings or proprietary items so they can be scaled up or down and can be made in any part of the world, and are fairly quick change. Their best property though is that they are really rigid and can enable really deep cuts. Dr Rose illustrates this aspect well in his articles and he has some comments on tooling for shapers. I made some lathe toolholders years ago and though I now have quick change tool holders I still use the simple ones when I really have to shift metal. (The originals were for HSS bits but they can be updated to carbide. Dr Rose's only other articles are in the same Volume and are on "Holding blocks" and are, perhaps, not quite so interesting.

Rod Renshaw, by email

Jack Safety

Dear Neil, I'm surprised that MEW published an article (MEW 300 page 57) describing working underneath a car supported solely by jacks on the side where the work was being undertaken. The offending text was emphasised by the photo caption: "Car supported on jacks..." The car should have been supported independently of the jacks. Axle stands would have been acceptable. Surely it is a fundamental rule of workshop practice that one should never work under a load supported by jacks?

Ian Moignard, by email.

Hi Ian, It may not have been clear from the article, but the jacks Dave was using have pins through the rack that completely prevent the jack from dropping. The danger with these jacks is slipping out of position or the load coming off the jack. The adaptors he attached to the jacks and bolted to the hubs meant they could not slip out of place and as he stated additional support./chocking needed to prevent the vehicle from moving was used.

I'm sorry this was not all obvious from the photo or the text and urge readers to take all possible care when working with a raised load. – Neil

Index Abbreviation

Dear Neil, the first Index I compiled covered issues 93-104. My understanding from Harold Hall was that INST/SERV was an abbreviation of Installation/Servicing. It first appeared in the index for issues 21-32 (published in issue #34) and was used five times on subjects ranging from a lathe mounting frame, moving heavy machinery to renovating a lathe. Your definition of 'How to do this' pretty much sums up this very general category perfectly.

Barry Chamberlain, by email

Dear Neil, Thank you for publishing my Mini-Lathe DRO article.. I think you made a good job of it. One thing worth mentioning is that I said that the EMS-I reader heads were about 25% smaller than the M-DRO heads, which made them able to fit on the cross slide. This was true at the time of writing, but I see in issue 300 that M-DRO are advertising that they now have three heads and the one called EHM Mini Head is the same size as that supplied by EMS.

Keith Beaumont, by email.

D-Speeder

Dear Neil, On reading issue No.291 again I realised The D-Speeder is one and the same, I have been using it for power tapping small threads, using my floor mounted Meddings pillar drill.

I thought I would share this bit of info – as It is very controllable allowing the casing to slip in the hand or be released when the tap bites or has reached the extent required – I have been using mine for over 20 years and never even given a thought to lubricating it. I assume regular use is the answer.

I'm a great believer " If it ain't BROKE " use it! Pictures are always interesting, attached is a view inside my shed which is 3x3m.

Dave Davison, by email

Inflation

Hi Neil, I have a minor complaint with the Jan/Feb 2021 issue of MEW, Page 40, Stan Bray's email.

The Weekly wage of 14/- conversion to 70p is misleading, as it seems to be ignoring the effects of inflation. I don't know how old Stan is, but for the sake of discussion, I will guess 78. Assuming he started work at 18, that will have been 60 years ago, in 1960 or thereabouts.

14/- in 1960 equates to £16.44 in today's money. I don't want to appear pedantic over this, but at my local club, EskValley Model Engineering Society, I try to emphasise to the junior members that engineering can be a worthwhile and remunerative career. It really doesn't help when they read articles implying that engineering only pays peanuts!

On a positive note, I think I must have purchased every one of the 300 editions of MEW. One of these days, I must sort them all out and get them filed in order. But for some reason or other, I can always find something more interesting to do in my workshop.

Keep up the good work with the magazine.

Dave Pack, by email

HI Dave, a precise conversion might be counter-productive! Even allowing for Stan being several years older and starting work younger, the wages still only equal about £25 at today's prices- Neil

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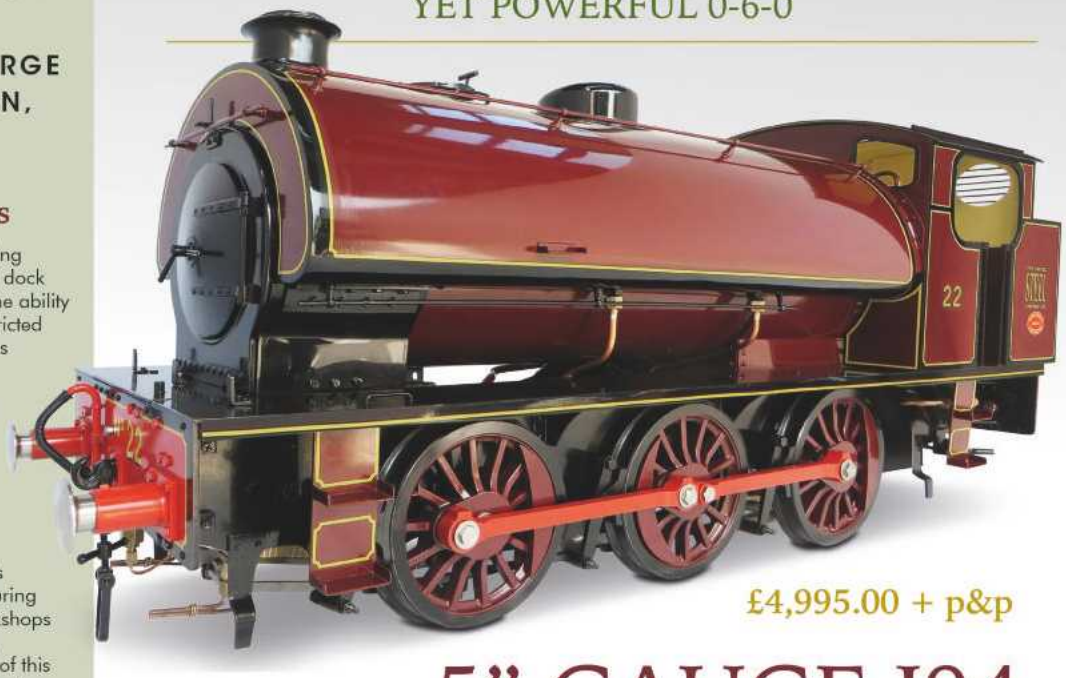

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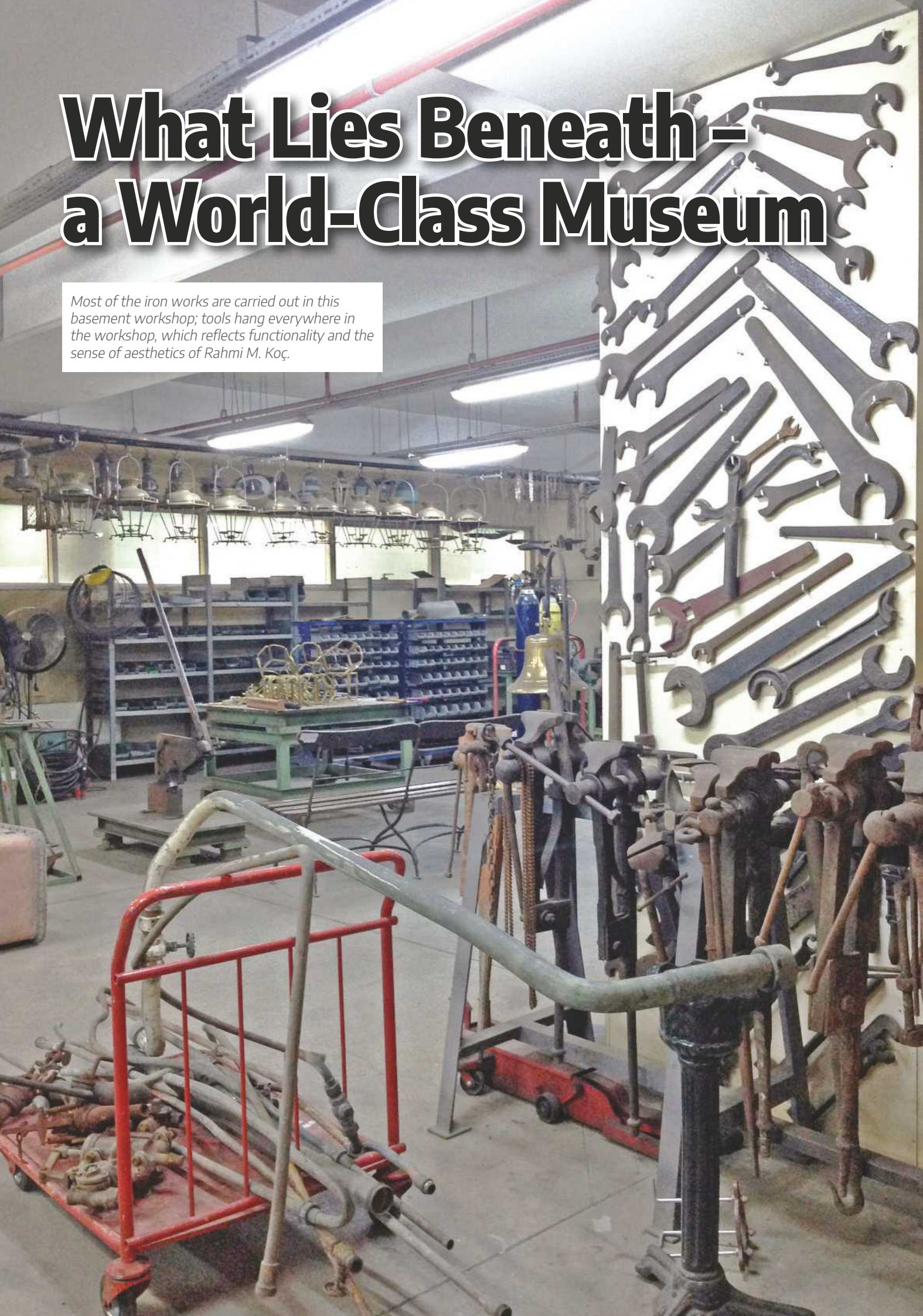
What Lies Beneath – a World-Class Museum



Most of the iron works are carried out in this basement workshop; tools hang everywhere in the workshop, which reflects functionality and the sense of aesthetics of Rahmi M. Koç.

The Rahmi M. Koç Museum of Istanbul boasts a collection of over 16 thousand objects, all related to the history of transport and industry. Bruno Cianci explains how behind it all is a workshop for restoration and maintenance work that employs 32 women and men. Photos by Bruno Cianci, Ali Konyali and Tarkan Kutlu

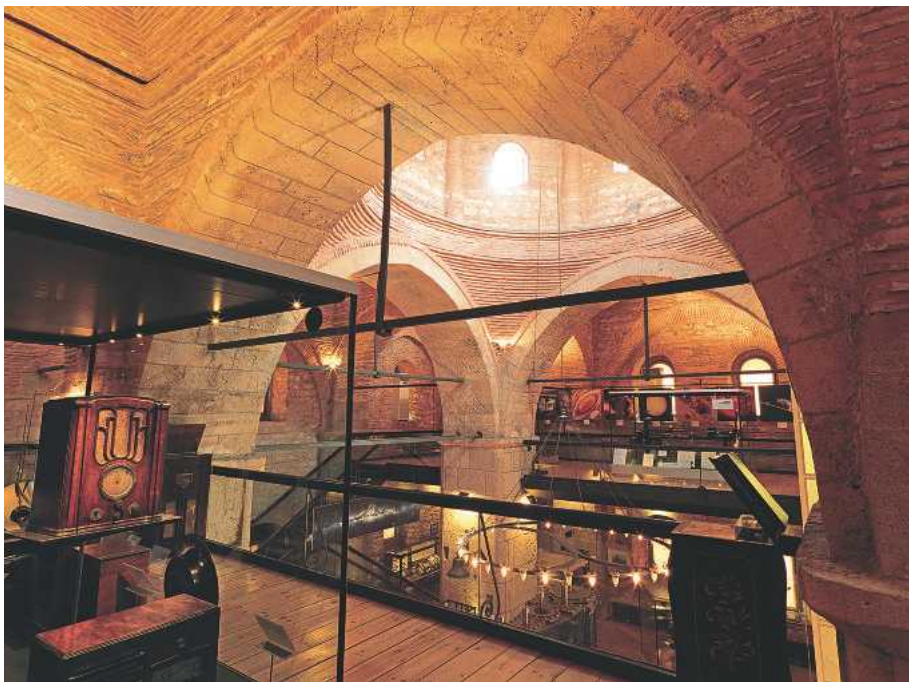
"We started our workshop as a small restoration chamber and today have a three-story, 2,000-square meter building, where our experts work on all types of metal, marble, rugs, kilims, woodwork, gilding conservation, frame restoration, wood carving, mechanical and marine restoration, and tin toys and locomotives' maintenance." These are the words of Rahmi M. Koç, CBE, a Turkish tycoon (born in Ankara in 1930) who for decades has been steering Koç Holding, Turkey's largest industrial and services group of which he is now the honorary chairman.

Founded in 1994 and expanded enormously in 2001 (after acquiring a much bigger venue on the northern shore of the Golden Horn, a former dockyard), the Rahmi M. Koç Museum was established in order to please Mr. Koç's passion for steam engines, boats, road and railway vehicles, memorabilia and antiquities in general. His passion had started a long time ago, after his late father Vehbi (1901-96), the founder of the Group, brought him an electrical toy train from Germany. With time, Rahmi's passion grew, so much so that his mansions, offices and warehouses were not sufficient to contain all the collectibles he was so very fond of. It was only after a visit to the Henry Ford Museum in Dearborn, Michigan that Rahmi Koç decided to put all his 'toys' together under a single roof.

Pioneering years

For obvious reasons, given the nature of the objects and the lack of indoor space for the larger items, maintenance played, and still plays a crucial role in handling such a massive collection and organization. In the early 1990s, when the museum was in the making, Mr Koç could rely on a small workshop located in Istinye, an inlet on the west bank of the Bosphorus. Richard Foster, a longtime advisor to Rahmi M. Koç, remembers pretty well how he got involved in the project. 'In the mid 1980's – says the Englishman – I was asked by a contact who knew of my interest in steam to see whether I could assist a scientific instrument restorer from London to obtain parts and information on restoring a model traction engine. As a result I became friends with Paul Bowskill who was supplying scientific and steam related items to a gentleman from Turkey, who had a keen interest in steam and engineering models. I was later introduced to Rahmi M. Koç, who was interested in setting up a museum of transport and engineering in Istanbul. Mr Koç visited me on several occasions to view my and other collections of steam models. In 1991 Paul was invited to move to Turkey to work on setting up the museum. Through Paul I was asked to visit and assist him with identifying, dating and cataloguing the models that had been acquired for the proposed

A drone view of the Rahmi M. Koç Museum of Istanbul, with the water of the Golden Horn next to it.



A view of galleries inside the Lengerhane.

new museum of transport and industry. This led to my first visit in 1992, after which I was asked to attend regularly and assist with the restoration of the steam and ship models, cataloguing and exhibit descriptions, etc. I was also tasked with locating and purchasing items of interest for Mr Koç, both models and in full size, from the UK and Europe. This has included locomotives, aircraft, motor vehicles, steam launches and tugs and many smaller objects. Some of the items were acquired in poor condition and required restoration in the museum workshop. This initially was a small low-level building adjoining a cycle wheel factory in Istinye, close to the Bosphorus. The workshop was large enough to house a steam roller and large oil engine and contained a sand blasting booth, metal workshop with overhead gantry, and a room and portacabin for the fine work. No outside storage was available, and this was a problem as many large objects were being acquired or donated to the museum.'

A large number of small locomotives, ship models, miniature engines and the like were restored in Istinye, as well as other projects. Among the early and notable restorations were that of a Marshall Portable engine carried out by Ian Clarke, a Fowler steam roller and a Crossley oil engine. These were then followed by that of a railway coach presented by Queen Victoria to Sultan Abul Aziz, manufactured in Birmingham and donated to the Ottoman sovereign in 1867, on the occasion of his very first visit to the West. All these items, obviously, are now exhibited at the Rahmi M. Koç Museum in Istanbul.

The size and quantity of the objects requiring restoration meant moving to new and much larger premises where under cover storage was available. These premises were spotted in Tasdelen, on the Anatolian side of the Turkish metropolis. Over three floors they contained individual workshops for metal fabrication, woodworking, stonemasons, modelmakers, artists, and carpet restorers and a paint shop, each featuring highly skilled Turkish craftsmen and women. Like Mr Foster says: 'A far cry from the early workshop in Istinye!'

In Tasdelen

The items restored and of note are many. These include three very fine classic steam launches like Esra (1888), Ysolt (1893) and Maid of Honour (1927). The first two were restored under the

The 1:8 scale model of the "Big Boy" locomotive after completion of the restoration process.

The immense car gallery gives an idea of the scale of the museum.

guidance and engineering skills of Mike Williams and boat building skills of the shipwright Michael Summers, who also restored the latter craft, a former picket-boat of the Royal Navy built in Cowes, Isle of Wight.

Other notable and 'bulky' restorations to working order include a 1925 Marshall S class steam roller which originally came from a children's playground in Greece, a large 62-ton 1906 Greenwald cross compound steam engine that operated a rice mill in Texas, a 1/8 scale 18-foot-long model of the Union Pacific 4-8-8-4 'Big Boy' locomotive, a full scale Berlin 65 special purpose dining car (part of a railway convoy that carried Kaiser Wilhelm II to Constantinople in 1917), not to mention dockyard cranes, triple expansion marine steam engines and much more, all to the highest quality. To the list can be added the cosmetic restoration of full-sized Turkish State Railway locomotives, all restored under the professional direction of Yildirim Aker, a skilled engineer and the director of the Tasdelen workshop.

Richard Foster still visits regularly in an advisory capacity on items that may need research. Other regular visitors are Rahmi M. Koç himself, Dr. Bülent Bulgurlu and Ms. Mine Sofuoglu, who was appointed general manager of the Istanbul Rahmi M. Koç Museum in 2020. Despite his venerable age of 90, Mr. Koç recalls well the pioneering years of his workshops: 'As you know, already restored items, objects, models, either bought from a dealer or at an auction, are much more expensive than those that need restoration. Therefore, we needed a workshop for the museum to do the maintenance and restoration works properly. In the beginning we lacked the culture or knowhow to properly restore items, so I brought in Paul Bowskill, and whom I met when he was selling the steam engines that he restored at London's Portobello Road antique market. Sadly, having spent some time at the workshop he passed away while flying his ultra-light plane. Paul was working full-time, but then I realized that it would be better to hire experts according to the objects that required restoration, whether

Rahmi M. Koç, CBE, founder of the museum, poses next to a model of the Union Pacific locomotive "Big Boy" under restoration at the Tasdelen workshops.

life-sized or model. Then, we brought in a museum quality restorer called Ian Clark for our life-size parts. He taught our engineers. We also hired Michael Summers, an expert in restoring old wooden boats. At one time, he worked for the renowned restorer Peter Freebody on the Thames. We then had Mike Williams, who was an expert on steam; then Chris Littledale, the owner of the Brighton Toy Museum, came here to teach our young craftsmen how to paint tin toys. We had also employed Richard Foster as an advisor right from the beginning. He was helping us to find good objects and bid for us at auctions. He introduced us to certain high-level dealers like Tim Armitage, Mike Cooks and David Pressland.'

Frequent visitors

Most of the times Rahmi Koç visits the workshops of Tasdelen – which employ 32 skilled women and men - on Saturdays. He often does it with Dr Bülent Bulgurlu, who chaired the Koc Group for four years, between May 2007 and April 2010. His memory is equally efficient when it comes to remembering the first operational years of the workshops: 'I visited the Tasdelen compound for the first time when it was just land with no buildings on it. At the time I was the President of the Construction and Tourism group of Koç Holding and a board member of the Rahmi M. Koç Museum. Our original workshop in Istinye was insufficient, so when I saw the land and the drawings of the compound, I thought that it would be great if we could allocate some space for the museum workshop in one of the planned buildings. I suggested this idea to Mr Koç and he approved it, and then we redesigned the whole project accordingly.'

Interested in industrial heritage and history, Bülent Bulgurlu regards the restoration of steam engines and boats as the most exciting one. 'I believe that steam engines and boats are very challenging – he says -; they require a great deal of research and know-how in order to achieve a perfect restoration. In general, though, any rare object is very interesting to restore. Personally, I like anything related to engineering, especially when steam and maritime history are involved. In my opinion the best restoration work realized by the museum workshop is the Gonca steam yacht, together with the Berlin 65, Kaiser Wilhelm's restaurant wagon. Currently we follow up the restoration of the boiler of the steam tug Liman 2, built in the Netherlands in 1936.'

Part of the staff of the Tasdelen Workshop; the gentleman in grey attire is Yildirim Aker, the workshop manager.

Yildirim Aker alongside a triple-expansion steam engine.

Once every month Ms. Mine Sofuoglu pays a visit to the workshop and its director, the abovementioned Yildirim Aker. 'He is a successful engineer who always finds solutions – she says -; other than Mr. Aker, I deal with Mehmet Erdogdu, Erdogan Cosar and Serra Kanyak. I speak to them almost every day over the phone', she assures us. Former general manager of the Rahmi M. Koç Museum of Ankara (and there is a third one in Ayvalik, Cunda Island), Mine Sofuoglu takes great pleasure in visiting the Tasdelen venue, and thus keeping an eye on the items under restoration, be they old or new acquisitions. Over the past seven months, she has welcomed to the museum over 50 items that received some sort of restoration and maintenance in Tasdelen, with a theoretical projection of 85-90 objects every year.

A bright future

On top of these are several hundreds of smaller operations that are carried out in a small workshop located in the basement of the 'Lengerhane', the former Byzantine stone building that houses the original Rahmi M. Koç Museum, as it was founded in 1994. Burak Erdogan (no relation to the President of Turkey!) is the 'usta' ('literally 'master' or 'skilled craftsman') in charge of this little, but very clean and welcoming environment filled with every sort of tool and item that needs some care. Burak has been working for Rahmi M. Koç and his museum since its inception; therefore, despite his middle age, he is a true veteran. In his daily activities, Burak is assisted by a young woman, Filiz Aksu, a skilled and passionate apprentice. In her, one can readily see the Rahmi M. Koç Museum of the future: an institution committed to promoting and making culture, and to exhibiting items of industrial history and other timeless beauties in mint condition, for many years to come. All for the benefit of coming generations.

The author would like to thank all the individuals mentioned in the article.

●To be continued

Workshop Storage

As we progress in this hobby, we will find that you workshop starts to fill up. Not just with new machines, but with smaller tools, gadgets, materials, plans, adhesives and so on! As everyone ends up with a different collection of bits and pieces, it's best to use your ingenuity - a good example is using sections of plastic drain pipe to store lengths of metal.

Strangely, some people spend more on a new kitchen than their workshops – but old kitchen units can be an economical way of providing workshop storage. Base units under lightweight benches and wall mounted cupboards work well. Although the shelves in such units are sometimes flimsy or often spaced too far apart, it is easy to fit new or stronger ones. If you want lots of drawer space, you may be able to repurpose a dressing table or desk by fitting a thicker top.

If you have the space, a garage-style multi-draw tool storage unit can provide a considerable amount of storage. Things tend to rattle around in plain metal drawers, so lining them with rubber anti-slip sheets is a good idea for reducing noise and stopping tools knocking into each other.

Make full use of space under benches. If your benches don't already have shelves underneath, fit some. It can be helpful to also fit simple doors from sheets of plywood, as this helps keep swarf out. Shop around for large plastic storage boxes, especially lidded ones. These can be filled up and slid under benches allowing you to access things more easily than groping around in the dark at the back of a deep shelf. Take a close look at kitchen drawers; it is often easy to adjust their width so they can be fitted underneath benches or you can by individual drawer runners and make your own drawers. Those with roller slides can take a fair amount of weight and are well suited to storing hand tools.

A workshop cupboard from plywood by Ed Corley, SEE mew 218

If your workshop or garage has a pitched roof, you may be able to create storage space overhead. Naturally, this will not be very accessible -you may need a step stool or stepladder to access it, but it can be a useful place to put things you rarely need.

Over benches or behind machines you may not want to fit relatively deep cupboards, but shelves and wall hooks can provide less intrusive storage while keeping your most regularly used accessories readily to hand. Files, in particular, are better off being hung up rather than rattling against each other in a draw. Storage bins are a handy halfway-house between shelving and wall racks. They work really well if you have a lot of small components.

Drills, milling cutters collets and other small tools are often supplied in storage boxes, but you will inevitably accumulate unboxed items that are best not stored loose in boxes or draws. Many of these are well suited to making holders from blocks of timber with multiple holes sized to fit their shanks. ∎

A simple storage rack for ER25 collets

A storage box for FC3 end mills

Readers' Tips

CHESTER MACHINE TOOLS

A Building Turntable

TIP OF THE MONTH WINNER!

This month our lucky winner of £30 in Chester gift vouchers is Peter Venn whose idea could be useful for other large models and assemblies, not just locomotives.

This is my solution for working on all sides of my 5" gauge Adams 02 as it increases in size and weight.

I used a "Lazy Susan" (that we have never used on our garden table) and which was purchased cheaply at the local garden centre a few years ago. It has a reasonably robust ball-race ring running close to the perimeter underneath, and the table is 24 inches diameter. The engine is 28 inches in overall length so all the weight is carried on a piece of chipboard flooring within the turntable diameter. It works beautifully and stops all that precarious heavy lifting and turning the engine round on the bench.

We have £30 in gift vouchers courtesy of engineering suppliers Chester Machine Tools for each month's 'Top Tip'. Email your workshop tips to **neil.wyatt@mytimemedia.com** marking them 'Readers Tips', and you could be a winner. Try to keep your tip to no more than 400 words and a picture or drawing. Don't forget to include your address! Every month I'll chose a selection for publication and the one chosen as Tip of the Month will win £30 in gift vouchers from Chester Machine Tools. Visit www.chesterhobbystore.com to plan how to spend yours!

Please note that the first prize of Chester Vouchers is only available to UK readers. You can make multiple entries, but we reserve the right not to award repeat prizes to the same person in order to encourage new entrants. All prizes are at the discretion of the Editor.

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CODE: 341FP

Marking off

GEOMETER explains the procedure for marking work to make neat and accurate cuts in various materials.

Beginners' Workshop
Geometer introduces the art of Marking Out
These articles by Geometer (Ian Bradley) were written about half a century ago. While they contain much good advice, they also contain references to things that are out of date or describe practices or materials that we would not use today either because much better ways are available or for safety reasons. These articles are offered for their historic interest and because they may inspire more modern approaches as well as reminding us how our hobby was practiced in the past.

IN ORDER TO cut and fit material neatly and position the centres of holes accurately, the essential preliminary is proper marking-off. For most work, the tools required are few, a steel rule for measuring and to serve as a straight-edge; a square for marking right angles; a depth gauge for marking from edges; dividers for describing arcs, circles, and finding centres (or a pencil compass for wood); a centre punch and a hammer for indenting centres, a scriber for metal and a hard pencil for wood.

Wood will mark easily with a pencil, metal needs a scriber if it is slightly rusty or scaly but not hard. If the metal is bright, scribed lines will not show easily and a simple remedy is to rub it with chalk.

Marking centre lines

To cut a piece of wood or metal down the centre, or to position a line of holes, a centre line is made using the depth gauge (Fig. 1). The blade is set to approximately half-distance and a line *A* made. From the opposite edge, another line *B* is made, then the difference split to obtain the line C.

Cross-checking from each edge, the exact centre can be found and the line continued full length, moving depth gauge and scriber together. Alternatively, not readjusting the depth gauge, lines *A* and *B* can be left for the width of the saw cut.

Straightness check

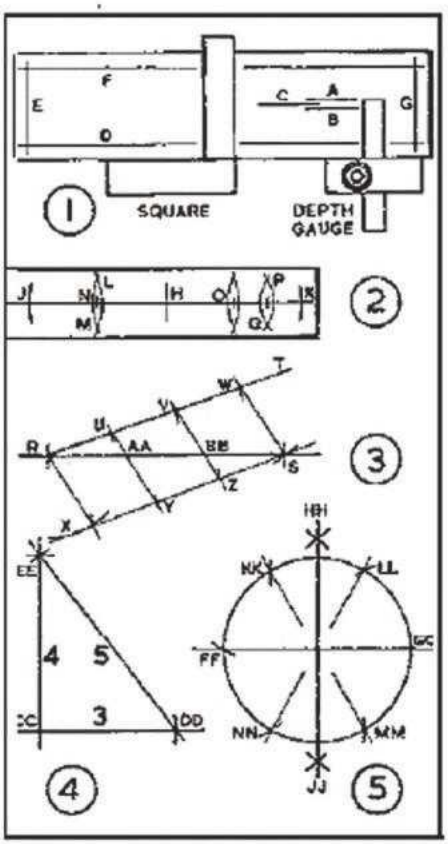
Checking the working edge of material for straightness, the blade of the depth gauge can be set in for marking strips, or to bring the material parallel. The square is used for marking ends or checking their truth. On accurate material, the depth gauge can be set in for marking lines *D, E, F, G* at a uniform distance from the edges to the position holes.

Engineers often work from centre lines, taking dimensions or the positions of holes from such. The position H in Fig. 2 on a piece of true material can be obtained with the depth gauge from the ends and sides, and the line *J-K* scribed down the centre.

Position *H* being centre-punched, dimensions *H-J, H-K,* are marked with dividers, taking from a steel rule, centring one leg at *H,* and describing arcs at *J* and *K.*

When these positions have been centre-punched, the dividers can be closed to describe arc L from centre *J,* and arc M from centre *H.* Using the square at the intersections of these arcs, centre N is obtained, the mid-position. Centre 0 is obtained similarly.

Using this centre and closing the dividers, arc *P* can be described, followed by arc Q from centre *K* and, again using the square, the mid-posrtion is found between 0 and K.



The five methods of marking materials explained in the text

Dividing a line

When the number of holes does not permit bisecting on this principle, another method can be used to obtain the setting for dividers for marking off the centres-though it may be necessary to use a piece. of waste material.

Referring to Fig. 3, a line is marked using the rule, and the overall dimension *R-S* marked. Another line *R-T* is run at an angle, and the dividers are used to step off positions U, *V, W* -the last being joined to S. With the dividers set to dimension *W-S,* and using centre *R,* an arc X is made and then joined by a straight line to S. With the dividers reset to dimension *R-U,* and beginning at S, dimensions *Z* and Y are stepped off. Joining U-Y, *V-Z,* centres *AA* and *BB* are found. The dividers can be set to dimensions *R-AA,* and this transferred to the work.

Fig. 3 shows a line divided into three, but the principle is applicable to any reasonable number of spaces.

Obtaining angles

A right angle (Fig. 4) can be marked from a line *CC-DD,* using the principles three, four and five. With dividers set to three units, centre *DD* is marked from CC, and from this position also, dividers set to four units, an arc is made at *EE.* Using centre *DD,* an arc of five units is made crossing at *EE.* Thus, the intersection of arcs at *EE* forms the right angle.

Dividing into 12 parts

Using centres *FF* and GG diametrically opposite on the circumference of a circle (Fig. 5) arcs *HH* and *JJ* can be made and when joined will run a line at right angles. With the dividers set at the radius of the circle, and starting at *FF* or GC, positions KK, *LL, MM,, NN* can be stepped off round the circumference, dividing the circle into six. Consequently, bisecting as required, a circle can easily be divided into 2, 3, 4, 6, 8 or 12 parts. ❑

Setting Up a Workshop Hoist!

John Leach installs some help with the heavy lifting

Everybody seems to require a hoist arrangement to assist in their old age. I am no exception, and the following will describe what I did and how I did it.

No dimensions are given, as if you do something like this, dimensions will be self -evident.

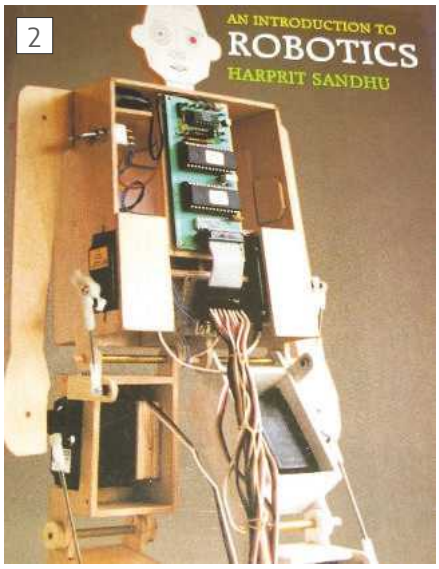
I am very lucky in having joined the Sutton Model Engineering club about 20 years ago, as their enthusiasm and friendly attitude to a complete novice. enabled me to develop skills and knowledge to tackle many projects.

I joined the club as I am interested in robotics. I managed to make and to programme a walking humanoid robot, but, despite my reasonable skills with cutting out and gluing timber components, the accuracy that I knew electronic stuff was achieving, way surpassed the accuracy of my woodwork skills. In reality, it's only marginal, but sufficient to make me discontent. Anybody who came to the Lee valley Show in 1990, could have seen my walking robot at the Sutton Club stand, **photo 1**. The robot was programmed to walk up and down a platform and do a couple of bobs up and down. The robot worked tirelessly over the two days, but needed manual correction, as it would deviate slightly to the right and needed human intervention (the robot was made from the book, and I would thank the author for the woodworking design and other tips), **photo 2**. At this time, it was perhaps the infancy of making practical things controlled by electronics.

Naïvely, I did think that joining the club and few tips would result in the production of tip top accuracy robots. Was I in for a learning curve! Well, I have made a few robots with robotic controls over the years, but

1

Walking robot



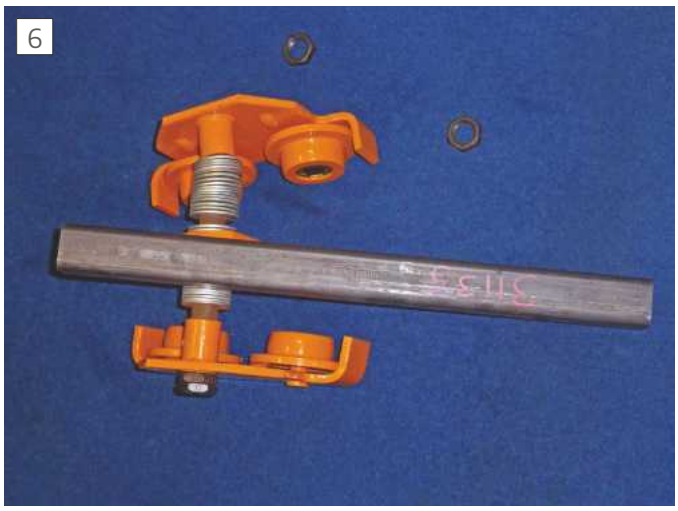
2

Harprit Sandhu's robotics book

Hoist bought at the boot sale for £15

RSJ beam in my overcrowed workshop

Trolley bought for fixing to the RSJ



Trolley with box section on to dowel

with plenty of other models in the meantime. It's such a fantastic hobby.

Like others, this old age stuff has made me think. Lifting heavy loads from ground up is becoming a problem, even more so now that the quack has suggested I should not lift anything. Well, that is not very satisfactory for a model engineer (and aircraft radio control chap with some large aircraft –up to 50cc engines).

I live an hour's drive from Sutton and am fortunate to have a winter and summer boot sale within about a mile of where I live. I've been lucky to pick up a large number of tools and accessories over the years, and on one occasion, I spotted a hoist, brand new, never been used, and after making enquires, was offered it for £15, **photo 3**. Never to resist a bargain, I bought the hoist, and it has lain untouched for the last couple of years.

My workshop is my garage. A double garage with a steel 6 x 4" RSJ beam (Rolled Steel Joist) running about mid span across it, **photo 4**. About 20 years ago I had purchased at the boot sale (another) chain hoist complete with runners, again for about £15. I have fixed this to the beam which has been useful.

So, why do I need the second? The chain hoist does require a lot of chain to lift anything and is ideal for lifting heavy objects where a lot of instant control

Trolly and hoist mated together (Upside down)

Drilling hole in box section

Enlarging hole in box section

Enlarging hole to 35mm in box section

Hoist and trolley in position and showing bracket not working

can be exercised. But, for lighter objects, it would be great to have an electronic knob to do the work.

At the end of last year, the quack suggested I should not do any lifting which made me remember the hoist gathering dust under the bench. Upon examination, a few things were discovered:

- The hoist is expected to be fixed in a static location.
- It requires certain headroom, which I do have to a certain extent (8'0").

My engineering friends suggested that the 6"x4" beam under load should have mid-span deflections of : 100kg 6.3mm, 200kg 12.6mm, 300kg 18.9mm – These are theoretical calculations...I do not expect to put more than 50kg so I am not expecting much movement (hopefully!).

What I wanted was a hoist which could run on the RSJ across the width of the garage. From the existing chain hoist, I could see how the unit worked and how the wheels rested on the RSJ, and so a quick search on the internet,

3D printed wheels and arrangement for cable trolley

resulted in spotting of a substantial carrier for £29, including postage.

I was content that these things would work, so sent off, and a week or so later, in the post arrived the unit. **Photograph 5** is upside down in relation to the flanges of the RSJ. By removing washers the unit can fit various size widths of RSJ's. I then set about designing the means of fixing the

Cable trolley in position on RSJ

Revised bracket position after changing C of G

Extension piece to allow handle to be fitted

Bottom of extension piece and holder for control unit

hoist to the runner of the RSJ.

The top of the hoist has two brackets for fixing the hoist to something. The void in the brackets was such that a 60x60 box section could be received. I duly purchased a bit of 5mm thick walled steel. The only issue was how to fit the hoist to the runner. The hoist has a 30mm bar running through it from side to side and, if I could drill a hole into the box section, I could slide the box section between the brackets and make a fixing, **photo 6**.

The issue of the centre of gravity of the hoist fitting to the runner was of some consideration as, clearly, the hoist pivots about the bar and loading could make the hoist swivel, **photo 7**. I initially thought that the bar could be mid-point between the wire and the motor, and proceeded accordingly.

I drilled a progression of holes through the 5mm steel sides to the box section in stages, using an ever large drill bit and eventually enlarging the hole with an indexable cutter, **photos 8**, **9** and **10**. I do not like using index tools. They seem very brutal on the milling or drilling machine, as they seem to tear their way through the metal with a lot of vibration.

I assembled the works and hung it from the RSJ and had a few trial lifts. It was apparent that the location of the C of G was making the hoist rise so at one end, **photo 11**, I fitted some bars to stop the lift. This seemed to work, but I was not too content with the outcome.

Having got the hoist to work nicely, I suddenly found you need the means of supporting and feeding the cable to the hoist over the width of the room. I needed an electrical carrier to travel back and forth across the garage, and not be a hazard to health!!

I have a 3D printer and printed out some wheels and assembled a framework to contain the cable. This again was a bit of trial and error, but on the second attempt I succeeded in developing a system that worked, **photos 12** and **13**. The cable is temporarily held up by green ties awaiting a permeant solution!

With the electrical carrier problem solved and with a few more trials with the hoist, I realised that the C of G had to be changed to be under the centre of the wire drum, so a few more modifications were necessary, **photo 14**.

The changed C of G location stabilised the hoist in the lifting mode and it seems to be the correct solution.

To finish off the hoist, I attached a copper pipe to the front of the hoist so it could be dragged to the right location, **photo 15**, and at the same time incorporated a baked bean tin, painted black, to hold the electronic control box as I felt it should not be on the ground, dragging into all kinds of trouble, **photo 16**.

That's about it, but what I do need is to be able to lift away from the RSJ line with some sort of jib arrangement... for the future. ■

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The Magic File Cleaner

Adrian Revill casts a spell over clogged files

Over the years I have acquired quite a few files, usually dirty and pinned. Most of these now live in the "Not good enough to use, but I am sure they will be useful one day" draw. I have recently needed to use more fine files; of course most of these live in the above mentioned draw. So a new item jumped on the to-do list, clean the files.

I already have a carding brush and a brass wire brush, but they don't give a deep down clean on fine files. In the past to remove pinning I have used bits of scrap aluminium or brass, but with varying levels of success. I trawled the internet for an answer and the consensus seems to be use a sharpened piece of brass. Well I don't have a large scrap bin overflowing with brass, and I don't want to spend my brass on buying brass. However I did get the point so to speak, the cleaning tool needs to have a sharp edge.

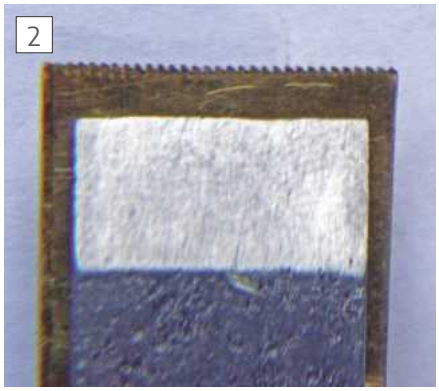
This got me to thinking, brass, sharp edge, blood! A messy lesson learnt; don't push thin shim into gaps using your fingers.

So brass shim it is! A quick rummage turned up a piece 19mm square that seemed stiff enough but still thin. Now to solve the cut fingers, another rummage turned up a rusty steel strip that was found in a hedge.

A short while later I had my cleaning tool, **photo 1**. I must admit, not the finest work I have ever done, but I am sticking with the excuse that it looks antique.

By the way, after using a wire brush,

Finished cleaning tool



Close up of file tooth profile

I removed the remaining rust using diluted citric acid toilet cleaner in a large jar. It took about three hours when left to warm on a sunny window sill.

I was delighted how quickly the tool cleaned my files, and I learnt some advantages of this tool:

- Being so thin, the shim quickly takes the tooth profile, **photo 2**.
- As you clean, the points turn up slightly; if you turn the tool over it really gets down deep in the groves.
- The shim has four sides; these can be used with different file cuts to save re-cutting the profile each time.
- For really stubborn pinning you can use the corner of the shim.
- As it takes the tooth form so easily, you can also use it to clean the file cross cuts too.

For this article I thought I would give it a real test. I chose the dirtiest rusty file I have; in fact this had already escaped the draw and was in the scrap bin. I think **photo 3** shows how well the tool work, although I think the file has still had it, rust has completely eaten some of the teeth.

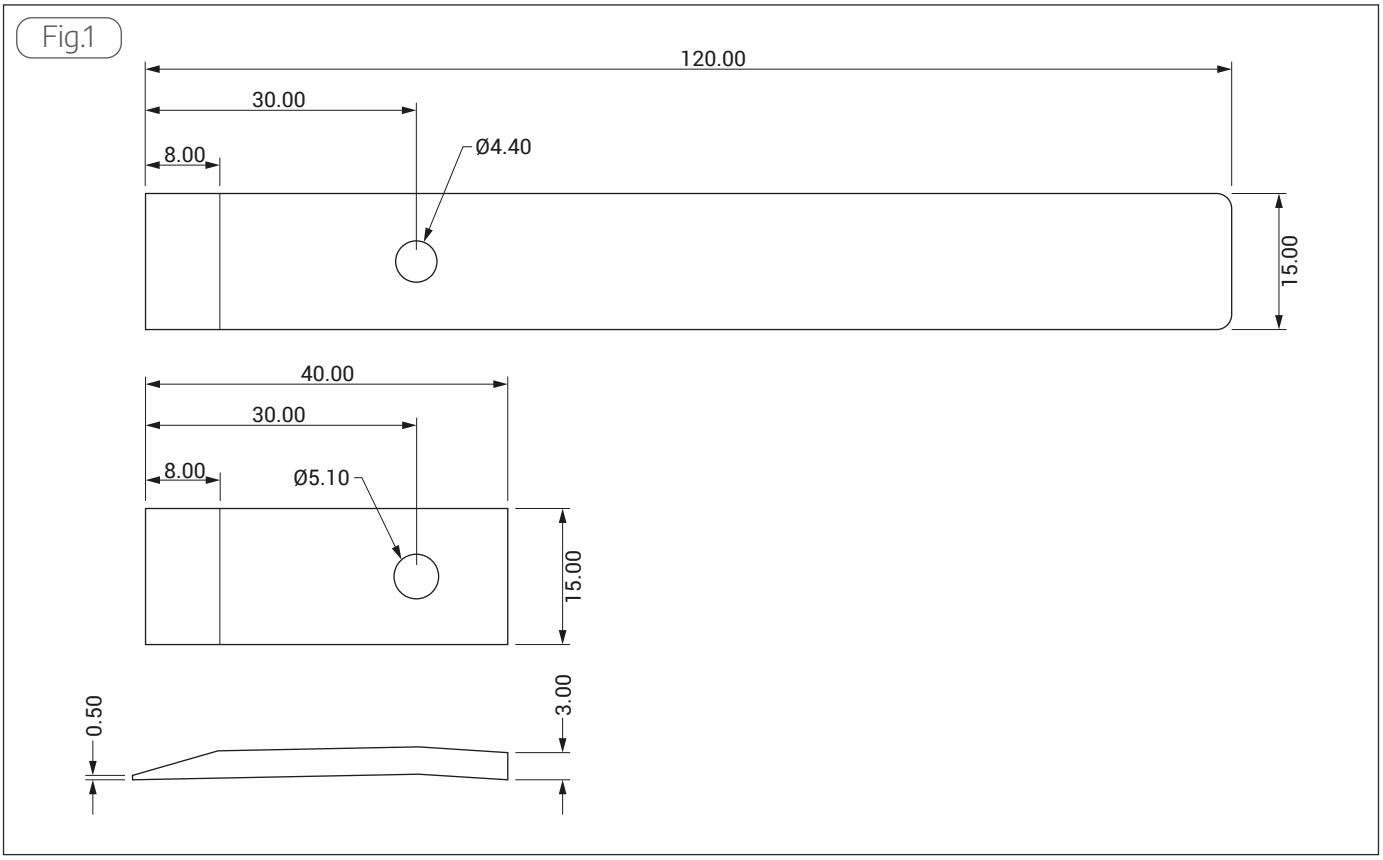
If you are interested in making your own magic file cleaner, I have drawn it up in **fig. 1**. Obviously, none of the dimensions are critical as they were decided on for pragmatic reasons. The steel was about the right size, and the length was chosen to fit my rather small hands. Only details I think are important are:

- The 4.4mm hole is for a M5 tapping.
- The clamp piece has a small bend at the hole to give a gap between it and handle of about 0.5mm to 1mm. This is to ensure the shim is gripped at the tip of the tool. I just clamped it in a vice and gave it a push.
- The taper to 0.5mm at the end of the handle and clamp is to ensure

Half cleaned test file

›

Fig.1



clearance from the file the shim does not have to stick out too far, **photo 4**.

- The shim I used was 0.25mm (0.010").

If you do decide to make one, I hope it works as well for you as it did me. ■

4

Side view of cleaning tool

NOTES REGARDING SCREW THREAD CHARTS

1. These screw thread charts give the basic thread data of, outside diameter, core diameter and pitch.
2. The thread forms and complimentary factors, angular depth etc, are given in drawing form on separate sheets.
3. The details quoted relating to tapping drill sizes, are given on the basis of providing the maximum amount of information on which the reader can make the final choice regarding the size of drill to use.

3.1. Most charts give a tapping size drill with no indication of what depth of thread it provides, or the effect of choosing a different size drill to that quoted. The user is therefore uninformed as to what is being, or can be, achieved.

3.2. If the tapping size drill is chosen to give a full thread, very little is achieved in terms of strength over that with around 75% of maximum thread depth. There will be however a considerable increase in the torque required to be applied to the tap, with the resulting increase in the likely fracture of the tap, particularly with the smaller sizes.

3.3. These charts attempt to achieve a thread depth of between 60 and 70% with the lower figure aimed at the smaller sizes and visa versa.

4. The charts also give the diameter required to give 60 and 70% thread depths, to assist the user in choosing smaller or larger drills for more, or less, thread depth, as considered appropriate for the application.

4.1. These figures show that at the smaller thread sizes in particular, moving up or down one drill size will considerably alter the percentage thread achieved. This highlights that, at the smaller sizes, it is very important for the drill not to drill over size

MODEL ENGINEERS'WORKSHOP DATA BOOK

5. The following indicate the considerations for final choice of tapping drill. For smaller taps, harder materials and deeper holes, tend towards larger drills. For stronger threads, larger taps, softer materials and holes in thin sheet, tend toward smaller drills.
6. The ability to accept a reduced internal thread depth is on the basis that the external thread will be complete and not drastically undersize.
7. The percentage is based on the proportion of, the difference between outside diameter and core diameter, and the difference between outside diameter and tapping drill diameter.

7.1 Take note that in the case of unified and metric threads, where the inside and outside threads are of sightly different form the percentage quoted is not a percentage of maximum thread engagement. This figure would be slightly greater but has less meaning in terms of preferred tapping drill.

8. At the right hand side of the charts are the metric or imperial equivalents of the more important parameters given on the left hand side.

9. DO STUDY THESE CHARTS CAREFULLY SO AS TO GAIN MAXIMUM BENEFIT FROM THEIR USE.

Readers notes

ISO METRIC THREADS COARSE

SIZE	OUT DIA. mm	CORE DIA. mm	PITCH mm	TAP DRILL mm	DEP TH %	DIA. 60% mm	DIA. 70% mm	APROXIMATE INCH CONVERSIONS OUT DIA. in.	PITCH TPI	DIA. 60% in.	DIA. 70% in.
M1	1.0	0.69	0.25	0.80	65	0.82	0.79	0.039	101.60	0.032	0.031
M1.1*	1.1	0.79	0.25	0.90	65	0.92	0.89	0.043	101.60	0.036	0.035
M1.2	1.2	0.89	0.25	1.00	65	1.02	0.99	0.047	101.60	0.040	0.039
M1.4*	1.4	1.03	0.30	1.15	68	1.18	1.14	0.055	84.67	0.046	0.045
M1.6	1.6	1.17	0.35	1.35	58	1.34	1.30	0.063	72.57	0.053	0.051
M1.8*	1.8	1.37	0.35	1.55	58	1.54	1.50	0.071	72.57	0.061	0.059
M2	2.0	1.51	0.40	1.70	61	1.71	1.66	0.079	63.50	0.067	0.065
M2.2*	2.2	1.65	0.45	1.85	63	1.87	I.81	0.087	56.44	0.074	0.071
M2.5	2.5	1.95	0.45	2.15	63	2.17	2.11	0.098	56.44	0.085	0.083
M3	3.0	2.39	0.50	2.60	65	2.63	2.57	0.118	50.80	0.104	0.101
M3.5*	3.5	2.76	0.60	3.00	68	3.06	2.98	0.138	42.33	0.120	0.118
M4	4.0	3.14	0.70	3.40	70	3.48	3.40	0.157	36.29	0.137	0.134
M4.5*	4.5	3.58	0.75	3.90	65	3.95	3.86	0.177	33.87	0.155	0.152
M5	5.0	4.02	0.80	4.40	61	4.41	4.31	0.197	31.75	0.174	0.170
M6	6.0	4.77	1.00	5.20	65	5.26	5.14	0.236	25.40	0.207	0.202
M7 *	7.0	5.77	1.00	6.10	73	6.26	6.14	0.276	25.40	0.247	0.242
M8	8.0	6.47	1.25	6.90	72	7.08	6.93	0.315	20.32	0.279	0.273
M9 *	9.0	7.47	1.25	7.90	72	8.08	7.93	0.354	20.32	0.318	0.312
M10	10.0	8.16	1.50	8.70	71	8.90	8.71	0.394	16.93	0.350	0.343
M11 *	11.0	9.16	1.50	9.70	71	9.90	9.71	0.433	16.93	0.390	0.382

ISO METRIC THREADS FINE

SIZE	OUT DIA. mm	CORE DIA. mm	PITCH mm	TAP DRILL mm	DEP TH %	DIA. 60% mm	DIA. 70% mm	APPROXIMATE INCH CONVERSIONS OUT DIA. in.	PITCH TPI	DIA. 60% in.	DIA. 70% in.
M1 x 0.20	1.0	0.75	0.20	0.85	61	0.85	0.83	0.039	127.00	0.034	0.033
M1.2x 0.20	1.2	0.95	0.20	1.05	61	1.05	1.03	0.047	127.00	0.041	0.040
M1.4x O.20*	1.4	1.15	0.20	1.25	61	1.25	1.23	0.055	127.00	0.049	0.048
M1.6x 0.20	1.6	1.35	0.20	1.45	61	1.45	1.43	0.063	127.00	0.057	0.056
M1.8x 0.20*	1.8	1.55	0.20	1.65	61	1.65	1.63	0.071	127.00	0.065	0.064
M2 x 0.25	2.0	1.69	0.25	1.80	65	1.82	1.79	0.079	101.60	0.071	0.070
M2.2x 0.25*	2.2	1.89	0.25	2.00	65	2.02	1.99	0.087	101.60	0.079	0.078
M2.5x 0.35	2.5	2.07	0.35	2.25	58	2.24	2.20	0.098	72.57	0.088	0.087
M3 x 0.35	3.0	2.57	0.35	2.75	58	2.74	2.70	0.118	72.57	0.108	0.106
M3.5x 0.35*	3.5	3.07	0.35	3.20	70	3.24	3.20	0.138	72.57	0.128	0.126
M4 x 0.50	4.0	3.39	0.50	3.60	65	3.63	3.57	0.157	50.80	0.143	0.141
M4.5x 0.50*	4.5	3.89	0.50	4.10	65	4.13	4.07	0.177	50.80	0.163	0.160
M5 x 0.50	5.0	4.39	0.50	4.60	65	4.63	4.57	0.197	50.80	0.182	0.180
M6 x 0.75	6.0	5.08	0.75	5.40	65	5.45	5.36	0.236	33.87	0.214	0.211
M7 x 0.75*	7.0	6.08	0.75	6.40	65	6.45	6.36	0.276	33.87	0.254	0.250
M8 x 0.75	8.0	7.08	0.75	7.40	65	7.45	7.36	0.315	33.87	0.293	0.290
M8 x 1.00	8.0	6.77	1.00	7.20	65	7.26	7.14	0.315	25.40	0.286	0.281
M9 x 0.75*	9.0	8.08	0.75	8.40	65	8.45	8.36	0.354	33.87	0.333	0.329
M9 x 1.00*	9.0	7.77	1.00	8.20	65	8.26	8.14	0.354	25.40	0.325	0.321
M10 x 1.25	10.0	8.47	1.25	8.90	72	9.08	8.93	0.394	20.32	0.357	0.351

ISO METRIC THREADS FINE

SIZE	OUT DIA. mm	CORE DIA. mm	PITCH mm	TAP DRILL mm	DEP TH %	DIA. 60% mm	DIA. 70% mm	APPROXIMATE INCH CONVERSIONS OUT DIA. in.	PITCH TPI	DIA. 60% in.	DIA. 70% in.
M11 x 1.00*	11.0	9.77	1.00	10.10	73	10.26	10.14	0.433	25.40	0.404	0.399
M12 x 1.00	12.0	10.77	1.00	11.10	73	11.26	11.14	0.472	25.40	0.443	0.439
M12 x 1.50	12.0	10.16	1.50	10.70	71	10.90	10.71	0.472	16.93	0.429	0.422
M14 x 1.00*	14.0	12.77	1.00	13.10	73	13.26	13.14	0.551	25.40	0.522	0.517
M14 x 1.50*	14.0	12.16	1.50	12.70	71	12.90	12.71	0.551	16.93	0.508	0.500
M16 x 1.00	16.0	14.77	1.00	15.00	82	15.26	15.14	0.630	25.40	0.601	0.596
M18 x 1.00	18.0	16.77	1.00	17.00	82	17.26	17.14	0.709	25.40	0.680	0.675
M18 x 2.00*	18.0	15.55	2.00	16.00	82	16.53	16.28	0.709	12.70	0.651	0.641
M20 x 1.00	20.0	18.77	1.00	19.00	82	19.26	19.14	0.787	25.40	0.758	0.754
M20 x 2.00	20.0	17.55	2.00	18.00	82	18.53	18.28	0.787	12.70	0.729	0.720
M22 x 1.00*	22.0	20.77	1.00	21.00	82	21.26	21.14	0.866	25.40	0.837	0.832
M22 x 1.50*	22.0	20.16	1.50	20.50	82	20.90	20.71	0.866	16.93	0.823	0.815
M22 x 2.00*	22.0	19.55	2.00	20.00	82	20.53	20.28	0.866	12.70	0.808	0.799
M24 x 1.00	24.0	22.77	1.00	23.00	82	23.26	23.14	0.945	25.40	0.916	0.911
M24 x 1.50	24.0	22.16	1.50	22.50	82	22.90	22.71	0.945	16.93	0.901	0.894
M24 x 2.00	24.0	21.55	2.00	22.00	82	22.53	22.28	0.945	12.70	0.887	0.877

* NON PREFERRED SIZES.

SEE ALSO METRIC CONDUIT AND SPARK PLUG LISTS FOR OTHER FINE PITCH THREADS.

ISO METRIC THREADS COARSE

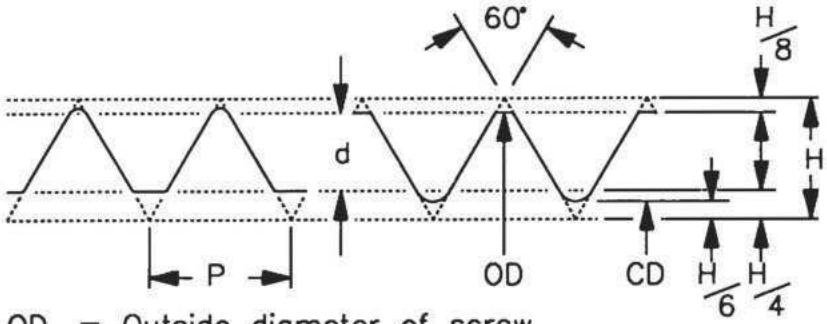
SIZE	OUT DIA. mm	CORE DIA. mm	PITCH mm	TAP DRILL mm	DEP TH %	DIA. 60% mm	DIA. 70% mm	APROXIMATE INCH CONVERSIONS OUT DIA. in.	PITCH TPI	DIA. 60% in.	DIA. 70% in.
M12	12.0	9.85	1.75	10.50	70	10.71	10.50	0.472	14.51	0.422	0.413
M14 *	14.0	11.55	2.00	12.30	69	12.53	12.28	0.551	12.70	0.493	0.484
M16	16.0	13.55	2.00	14.25	71	14.53	14.28	0.630	12.70	0.572	0.562
M18 *	18.0	14.93	2.50	15.75	73	16.16	15.85	0.709	10.16	0.636	0.624
M20	20.0	16.93	2.50	17.75	73	18.16	17.85	0.787	10.16	0.715	0.703
M22 *	22.0	18.93	2.50	19.75	73	20.16	19.85	0.866	10.16	0.794	0.782
M24	24.0	20.32	3.00	21.25	75	21.79	21.42	0.945	8.47	0.858	0.843

* NON PREFERRED SIZES. SEE ALSO DETAILS OF NUTS AND SCREWS

MODEL ENGINEERS' WORKSHOP DATA BOOK

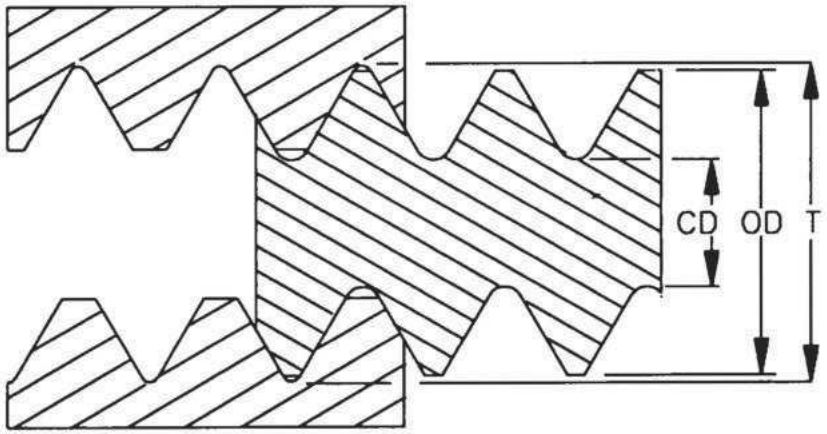
BASIC THREAD FORMS.

ISO METRIC AND UNIFIED THREAD.



OD. = Outside diameter of screw.
CD. = Core diameter of screw.
P. = Pitch.

d.	= depth of engagement	= 0.541266P
H.	= Angular depth.	= 0.866025P
H/4.		= 0.216506P
H/6.		= 0.144337P
H/8.		= 0.108253P



NUT. SCREW.

SKETCH SHOWING HOW THE THREADS IN THE NUT AND SCREW DIFFER.

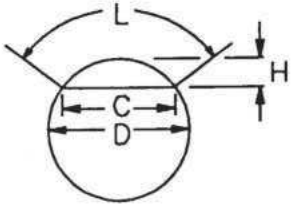
T. NOTE HOW THE RADIUS IN THE BASE OF THE THREAD IN THE NUT MAKES THE TAP LARGER THAN SCREW DIAMETER.

USEFUL MATHEMATICAL FORMULAE

Circle Circumference = $\pi \times D$

$$\text{Area} = \frac{\pi \times D^2}{4}$$

Segment



$$\text{Arc } L = 0.00873 \times D \times \theta$$

θ = Angle of arc

$$\text{Chord } C = 2\sqrt{H(D-H)}$$

$$\text{Height } H = \frac{D-1}{2}\sqrt{D^2-C^2}$$

Solids

$$\text{Volume of a cylinder} = \frac{\pi \times D^2}{4} \times L$$

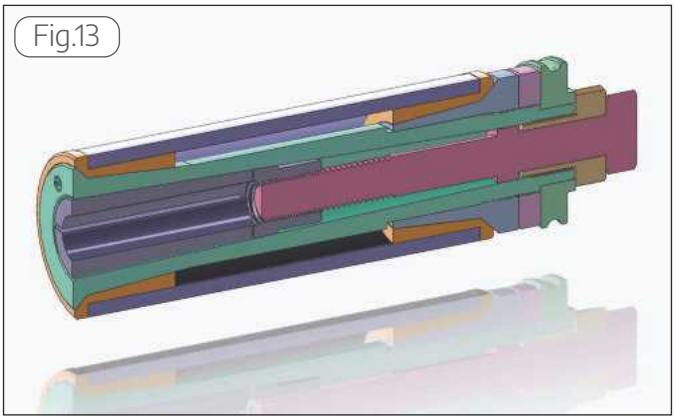
$$\text{Volume of a ball} = \frac{\pi \times D^3}{6}$$

$$\text{Volume of a cone} = \frac{\pi \times D^2 \times H}{12}$$

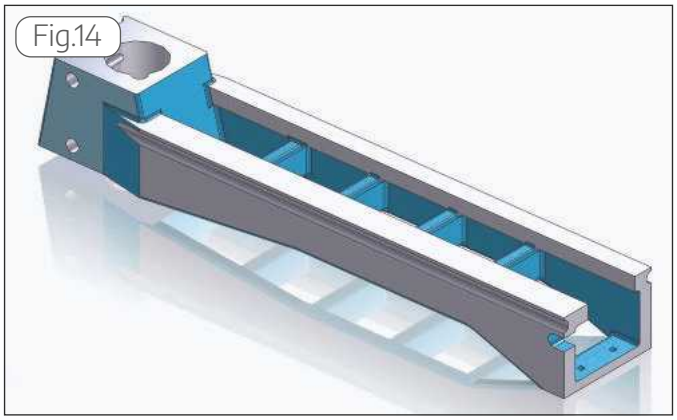
D = diameter,
L = length of cylinder,
H = height of cone,
π = 3.1416

Stepperhead 2

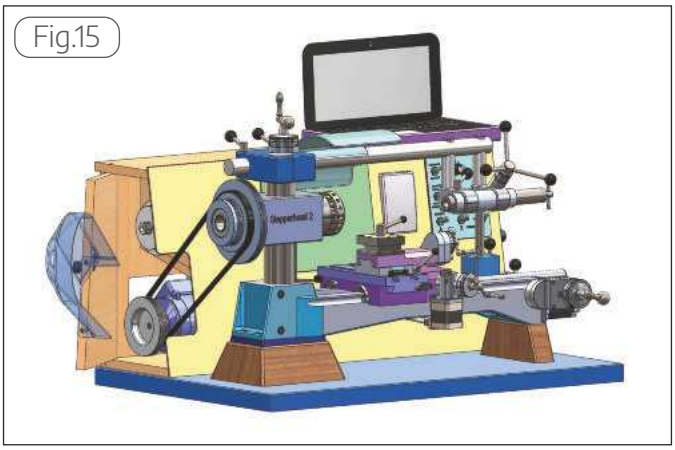
In this two-part article, Alan Jackson looks at some ways in which his award-winning Stepperhead Lathe might evolve. Part 2.



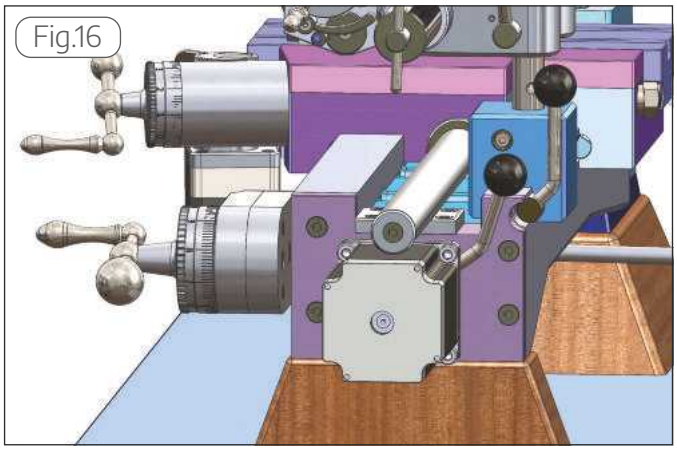
Milling spindle – sectioned on centreline



One-piece bed



Head, Overarm & Tailstock raised



Saddle controls

This makes use of the main motor with its inverter control, enabling a wide speed range for a milling spindle mounted on the topslide for example. The arrangement I used on Stepperhead with a milling head driven by a DC motor with electronic control worked but had a limited speed range around 2000 rpm. It had limited power and got quite hot, its bulk was also restrictive. The problem with the high speed was that a carefully shaped carbon steel cutting tool would overheat and lose its hardness halfway through the operation, say when cutting a gear, especially in steel. High speed steel cutters solve the problem but are difficult to make and shape compared to carbon steel. So to be able to slow down the cutting speed without power loss would be of great benefit. Round belt pulleys and belts of various diameters can be used. This would enable a wide use of operations say, using the stepper driven spindle via manual or CNC control for a myriad of operations, including decorative ornamental designs etc., fig. 6. 1. The milling spindle has a bore for No 2 Morse taper collets and a locking/eject drawbar. It has bronze self-lubricating bearings and uses a double taper similar to a watchmaker's lathe headstock design. Ball bearings have been avoided to keep the overall diameter down to 40mm, **fig. 13**.

The lathe has a cast iron flat topped bed and incorporates the mounting block bored for the vertical column. The overall length is 580mm, **fig. 14**, The front guide is 40mm wide with a semi-circular groove on the front face. This groove houses an oval gib mounted in the saddle. The rear guide is 20mm wide and has a similar groove on its outside face for a similar oval gib. The bed width is 110mm which exceeds the nominal 80mm centre height giving the saddle a wide platform to slide on. The saddle is narrow guided on the front guide while the rear slideway supports and prevents the saddle from lifting. There are four intermediate stiffeners connecting the guide sections, so this should provide a rigid platform for the saddle and tailstock bed slide. The bed mounting point at the headstock end incorporates a 10mm thick damping pad at its connection point with the mounting block. This is to promote quiet operation and minimise any vibrations due to the machining operations from propagating into the mounting board.

With a cast iron bed, a cast-iron head block and saddle, plus the overarm bracing the whole structure (a big plus I am going to say). The combined structure is really very solid, and much more rigid

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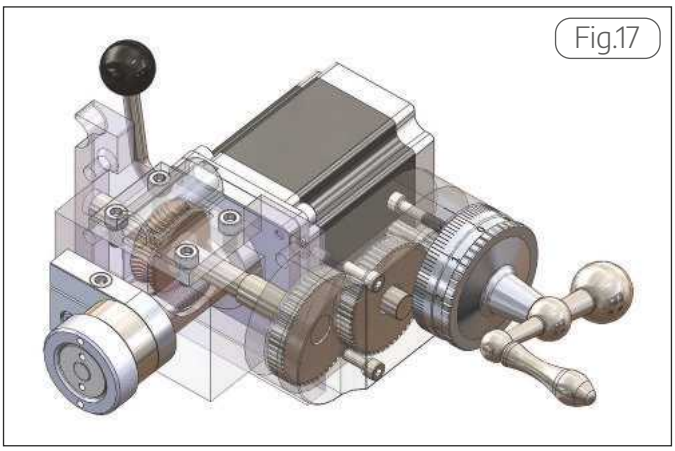
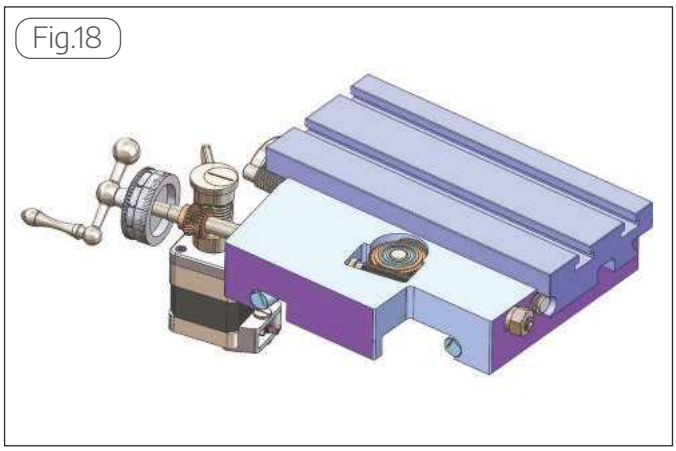
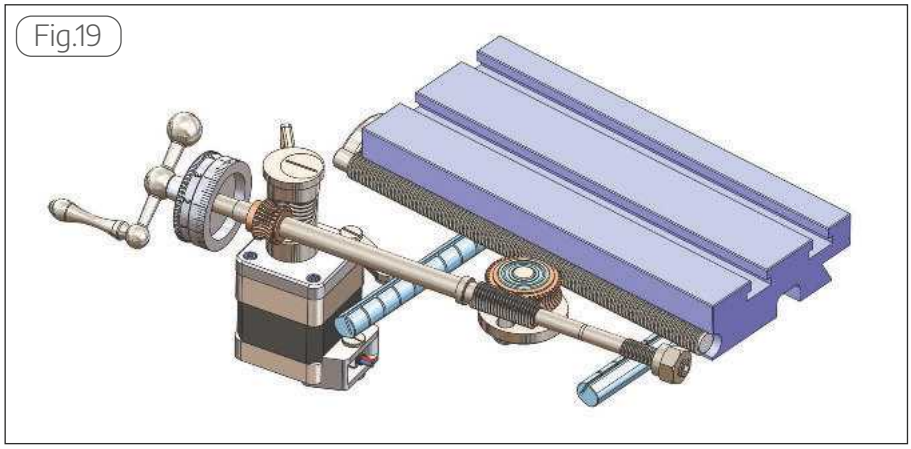


Saddle drive - (ghosted).



Cross slide drive - top plate & stepper mounting removed.



Cross slide drive - saddle removed.

than the equivalent small lathe.

The ability to raise or lower the head and tailstock relative to the bed has many advantages, enabling varied operations. The overarm connects the headstock to the bed and when the clamps are locked it provides additional rigidity to the headstock, tailstock and bed. The tailstock is incorporated into the overarm and supported at the headstock and bed. The tailstock vertical column has an eccentric connection to its bed block, this enables a fine setting for the tailstock to set its concentricity with the spindle. The space underneath the tailstock becomes available as an additional bed length (which is usually occupied by the tailstock foot) to be used by the saddle. The overarm also provides a convenient attachment point for accessories.

The saddle is guided by the front bed bar providing a long narrow full length guide using an oval gib in a curved groove; the inner guide face is 13mm deep and extends the full length of the saddle. It does not have to be reduced in length to clear the tailstock foot, as is normal in conventional flat bed lathes. The handwheel at the far right of the bed controls the saddle movement and can be engaged or disengaged from the stepper motor drive by rotating the lever shown to the right of the saddle drive stepper motor in **figs 16** & **17**.

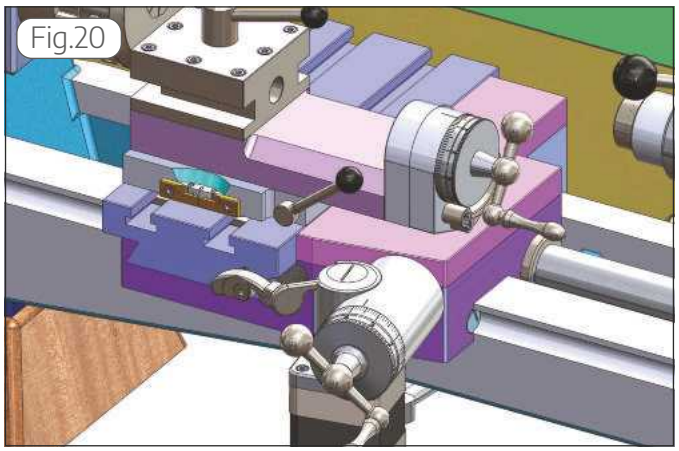
The biggest change is at the cross slide which usually straddles the raised vee slide on the saddle with the gib arrangements on the right hand side and a central feed screw. On this design a full size feed screw and oval gib are combined by cutting an oval gib contour on the screw thread periphery. This simplifies the construction and operation substantially. The saddle has a sunken vee slide and the cross slide has a raised vee slide on the LH side and an oval gib groove on the RH side. This has advantages in that the cross slide is much thicker and stronger even with tee slots. Somewhat similar to a milling machine table. This gives space for central groove to be cut into the underside of the cross slide to accommodate a DRO, **fig. 18**.

The threaded oval gib has a reduced area of contact in that the sliding surface is the top of an acme screw thread. But it gains by both the gib and screw thread being inherently parallel to each other and one robust item. This gib can also be rotated away from its set close sliding position to lock the cross slide to the saddle along the full length of the sliding contact.

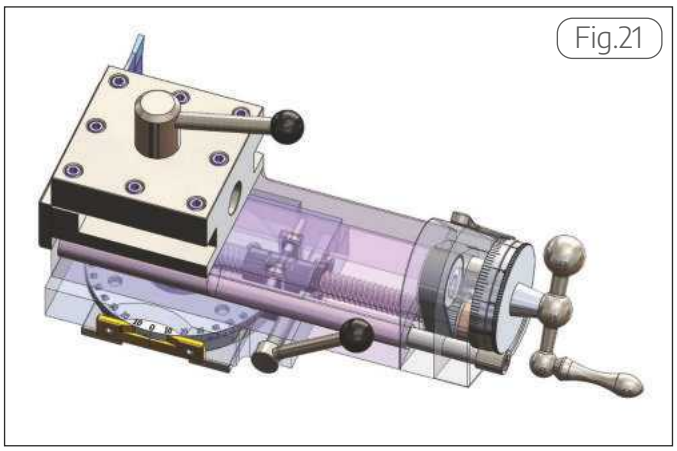
The cross slide handwheel drive is set at an angle to the cross slide and has thrust bearings and the provision to eliminate backlash. The layout is shown in **figs 18** & **19**. The stepper motor can be engaged or disengaged by the lever next to the feedscrew handwheel.

One advantage of this system is that the cross slide has a travel equal to the full length of the cross slide and is not restricted by the position of the cross slide handwheel. Another gain is the ability to set the backlash to a minimum. By releasing the screws locking the wormwheel pivot, the wormwheel becomes free to move between the converging axes of the handwheel worm and the feedscrew connected to the cross slide. Rotating the feedscrew handwheel clockwise will cause the wormwheel to wedge between these converging axes and anti-clock rotation will move the wormwheel away, increasing the backlash. By manipulating this, the backlash can be set to a minimum, then the pivot screws are locked to preserve this setting. This enables the backlash adjustment to be easily managed.

The drive arrangement for the cross-slide shown in fig. 19 may look slightly complicated. But, just to be fair, consider the cross slide drive arrangement for a conventional lathe. From the mandrel, a chain of three or more gearwheels transmit the drive to a feed gearbox, then to a long horizontal shaft with a keyway along its length, to drive a sliding gear/worm assembly which can then be engaged to the cross slide feedscrew via an engageable wormwheel and gear arrangement. On many lathes this horizontal shaft is also the leadscrew with a keyway groove cut through the screw threads - not an ideal combination!



Cross slide & Topslide.



Topslide - (body ghosted).

A topslide could be avoided completely as a cost cutting exercise. Topslides seem to be a source of problems, with rigidity reduced by large cut-outs in the cross slide to mount the topslide in a fixed location and inadequate clamping methods. Some have little or no support directly under the cutting tool and this is further compounded by fitting an overhung toolpost mounting. This seems to be a weak point in many lathes.

I have shown a lever locking topslide that can be mounted and moved anywhere at any angle on the cross slide. A screw cutting withdrawal lever for internal or external screwcutting is incorporated. Plus, of course, a full length oval gib, that can be rotated away from its set close sliding position to lock the upper and lower slides solidly together, by a lever beneath the feed dial. The lever wedges the slides together and the friction grip of the oval gib keeps the lever in the locked position until it is pushed down, virtually creating a Gibraltar toolpost, **fig. 20**.

The topslide handwheel drives a 10mm wide toothed belt via an adjustable idler to set the belt tension. This positions the handwheel high and clear of the tailstock barrel. The feed screw runs in a long plastic nut which has slits to enable adjustment for zero backlash. The toolpost is a simple design with no overhang from its support point and includes a mounting hole for a boring bar. The toolpost can be inverted and the lathe run in reverse if desired. There is no need for shimming or setting the cutting tool height at the toolpost. This can be done by the vertical height adjustment even when the tool is cutting, **fig. 21**.

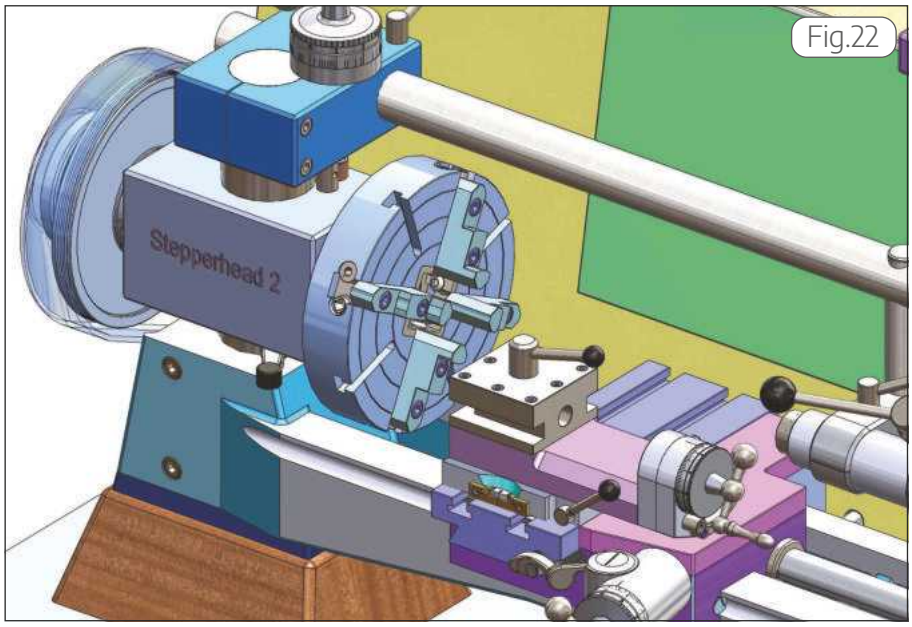
There is provision to add a DRO for the cross slide, bed and vertical column. The cross slide has a central groove cut in its underside. The vertical column is bored centrally at the lower section and a sensor can be added along the full length of the rear bed bar. This keeps the sensors hidden and safe. The readout can be incorporated into the L H face of the splashback or mounted next to the laptop screen. It might even be possible to also use the computer screen as a DRO.

The vertical column is radially guided by an oval gib. The lever can rotate the gib to lock the column in position or allow it to slide. The gib extends the full depth of the guide block. There are also two additional locking points in the bed block. These will not generally be required but are available to clamp the column for additional rigidity. The oval gib guide can also be removed, allowing the headstock and overarm to be rotated relative to the bed; enabling various machining operations using say the milling spindle. In general taper turning can be carried out using CNC or the topslide. The overarm and tailstock assembly can also be removed enabling a maximum diameter of 290mm to be swung over the bed, fig. 15.

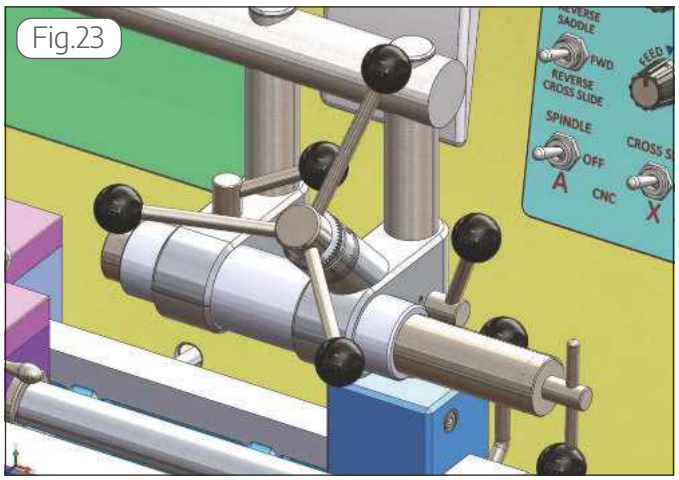
I have also shown a 150mm o/d four jaw chuck of my own design using (guess what?) oval gibs for the jaw slides. The screw that adjusts the jaw is located beside the jaw instead of to the rear where it is normally placed. This enables a slimmer chuck body. The body of the one shown is 32mm deep. The chuck may seem large for the lathe but it can also be used as a faceplate. Removing the reversible jaws reveals the threaded sliders which can be used as adjustable screw fixing points for the faceplate, **fig. 22**.

The tailstock barrel has a Morse No 2 taper and a screw ejection at the far end. The capstan handwheel has a micrometer feed dial for the 75mm travel and gives a sensitive feel when drilling and enables quick retraction of the drill, **fig. 23**.

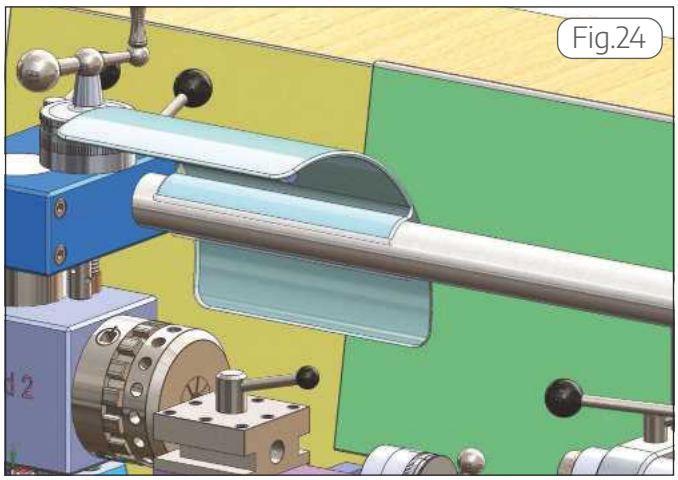
I have shown a belt guard over the spindle pulley and belt, it is a partial extension to the lefthand end splashback



Four Jaw Chuck.



Tailstock capstan.



Chuck guard raised.

door. It is shown translucent, say, made from polycarbonate but it could also be made from steel or aluminium. However, it is very handy to be able to manually rotate the mandrel via the large pulley for many operations and the door can be swung open to enable this. When the headstock is raised the belt guard can be opened to allow the movement. It is also possible to arrange the belt guard to move with the spindle but a simple version is shown here.

A chuck guard is shown in **figs 24** & **25** which can clip onto the overarm. It has an LED low volt strip light fitted along the underside face to illuminate the part being made. The guard can be rotated and positioned axially along the overarm to suit the operation and be best positioned to deflect chip spray.

Conclusion

This proposal is for a lathe that can do all the things a basic machine can do and also have the additional capabilities to perform very many operations that the home workshop could encompass and more. It could also be a machine with the built in ability to be upgraded in various stages. First a basic lathe with an inverter controlled drive motor and manual operation of the saddle cross slide and elevating the mandrel and tailstock. Secondly with the addition of stepper motor drives to the saddle and cross feed for optional power operation. Thirdly with a stepper motor drive added to the headstock, a laptop computer, and a CNC program. All these features can be used independently or together. For example, it is possible to power feed either the saddle or cross slide, or just use the spindle stepper drive for indexing. Or of course use full CNC control, or dare I say, CNC control with manual override. This would provide a very versatile lathe with machining capabilities beyond its small footprint. Capable of any screw thread system, tapers and profiles as well as easy indexing for gear cutting etc. and many other operations including milling and keyway cutting.

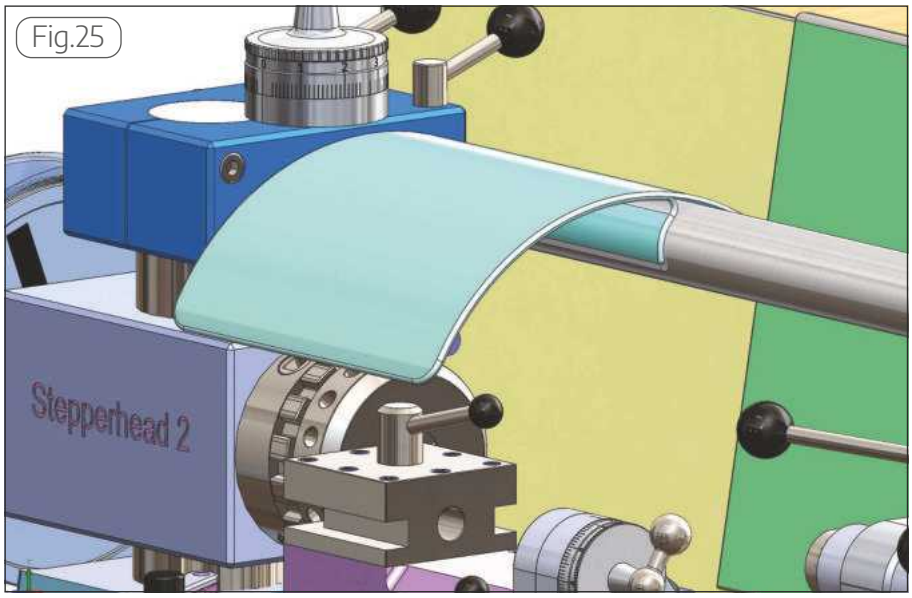
The versatility can be further enhanced by additional attachments. The tee slotted cross slide and the overarm provide convenient mounting points for them.

As to cost there are gains and trade offs. There are savings in eliminating the following items; a clutch assembly, a separate back gear drive shaft and gear assembly, the change gears and banjo arrangement, a tumbler reverse and a feed/screwcutting gearbox; and these could well equate to the cost of stepper motors and their drivers. The added bonus in avoiding these items, which are often a source of noise and vibration, is the potential for a quiet machine.

I am pleased that I managed Solidworks enough to get to the design shown, as now the results of this process have rewarded me with a dose of RSI and tennis elbow, is this my just deserts for advocating such engineering heresy? Here is a brief specification:

•Nominal centre height 80mm (can be varied from 70 to 150mm.

- Max. distance between centres 350mm
- Spindle bore 26mm
- Max diameter at normal headstock height. 170mm
- Max diameter over saddle at normal headstock height. 100mm
- Max diameter clearing overarm. 170mm
- Max diameter over saddle with headstock raised. 210mm
- Max diameter with overarm removed. 290mm
- Spindle speed range. 15 to 3500 rpm
- Cross slide travel 200mm
- Tailstock barrel travel 75mm (No 2 Morse taper.
- Topslide travel 70mm
- Overall dimensions Width 750mm Depth 500mm Height 400mm
- Overall weight 160lbs, 72kg. ∎



Chuck guard lowered.

A Lathe Clutch

Brett Meacle made a clutch to upgrade his 9 x20 lathe

The initial idea for this project started when thinking about fitting a countershaft to the lathe to reduce the lowest speed from an actual 130 rpm to 45 rpm to make screw cutting a less stressful task. Progress in the planning department did not go very far because normal vee pulleys were bulky and hard to machine. This part of the design was only overcome when I discovered poly vee belts and how they produced more compact drive belts and pulleys, plus machining the grooves for the multi vee belts is easier. This allowed an increase from 6 to 12 speeds covering a wider range 45 – 1985 rpm.

I had also been thinking about a clutch for a long time to save wear on the rotary switch and electric motor from constant starts. Which to be honest, worked faultlessly for 18 years, but it made my electrician's spidey-sense tingle. I realise technology has moved on and VFD's have reduced the stress on motors, but I still find a simple flick of the wrist to operate the clutch is far easier than even button pushing. A third reason was to reduce the stress on the small and expensive 5M drive belt to the spindle. Occasionally these just break starting up the lathe, but you can ease the drive in with a clutch and I have not broken a belt since it has been fitted.

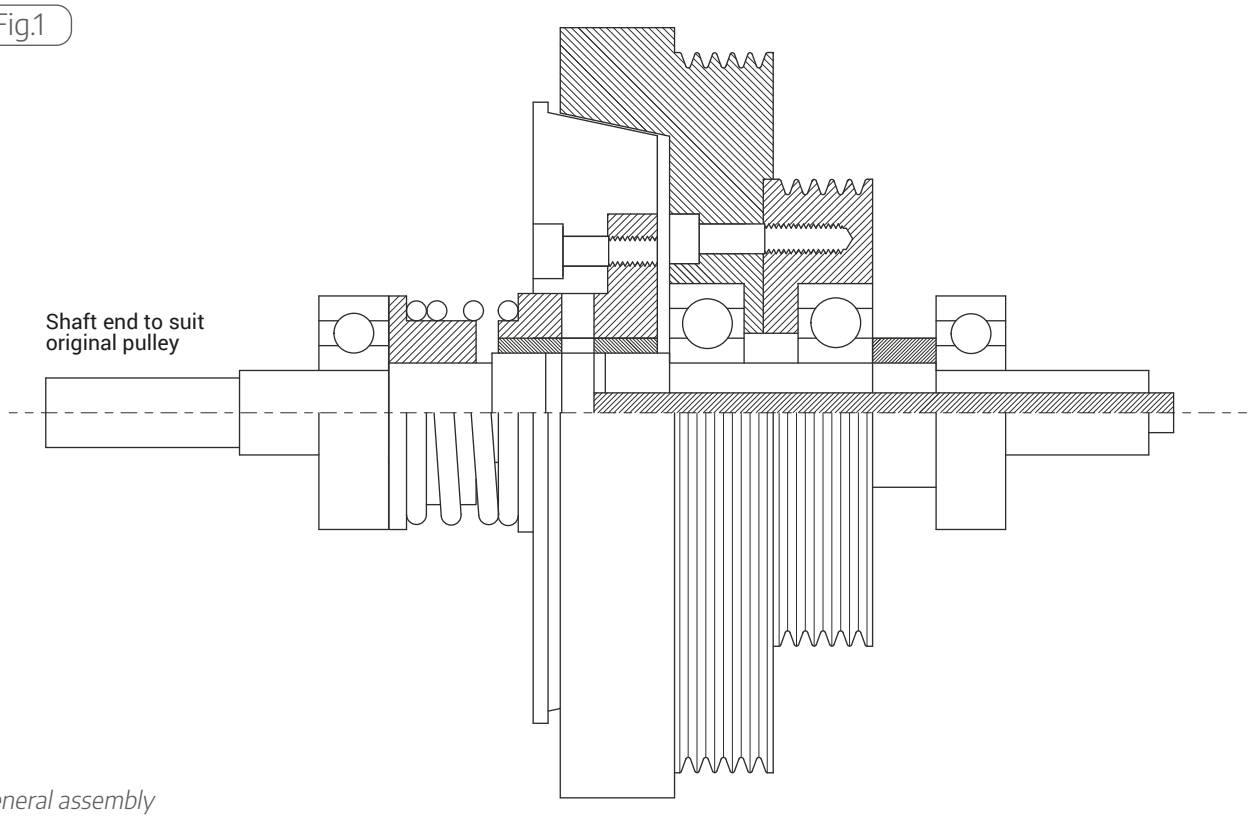
Completed clutch

This design allows the original drive pulleys, belts and belt tensioner to be used. The clutch assembly, **photo 1**, bolts into the original position of the electric motor but does require the motor to be moved to a different position. The motor could be mounted behind, above or as I have done as an underdrive mounting in a new lathe stand. In operation a compression spring pushes the coned clutch plate into contact with the main clutch body thus driving the headstock. To disengage the clutch plate, the cam

Drive plate, deep socket, machined socket and arbor

Centre drilling shaft

Fig.1



General assembly

4

Finish turning Shaft

5

Milling hex on clutch shaft

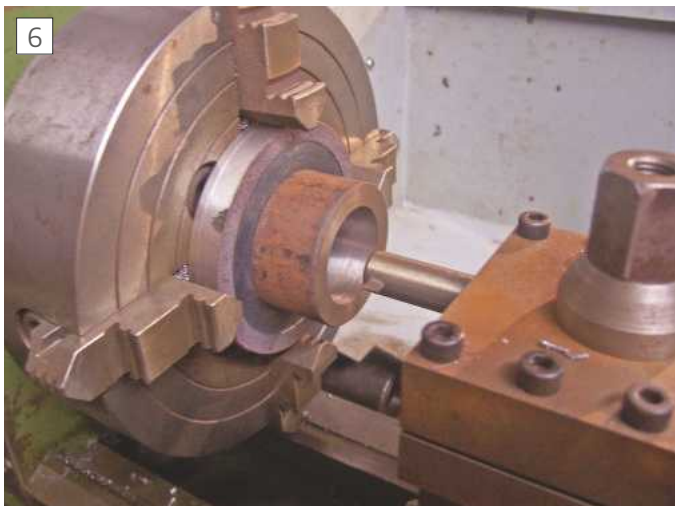
engages a pushrod which moves the clutch plate away from the main body via a cross pin inserted through the drive plate. The electric motor now just drives the main clutch body which rotates freely on ball bearings around the now stationary driveshaft.

I was pondering how to transfer the drive to the shaft knowing larger clutches and drill presses/mills use splines to allow sliding movement and power transmission. I didn't have facilities to do either the splined shaft or more importantly the drive bush with an internal spline. Inspiration came one day when using a deep six point impact socket, it already had a reasonably accurate deep hex hole in it. All that was required was machining the outside diameter concentric with the hex and shrink fitting it into the clutch drive plate. To transfer the drive it only requires a hexagon section to be machined on the shaft with some fitting to make it a nice sliding fit in the drive bush. A relatively easy machining operation for people lacking equipment or confidence to tackle more complicated machining tasks.

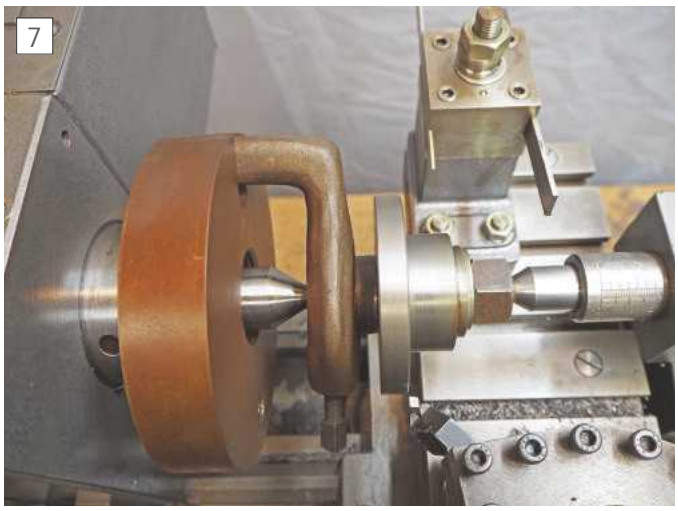
A drawing has been included showing the layout, **fig. 1** with the exception of the bearing pedestals, cam housing and base plate. This article will give an insight into the design and how I machined some of the components.

Machining operations

The first job is to make a couple of between-centres arbors for further machining operations. One sized for machining the electric motor pulley and another one to be a good fit in the bore of a 22mm deep 6pt Impact socket, **photo 2**. Both are threaded and clamp the components between a flange and nut. While the lathe is set up for between centres work, you can skim the outside of the socket and note the dimension for later reference. I only took enough material to clean up the surface keeping the wall as thick as possible. The length can be left long at this time with a section of socket reduced in diameter for use as a gauge



Boring drive plate for hex socket

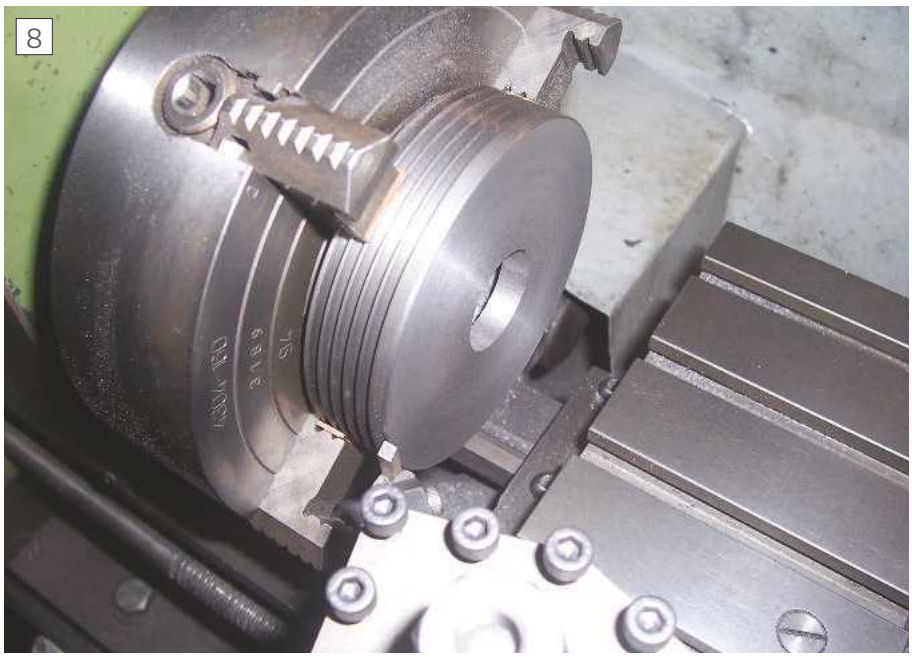


Machining drive plate on arbor

to accurately size the hole for the shrink fit. With a shrink fit you want a 0.001" per inch diameter difference between the two components. Between centres working is an excellent way to achieve good concentricity of the workpiece. The work can be removed for trial fitting and replaced, switched end for end but still set up accurately every time it is fitted to the lathe. This project involved swapping between a 4-Jaw chuck and working between centres a bit but if you organize a logical work flow you can do similar jobs together especially the cast iron work, then give the lathe a good clean up.

With the 4-jaw set up you can rough out the drive plate shape and bore the hole to fit the socket, once the socket is firmly inserted, finish both ends ready for fitting to the arbor. The cam housing could be fabricated and machined also the clutch shaft centred and roughed to shape at this time. Moving to the cast iron work, both parts of the motor pulley and the clutch plate can be machined ready for finishing on the arbors. Bearing pedestals machined. The components of the clutch body completely machined including the taper. After setting the angle to 12 degrees, leave set until the clutch plate is finished later.

Clean up the cast iron swarf and fit your lathe centres and driver plate. Machine the drive flange ensuring it's a nice close fit in the clutch plate, once it has been bolted to the drive plate, complete all the machining including the taper. Shaft can be finished turned on all diameters and lengths. The motor pulley can have the mounting spigot and outside diameter finished to size and vee grooves done then after assembling the two parts together, finish machining and grooving the large pulley. Clean up the lathe and refit the chuck again, now



Finishing Small Clutch pulley

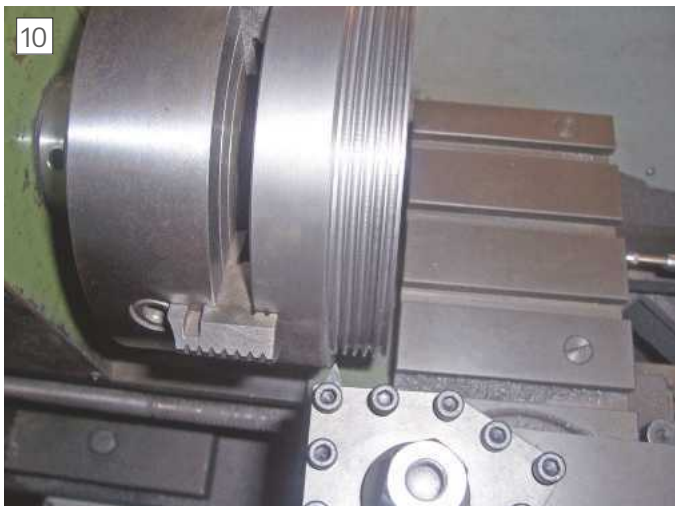
it's only a matter of finishing touches to the shaft, making the spring seat and machining of ancillary parts, cam, pushrods, handle and spacers etc. to complete the clutch.

Clutch Shaft

The shaft was made from some 1030 round steel (a suitable alternative more easily obtained in the UK could be EN16T – Ed.). Because of the length and diameter it would not fit through the headstock so to centre drill the ends, a fixed steady was used to hold the shaft. Although not often needed, a fixed steady is a good accessory to have. Set up the shaft accurately in the chuck and set the fingers of the steady to size at the headstock end. Move the steady to the extremity of the shaft to support it while facing the end and centre drilling, **photo 3**. Reverse the shaft in chuck, set up accurately again and repeat for the other end. Once centred you can support the shaft with a live centre for removing the majority of the excess material. Now set up between centres to ensure concentricity of the finished sections, **photo 4**. For roughing I use a rotating live centre but for the final finishing, I replace that with a carbide tipped dead centre. Ensure it is lubricated and adjusted so the work spins freely, heat expansion is not as great a problem with fine finishing cuts, but the clearance still needs to be checked constantly to ensure it's not too tight or loose. The most important dimensions are the bearing seats, to ensure the correct fit for the bearing race.

The shaft was then transferred to the mill to machine the hexagon section. As I didn't have a true dividing head, I pressed into service a punch former

Machining clutch plate



Cutting pulley grooves on main body

to divide around the six flats, **photo 5**. A Hex ER collet Block with tailstock support for the shaft is also another possibility. It is machined to be a firm fit in the drive plate and then filed and fitted to a smooth sliding fit. The slotted cross hole was then machined for the pin, this is oversize on the pin to ensure there is no binding and a keyway cut to match the original headstock pulley. The final job is to return to the lathe to drill and ream the hole for the pushrod.

Drive plate

The drive plate was fabricated from some flame cut plate fitted and welded to the round material, but it could also have been turned from some 75mm solid bar. I chose the fabricated route partly to save material, although maybe not time. It was also used as practice machining holes to fit within certain limits for when you are needing to get it right. The hole in the plate was made a shrink fit and then for extra security welded on.

Set up in lathe chuck, face and bore hole for the socket, **photo 6**. The size of the hole is 0.001" smaller per inch diameter than the socket. To assist in sizing the bore a section of the socket can be reduced in diameter and used as a gauge.

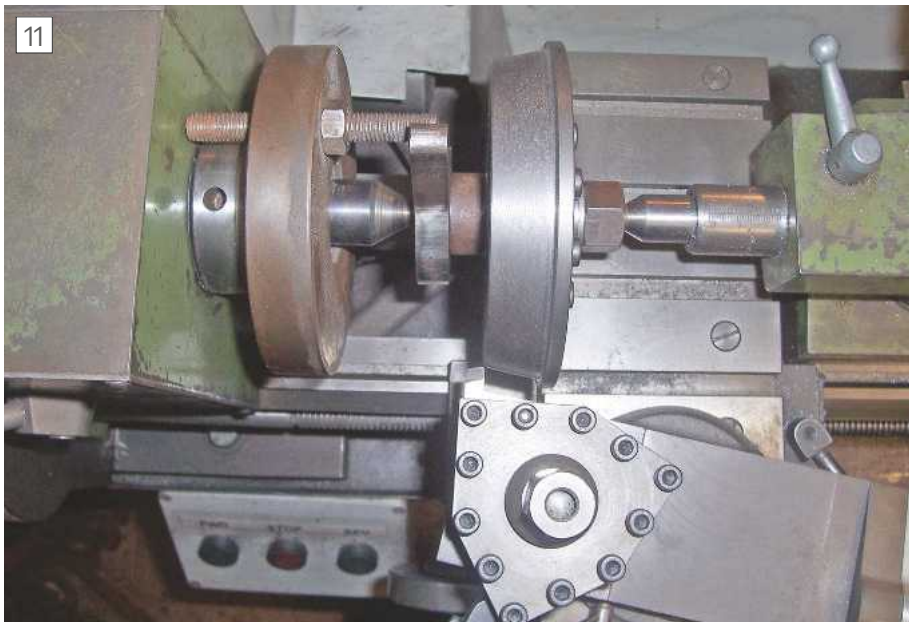
Remove from the lathe and now you are now ready to assemble the hex socket into the drive plate. The socket is placed in the freezer to cool down and the drive plate is heated up to expand the hole. If all goes to plan the socket will slip into the hole easily until drive plate cools and locks it into place. Refit to lathe and face both ends. Set up on an arbor between centres and turn the inside face, diameters and the step for the spring to locate, **photo 7**. Ream the hole for the cross pin aligned to one of the flats. When the holes have been transferred from the clutch plate and tapped the drive plate is complete.

The original clutch spring was found in the parts box, but for this second clutch I decided a 45mm OD x 45mm long 4mm wire spring would be suitable. The rear spring mount is mostly just to centralize the end of the spring and ensure the force of the spring is only acting on the bearing race on the shaft and not the outer race.

Main clutch body

When I made the first clutch, I fabricated it using centrifugal cast iron bar, to save time and material and reduce massive piles of swarf. The centrifugal cast bar is a delight to turn, available in a good selection of sizes. Fabricating the clutch this way reduces the overhang from the chuck during machining and the tooling to cut the vee grooves is less complicated. Cutting a slice of 160mm cast iron from a 450mm length of stock stretched the 4x6 bandsaw to its limit. To allow it to fit onto the saw, the fixed jaw was replaced with a piece of large unequal angle fitted in reverse. As the saw cut into the material, it was rotated to continue the cut around the whole diameter as a result of the limited throat depth. Stopping the saw and rotating the bar also helped keep the cut straight.

To machine the poly vee belt grooves, you need to make a form tool to feed to the correct depth, accurate sideways movement was determined by using a dial indicator located on the saddle. The small pulley is best machined while still attached to a chucking piece. Face and machine OD, bore a hole through the pulley and machine the bearing recess to be a good fit on the bearing. Cut the poly vee grooves. Remove from the chucking piece and refit in 4 jaw and set up accurately on the OD and ensure job



Clutch plate attached to drive plate for final finishing

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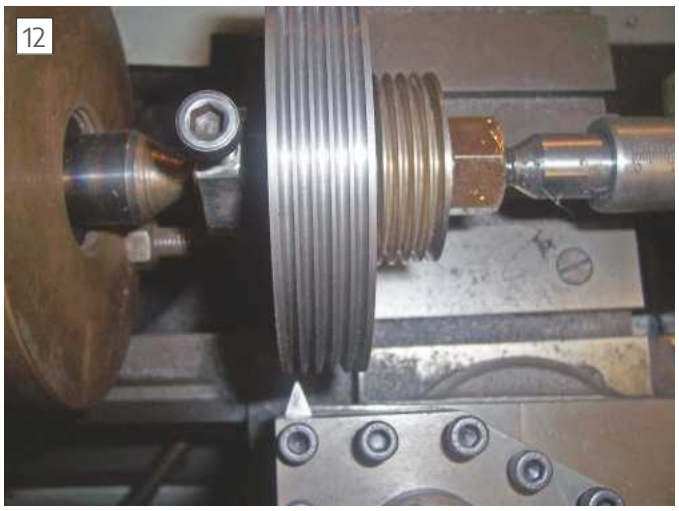


Machining grooves motor pulley

Set up to mill bearing pedestals to equal height

is seated properly in the chuck. **photo 8** shows the second face machined with good chamfer to ensure it seats fully in the main body.

The lump of the main body is set up in the chuck, a hole the same size as in small pulley bored completely through. The heavy work of removing the material for the clutch and bearing recesses undertaken. **photo 9** shows the topslide set up to finishing the 12 degree taper. Machine the outside diameter and chamfer, reverse in the chuck and indicate as accurately as possible, tapping the stock back into the chuck jaws to ensure it is fully seated. Face and machine the recess that locates the small pulley. Machine the large pulley diameter and poly vee grooves, **photo 10**. Before removing from the lathe, machine a faint V groove on the PCD of the mounting holes.

Step off the number of divisions required with dividers, when happy with the position centre punch for drilling. Starting with a spotting drill and only drill the holes to tapping drill size at this stage. Deburr and position on the mating component to transfer the holes. Transferring holes this way may not allow totally interchangeable parts as made in a dividing head or rotary table but is accurate enough for most jobs.

Completed base and bearing pedestals

I normally do one hole first drilling, tapping and opening up the corresponding hole to the screw size, this is then used to hold the components together to transfer all the other holes. A good practice when tapping components is to open up the hole full size for a short depth so burrs raised during tapping are below the surface. All that is required then is a quick twist of a countersink to clean up the face.

Open up the holes to whatever clearance you require and counterbore, countersink to your tastes.

Clutch plate

I decided on cast iron for the clutch plate and lined the tapered section with some thin rubberised cork gasket material, thinking this could be replaced if wear took place. I now note that Myford use brass on cast iron. I do like the idea of being able to replace the lining if required, so far, no wear has been detected during the years it has been in use. The design allows removal of the clutch plate from the clutch assembly without having to remove the bearings or spring, only the motor pulley and the front bearing pedestal need to be removed.

Set up in 4-jaw face both sides and machine to thickness, Machine the bore and recess for the flange of the drive plate and scribe the mounting hole PCD. Mark out holes and transfer them to the drive plate, Drill and counterbore the clutch plate for the fasteners. **Photograph 11** shows the assembly fitted on the arbor for final machining the outside diameter and the taper. If you choose now is the time to mark out and cut the lining material and glue it onto the clutch with contact adhesive. Clamp the plate into the clutch body till the glue sets.

Motor pulley

Again to save material, the two pulley sections were assembled using a shrink fit. Fabricating the pulleys this way allows the Poly vee grooves to be cut with a normal short V tool, being more rigid.

Set up the larger pulley blank in the chuck, Face and machine the bore to finished size. Chamfer the hole sufficiently to ensure any corner radius on the mounting spigot will not cause interference, stopping the assembled pulleys seating fully. Face the second side and put aside ready to assemble onto smaller pulley. Set up the material for the small pulley, face the end then bore or ream the hole to match the motor shaft. Rough machine the spigot which will be finished to shrink fit dimensions on the arbor between centres. Face the second side and put on the arbor for finishing between centres. You can now complete the outside diameters then machine the grooves for the poly vee belt on the small pulley. Using the heating / cooling techniques assemble the 2 components, then turn the OD and belt grooves on large pulley, **photo 12**. Final operation is to cut a keyway to suit the motor shaft and tap for any Grub screws if required.

Bearing pedestal and Cam housing

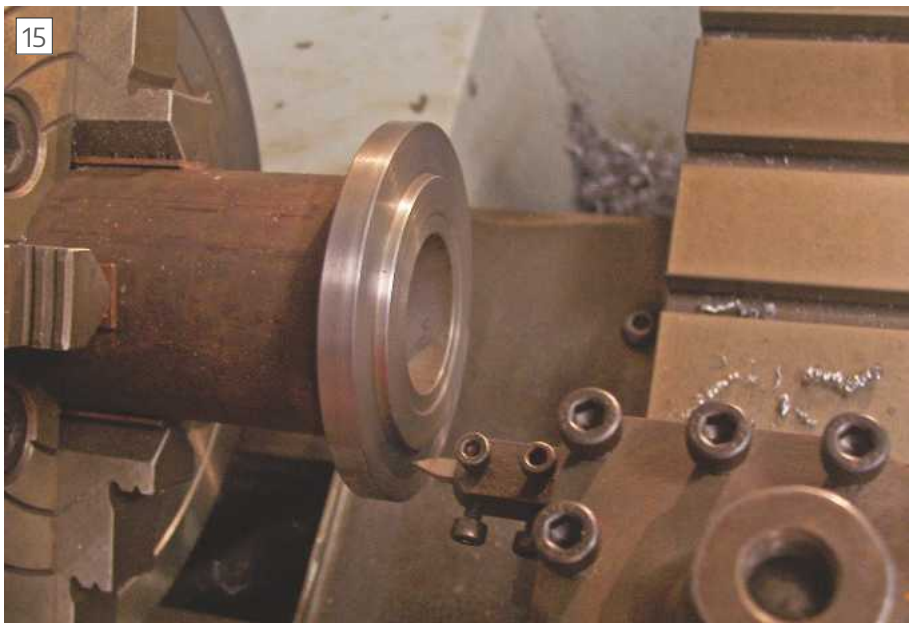
These were made from some spare castings I had but could just as well be made from steel or cast iron stock. One is machined for the bearing and cam housing and the other is machined with a recess for the bearing. To machine the

bearing pedestals to the same height they were set up on the mill and a light skim was taken from each pedestal using an end mill at the same setting. **Photograph 13** shows an angle plate fitted with the shouldered jig used to accurately locate each pedestal using the bore and one of the machined faces. When mounting to the base plate, **photo 14**, the clutch shaft is assembled with the bearings, Pedestals and cam housing. The position of pedestals is outlined, the plate is marked out, drilled for the screws then the holes transferred to one pedestal at a time to ensure free running alignment. Countersink the holes in the bottom of the plate. The base is a piece of 6mm plate drilled with adjustment holes to match the original motor ensuring the alignment and belt tensioning with the other headstock pulleys. Because of the size of the clutch body, a section was cut out to allow clearance for the belt to be moved off the larger pulley to change speeds.

The cam housing was fabricated from some heavy wall tubing with a flange welded on the end. This could be made from solid with a bored hole if you don't have facilities for welding. The wall thickness was kept as thick as possible because they are the bearing surfaces for the camshaft. When in the lathe machining the end, ensure the face is relieved so the rotating inner bearing race will not rub. Machine a faint vee groove on the PCD for drilling the mounting holes, **photo 15**. Transfer the holes to the rear pedestal for tapping. The mounting holes for the camshaft reamed and cam and operating handle fitted.

Cam and Pushrod

The cam was made from some silver steel hardened and tempered. The actual cam shape is just two flats machined onto the shaft, enough for the clutch to move a millimetre or so. Silver steel hardened at both ends was also used for the pushrod. When the clutch is engaged there should be a small clearance between the pushrod and the cam with little wear occurring. It is only during disengaging for a short period the pushrod will wear on the cam. The pushrod sections are joined with a threaded rod incorporating a plain section ensuring the adjustment shims remain central and not bind the shaft in the hole, **photo 16**. Adjustment is accomplished by adding or removing shims from the pushrod and reattaching the assembled cam housing until the operating handle has a small amount of free movement with the clutch engaged. Once set it rarely needs any future adjustments. The operating handle was made to shape and taste. The lever on my lathe is under the bed, down close to the push buttons, as I have my lathe mounted higher than most. I find it's a comfortable position compared to the above the chuck position on the Myford.


15

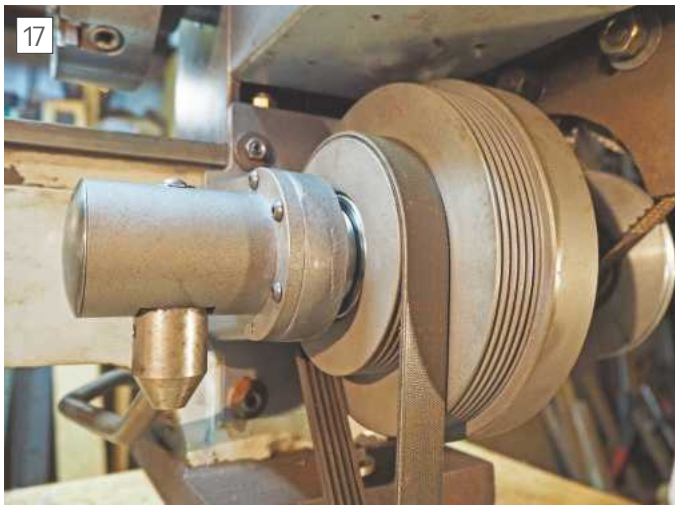
Scribing end housing for mounting screws

Conclusion

I have found this addition a vast improvement in the use of the lathe. Although designed for the 9x20 style lathe, **photo 17**, the basic design can be changed to suit your particular circumstances- Bigger or smaller, more or less Pulley sections, different cam and actuating handle design. This project will allow you to learn new skills and become better at planning a project through from start to finish. Part of learning experience of this hobby is to work through your own or someone else's ideas, adapt it to your equipment and experience level and finish up with an improvement in your skills and with something useful at the end. ∎


16

Cam and pushrod assembly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Completed clutch fitted to lathe

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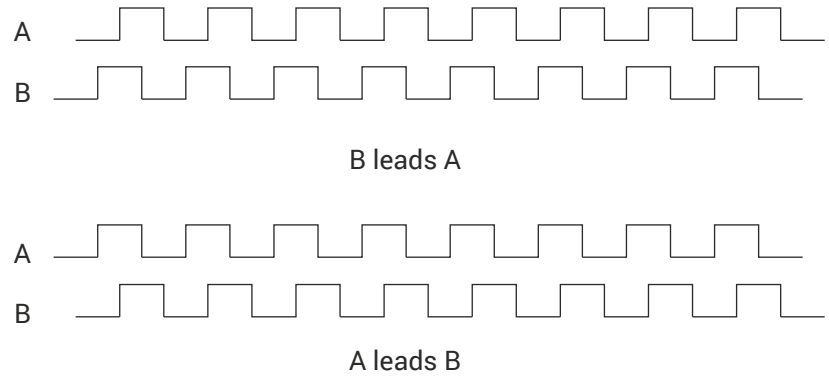
Rotary Encoder DRO for a Lathe Tailstock

Having fitted DRO's to the saddle and cross slide of my lathe, I've always been dissatisfied with the scribed lines on the tailstock as the only measure of how far it has been advanced. Doesn't often matter for drilling, but if you're using a D-bit or similar it does. My Colchester lathe came with a re-settable graduated dial on the tailstock, but my current lathe didn't. There are several ways of overcoming this, GH Thomas described the fitting of a re-settable graduated dial to a Myford Super 7, and Graham Meek has described a more sophisticated version in MEW recently. Probably the simplest way is to fit a linear slide as shown in Simon Burt's entry to the Stephenson Trophy, see MEW 297. I decided to do it differently, using a rotary encoder driven off the tailstock handwheel. Co-incidentally I entered this for the Stephenson Trophy as well, not thinking it would win, but Neil only had one entry at the time. Now he has had a request from a reader for a write up, so here it is. It will come as no surprise that this once again uses an Arduino microprocessor.

Fig.1

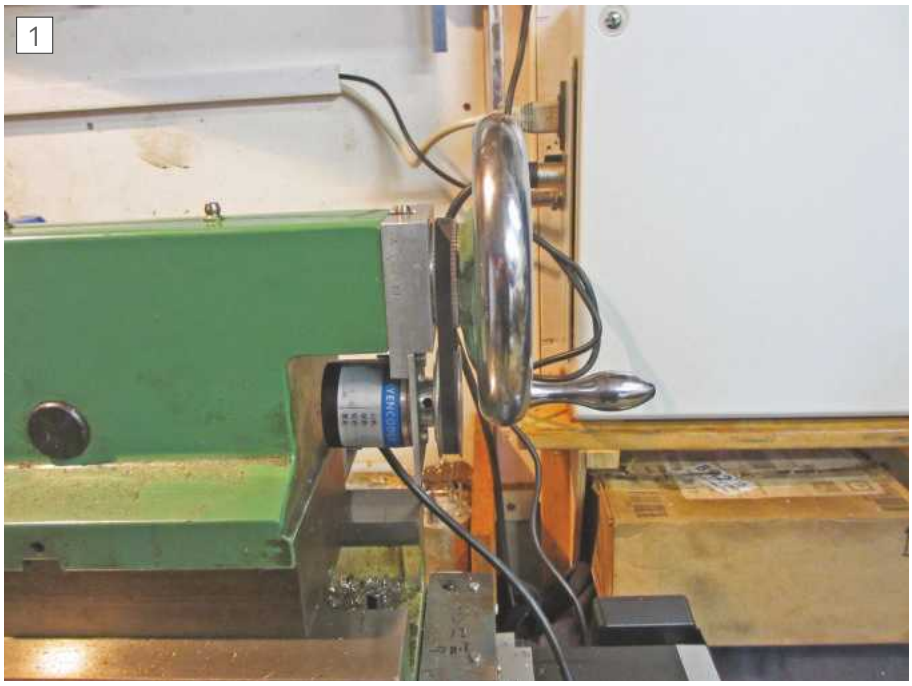


I'd better start by describing how the encoder works. Buried inside is a slotted disc, which has two opto-switches, channel A and channel B. When the disc is rotated the switches both produce square waves. The switches are slightly offset so that the waveforms are offset by ¼ of a cycle, as shown in **fig. 1**.

The software cunningly reads the edges of these waveforms and can tell which way the disc is rotating (an edge is the vertical line, transition from low to high or high to low, a pulse is one channel going low to high and back again).

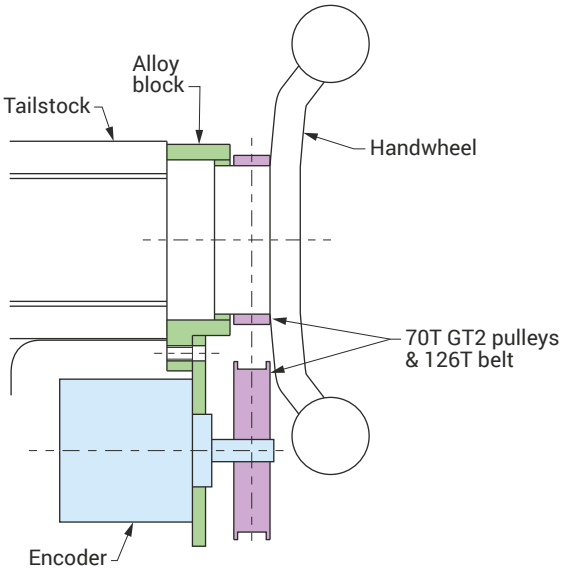
The tailstock on my lathe (Myford 254S) has a 0.3" pitch screw. I believe this to be the same components as the Super 7. I decided that trying for better than 0.001" resolution would be fruitless, I don't think I can turn the handwheel to better then that. The software can count on each edge of both channels, so ideally I'm looking for 300/4 = 75 pulses per rev. The lowest I could find on Ebay was 400, so I've arranged the software to count only on one edge of channel A, thus I get 400 counts per rev. The software sorts out the relationship between counts and display, for both imperial and metric.

All that is then required is a means of mounting the encoder on the tailstock and driving it. I have a phobia about drilling holes in my machines. I'll do it if I have to but try not to. What I did therefore was to bore out a block of aluminium to fit over the boss at the back of the tailstock and attach a mounting plate to this. A couple of small grub screws hold it secure. The holes through the mounting plate for encoder are slotted to allow belt



Hardware fitted to the tailstock.

Fig.2

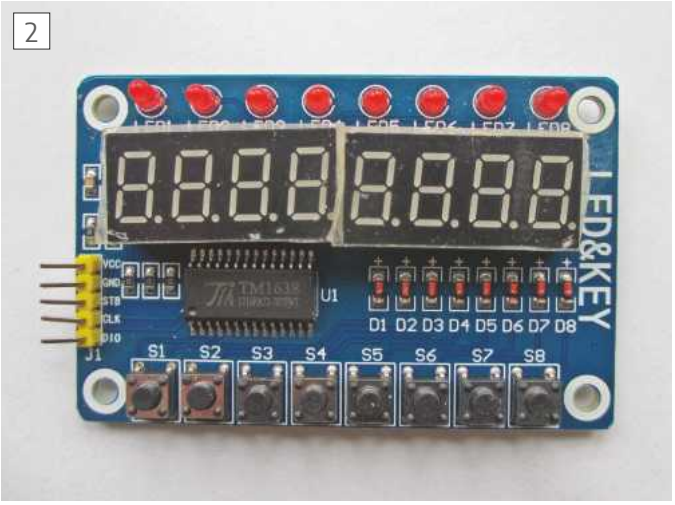


adjustment, and a cunningly placed hole through the encoder pullet allows the securing screws to be tight end once adjusted. I had to machine clearance in the aluminium block to clear the lubrication nipple. I assumed the existing oil nipple would be on the vertical centre, not true, so it finished up slotted a bit.

The handwheel already had a concentric machined section, so I bought a 126 tooth, 6mm wide GT2 section belt and two 70t wheels, this was the smallest that I could bore out to fit over the handwheel (39.26mm diameter on my machine). The belt gave a centre distance of 56mm which allowed clearance of the encoder under the back of the tailstock. The wheel which goes on the handwheel started out as suitable for an 8mm wide belt so I could hold it by its boss and bore it out to fit over the handwheel and then part it off. As space was at a premium, I took the guide flanges off this wheel, you only need them on one wheel. As it turns out I could have left the outer one on this wheel and the opposite one on the encoder wheel which would have made getting it together a lot easier. This is all shown in **photo 1** and **fig. 2**. A bracket bolted to the rear of the tailstock gives strain relief to the cable.

In my box of 'will come in handy' bits I had some 8-digit LED displays incorporating eight push buttons and eight single LEDs all mounted on one board and costing only a few pounds, see **photo 2**. This saves a lot of messing with separate push buttons and indicators.

2

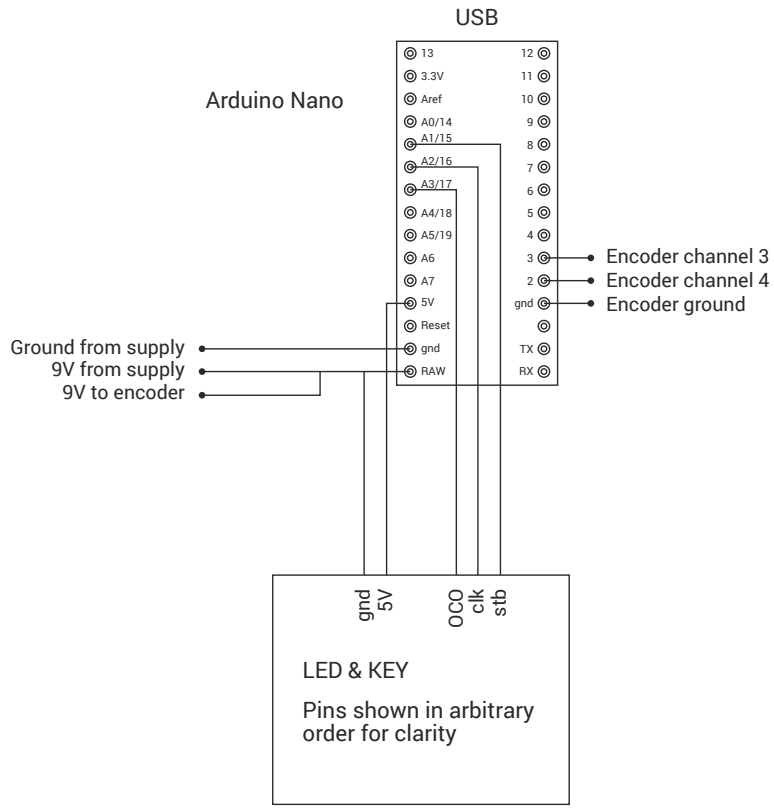


The display module.

This board has a serial interface, and so the outputs and inputs can be controlled by only 5 wires. The Arduino Nano is mounted on Veroboard at the back of this board as shown in **photo 3**, and a schematic in **fig. 3**.

The enclosure came from Newey & Eyre, now Rexel, and the front panel was made from my drawing by a local engraving company. The display is mounted on stand-offs so its front face is level with the outside of the enclosure, the panel slightly overlaps. Holes corresponding to the required buttons and single LEDs are drilled through both panel and enclosure, the holes for the buttons are bigger through the enclosure so some fat drawing pin shaped extensions are trapped between the button on the display and the panel.

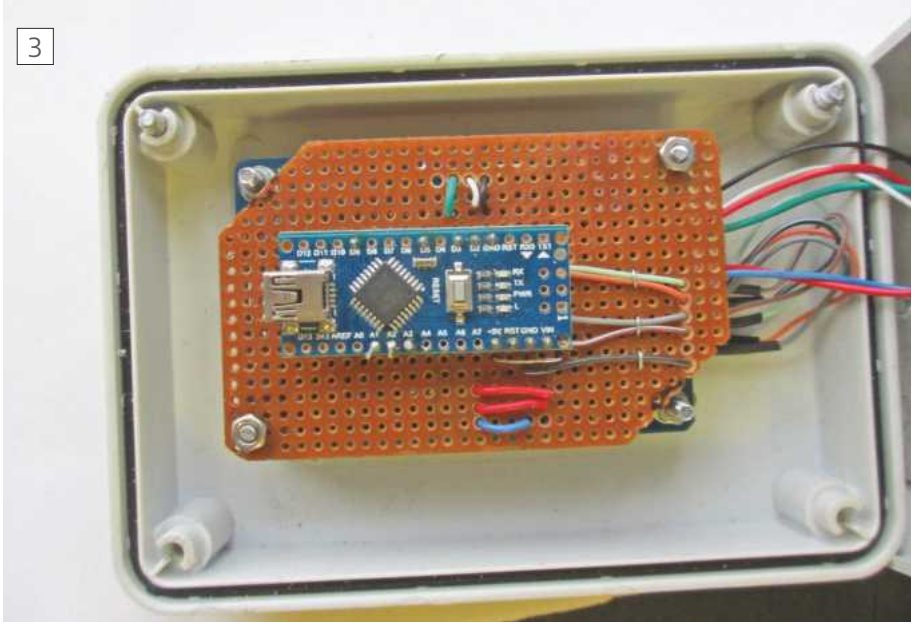
Fig.3



Short lengths of clear Perspex glued into the appropriate holes bring the light from the separate LEDs to the front, all shown on **photo 4** (running temporarily on a battery).

Finally I fitted a guard over the belt as shown in **photo 5**, with the display screwed to the wall behind.

In the unlikely event of anyone wanting copies of software or drawings, contact me via the ME forum or via the Editor. If your lathe has a different pitch on the tailstock it should be possible to rework the software to suit. ■



Arduino fitted to vero board.

Display unit.

Guard fitted over pulleys.

In our Next Issue

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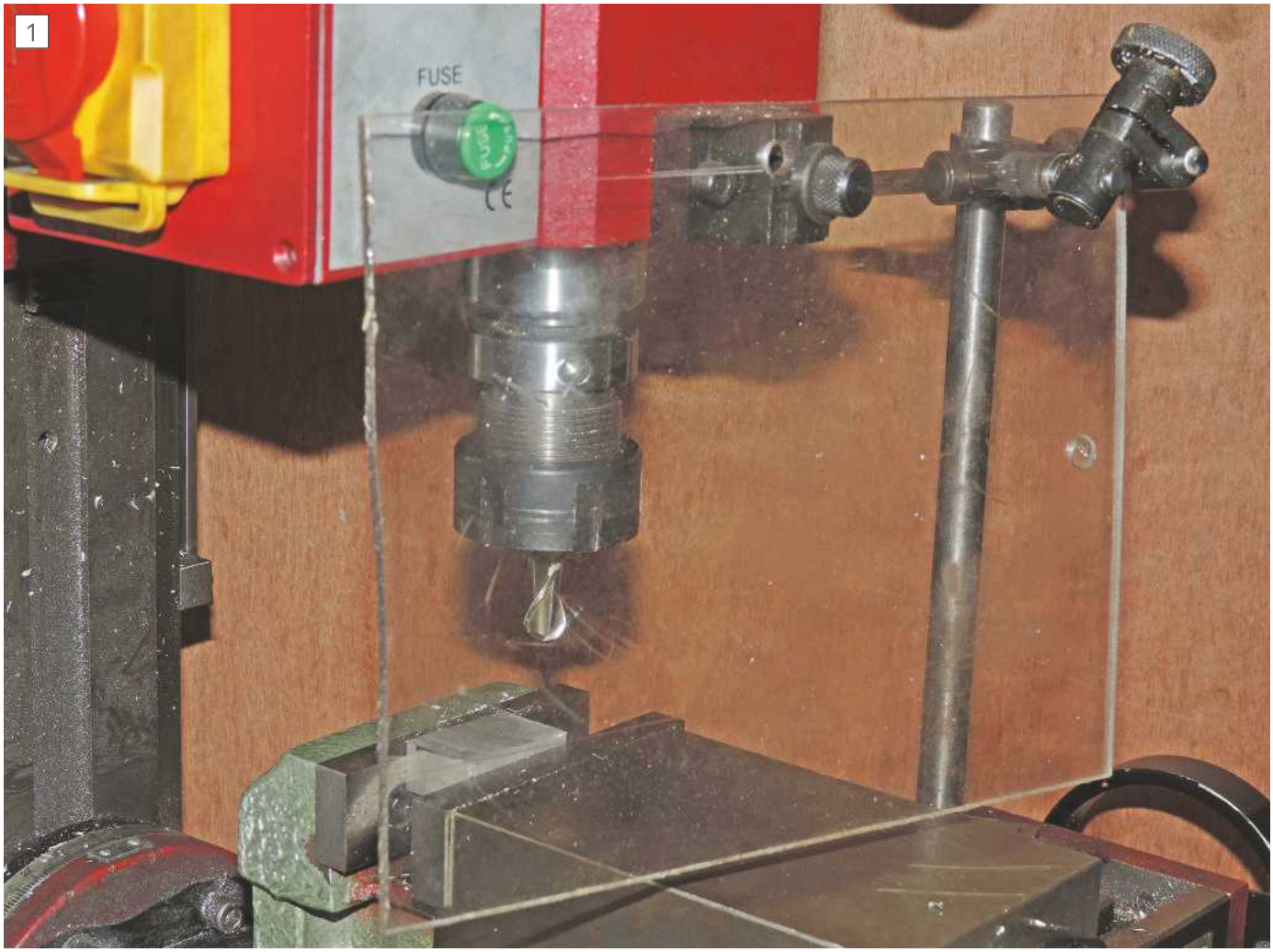
Look out for MEW 302, your April issue:

Roger Vane details the making of a pair of edge finders

Stewart Hart explains how to get the best out of a spin indexer.

Terry Gorin makes an adjustable offset tailstock for his Unimat lathe.

Workshop Safety



This polycarbonate guard is simple but effective and can be used for more than one machine.

The most important tools in your workshop are your eyes, ears and fingers – unlike other tools they are irreplaceable, so take good care of them! They used to say you could judge how experienced a machinist was by counting how many fingers he had left. Perhaps this has some truth when every machine operated from open leather belting, there were few guards and 'protective clothing' was at best a bowler hat or a leather apron.

Fortunately, despite claims about 'elfin safety gone mad', ensuring your workshop is a safe place to be is largely a matter of common sense, some sensible protective gear and perhaps a few less obvious precautions.

Machine Tools

Most obvious hazards in any metalworking shop are the various power tools, such as the lathe or milling machine. Modern machines have enclosed drives, built in guards and emergency stop switches but if you have an older second-hand machine you should consider ways of providing these facilities. Its also important to make sure that workpieces are securely fixed in place before starting work – even an innocuous drill press can fling a heavy workpiece across a room.

Swarf

It isn't just moving work or cutters that pose a hazard, when working a machine hard hot or sharp swarf can fly around, a simple swarf guard can help prevent problems. Never try and clear swarf from a machine with bare hands – some people use a rod bent into along 'L' shape as a swarf rake, while others find an old paintbrush works well.

Guards

Most modern machines are equipped with guards around moving parts and the work area. Usually these are well designed, but sometimes they can be small and ineffective or even offer a hindrance to safe working. Even so, think carefully about possible risks if you remove or over-ride any fitted guards.

It pays for every workshop to have a simple, easily set up and moved guard, in the form of a sheet of transparent polycarbonate attached to a suitable base – magnetic bases are ideal and can provide protection against flying swarf as well as keeping fingers clear of cutters, **photo 1**. Such a guard can be easily moved into position, and if its easy to use, then you will use it. Always use polycarbonate – it is less likely to shatter than slightly cheaper acrylic sheet.

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Protective Equipment

In order to work safely, you don't need to be dressed up in full body armour, but even so it pays to have some safety gear. General purpose equipment should include eye protection – either safety spectacles or goggles – but choose something comfortable so you use it, **photo 2**. Ear protectors or earplugs can be useful for some jobs, although loud noises often mean that something needs adjusting.

Breathing masks are useful if doing any work that generates fumes or sprays liquids, such as cutting fluid, about. A ventilated face-shield and breathing mask may seem over the top, but is preferred by some people as a well-designed mask can be very comfortable to use.

Don't wear gloves when using rotating machinery. The injuries caused if a glove is pulled off a hand can be horrific and disabling. If allergies are an issue for you, you can get light and relatively easily torn surgical-type gloves that are less likely drag your hands into the machine if they are caught.

Certain activities such as welding, casting or anodising demand additional protective equipment – always plan such activities and make sure you are protected.

Loose Clothing

Watch out for cuffs, ties or any baggy or loose clothing that could get pulled into a machine. The drawstrings on hoodies seem to be designed to dangle in rotating machinery when you lean forward. It's a good idea to get a workshop coat, like a scientist's lab coat but perhaps in a colour that doesn't show the dirt so readily! With a Velcro fastening they can be popped on and off in seconds and keep you clean as well. If you have flowing locks, keep them tied back when in the workshop. Cotton is better than synthetic materials if there is any danger from fire or hot metal.

Electricity

Familiarise yourself with how any electrical machinery works before using it, especially be aware of any emergency stop switches, **photo 3**. The usual no-voltage switch is designed so that if power is lost then restored the machine won't start on its own. Try and avoid trailing leads and multiplugs, and make sure that all plugs are correctly wired and every machine is earthed. Ideally, the workshop should have its own RCD circuit breaker. Keep heat and fluids away from electrical devices. If anything malfunctions or keeps blowing fuses, get an electrician in to fix the problem.


2

A comfortable pair of googles like these UVEX ones are more likely to be used.

Lighting

Good lighting is essential for safety in the workshop. There's another section that deals with lighting in detail, but a general tip is to back up general lighting with task lighting for each machine.

Other People

Make sure that your workshop is a safe place for other people, not least if it is within your home. No-one can be 100% sure that other people, or even children and pets won't enter the workshop. Most of the dangers are obvious, but beware of modifying things in ways that could be a hazard to someone else who doesn't know what you have done.

Safety Dos and Don'ts

Do check machines, cutters are set up correctly before starting up.
Do make sure that work is held securely and that the cuts and feeds you use are within the safe capacity of the machine.
Do make sure that everything is setup to move how you expect.
Do give machining your full attention, avoid distractions, the majority of accidents are due to inattention.
Do remember that you aren't the only person who may walk into your workshop and switch on the power.
Do use personal protection and suitable guards.
Don't, ever, leave chuck keys in the chuck of any machine.
Don't leave machines switched on when changing tools or setting up work.
Don't try and remove swarf by hand, it is sharp and can easily cut or pull fingers into the work.
Don't leave unattended machines switched on.

Finally, as most of us work alone in our workshops, keep a phone in your pocket or close by, so if something unexpected happens you can call for assistance. ∎


3

Always make sure you are familiar with your machine's emergency stop switch.

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AMCO truck fleet takes solar energy on the road

Road Transport is one of the biggest sources of pollution in the UK, contributing to poor air quality, noise disturbance, congestion and climate change and is a significant contributor to Greenhouse Gas Emissions.

Amco Operations Director, Mark Jones says "As part of our 2021 logistics strategy, Amco are focused on reducing our own carbon footprint as we acknowledge the damaging effects it has on people, animals, local vegetation and the environment. We also want to stay ahead of the curve in helping to meet the UK's 2050 emissions target."

The TRAILAR system captures solar energy via ultra-thin solar mats that are applied to the roof of the vehicle. These mats are connected to a Smart Charge Controller which regulates the energy transferred from the vehicle's alternator and the solar mats, to the battery. Sensors on the vehicle then monitor all the electrical characteristics and calculates the fuel and CO2 savings whilst providing the additional benefits of real-time telematics on vehicle, solar performance and GPS.

This system enables Amco to see in a live time situation how much carbon is being saved through their fleet via a telemetry dashboard.

For a rigid utilising the TRAILAR solar mat over the course of a year, typical fuel and CO2 savings amount to up to 850 litres of fuel is possible, with up to 2.3 tonnes annual CO2 saving and an average ROI of between 12 and 18 months.

Chainsaw Rail Closing Tool

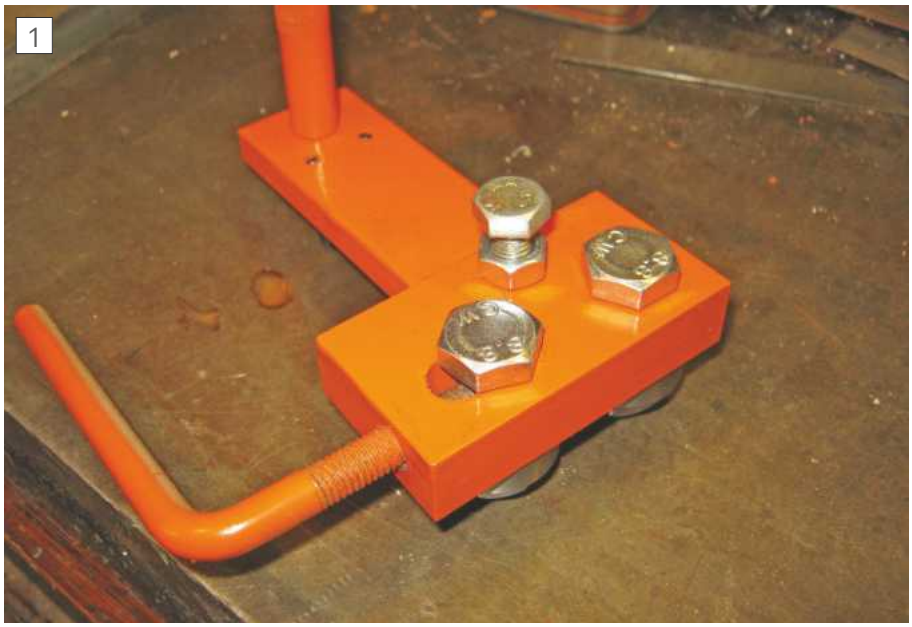
Will Dogget makes a jig for helping true up chainsaw bars

The reason for making this tool, **photo 1**, was I found a chainsaw blade in the workshop when I was having a clean up, I wondered why I had saved it and was just going to put it the bin when I noticed there was some wear on the centre of the guide bar rail. Then I remembered seeing something about repairing this damage on the internet.

After a search on the internet, I found several methods of repairing the bar. I thought I could renovate this chainsaw bar by closing the guide bar groove that the chain's driving teeth run though. Over time these rails can open up, letting the chain rock from side to side in the guide rail making the chain less accurate when cutting timber. Normally the bar would be replaced with a new bar but this tool extends the life of the bar and putting off the cost of a new bar for a time.

To check the guide bar rail for damage, remove the guide bar from the chainsaw and place in a bench vice holding it centrally. Wearing gloves place the chain in the bar rail and check excessive movement in the rail by moving the chain back and forth across the bar, if there is a lot of movement then work is required.

Another method to check for damage is to use a straight edge on one of the chain teeth and against the bar - there should be a gap, if not and the straight edge is against the bar with no gap this also requires work on the guide bar rail, see **fig. 1**.

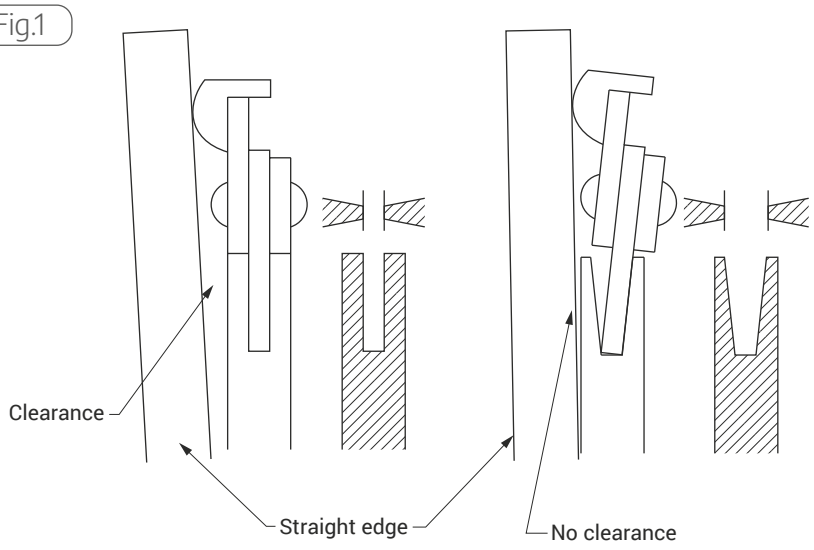


The finished tool

Of the methods that I found for closing the guide bar groove, one involves a v shaped tool that is placed over the part of the bar rail to be altered and hammered to close the rails groove, another method is using a hammer and a steel plate to close the groove by hitting the side of the bar against the plate. Both of these methods are a little brutal in my opinion and they don't seem to take into account the groove is a specific size for the chain's driving teeth.

The tool that I am going to describe and make, is much gentler on the guide rails, as it uses two ball bearings and a screw to push the bearings onto the sides of the bar to close the guide bar rails. This action pushes the two sides together gently as I run the tool up and down the rail and I tighten the screw as I go, checking the groove several times with the chain drive teeth.

Fig.1



Construction

The base

The first part to be made was the base. This is made in two parts and then welded together, the first part was cut from a piece of 38 x 16mm, finished 70mm long, the other part was cut to size from a piece of heavy angle as I didn't have anything else suitable and I

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Base

Blue and marking out

Drilling 10mm hole

Making the slot

didn't want the back part as thick as the bearing carrier. The finished size for this part is 30 x 10mm and 80mm long. The two parts were cleaned up with a file and then welded together to form an off centre tee, the welded parts are shown in **photo 2** after cleaning up with a wire brush and some emery cloth.

Now marking blue can be applied to help with marking out both top and bottom, and one end was treated with the blue as the holes are going to be marked out and drilled on these faces.

Once the marking blue is dry marking out can be done, **photo 3** shows the start of the marking out.

The single punch mark nearest the end on the right of the photo is for the handle, the pair of centre punch marks in front of this are for roll pins that keep the tool inline with the guide bar.

Also shown in the photo is the centre line, this will be used to keep the holes for the fixed bearing in position in relation to the two guide roll pins. The other bearing is movable and will be used to push the guide bar into line.

The first machining operation after the marking out is to centre drill the holes for the bearing bolts this was done on my mill/drill. So that the table of the mill/drill was not damaged, I put the 10mm in the drill chuck then lowered into the slot, moving the x and y axis to position the drill in the centre of the slot. After this I changed the drill to a centre drill, I then put the tee piece over the slots and using the centre drill to position the hole marking under the centre drill, then clamped the tee piece to the table. The centre drill was then over the fixed bearing position and the digital readout bar head was zeroed. The first hole was centre drilled with the centre drill then the table was indexed to the next two hole's positions and these were centre drilled.

The centre drill was then changed to the 10mm drill, **photo 4** shows the first of the three holes being drilled with the 10mm drill. There are two holes on the right hand side to be drilled for the slot and one on the left hand side for the fixed bearing.

After the holes were drilled, I then used a 9mm milling cutter to make the slot for the moving bearing and bolt to move in, so that the bearing can squeeze the rail onto the other fixed bearing. The cutter can be seen in **photo 5** making a start on the slot, after the two holes had a slot between them up I cleaned the sides to 10mm with the same cutter.

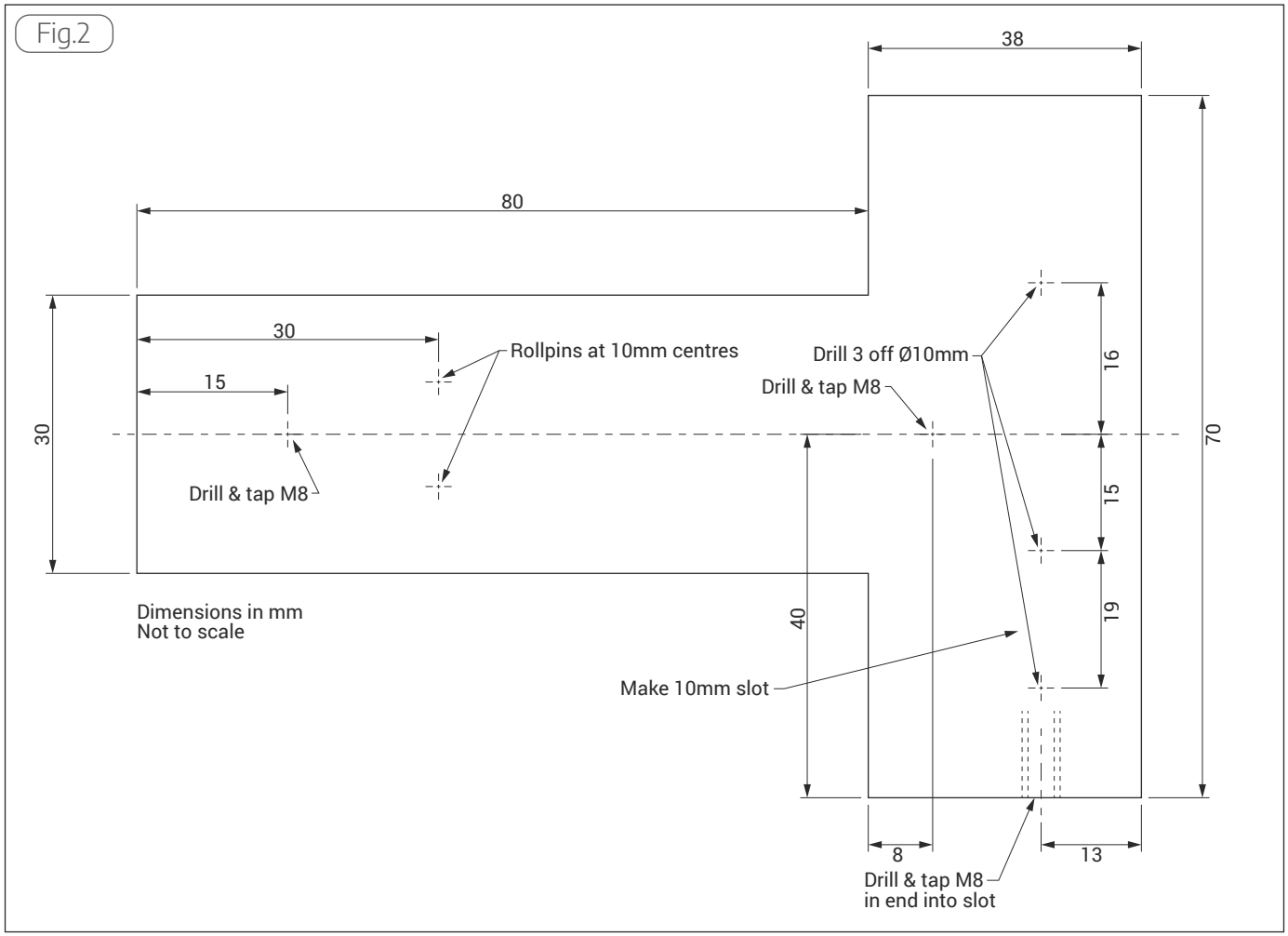
After the hole and slot were finished and the base was cleaned, I assembled the bolts, bearings and nuts to check that the moving bearing and bolt moved freely in the slot and that they closed the gap onto the fixed bearing as **photo 6**. The assembly was then stripped down and made ready for the rest of the drilling in the base.

The next drilling was in the end of the main block with the slot so that the screw could push the right-hand moving bearing bolt to close onto the other bearing. This was drilled on a stand alone drill press with it held in a machine vice to drill and then tap for the M8 screw. The other large hole in the back was drilled and tapped M8 for the pushing handle as **photo 7** shows, with the handle fitted the last two small holes in the back in front of the handle were drilled for 5mm for roll pins. The pins will be fitted after all the painting is finished.

The dimensions for the base are shown in **fig. 2**.

Testing the slot for fit

The pushing handle



Other parts

The push handle was made from 10mm diameter mild steel, 70mm long with a 10mm long section reduced to 8mm for an M8 thread to secure it to the back extension of the main body.

The tightening screw that is used to push the moving bearing was made from 8mm diameter mild steel, 160mm long with 35mm length of M8 thread on one end. The other end was rounded off in the lathe, the bar was then heated and bent to a 90º angle about 55mm along from the thread end.

The two parts were then cleaned and polished with emery cloth.

The roughly assembled parts are in **photo 8** showing the tightening screw nearest to the camera pushing the movable bearing over towards the fixed bearing.

All the parts made so far are shown in **photo 9** before the finishing and assembly is done. The setscrews that were supplied were supposed to be bolts, but the suppler doesn't seem to know bolts from setscrews, I will use them for now but if there is a problem I will change them to bolts.

Testing was done before finishing the tool with just the bearing bolted in position and the tightening screw and push handle fitted. It seemed to do a good job on an old chain guide bar, but it didn't get fully to the top. The solution was to put a screw in behind the rollers

Roughly assembled parts

All the parts together

The jacking screw and threaded hole

The jacking screw from the underside

Top side of jacking screw

on the centre line so that the rollers could be raised nearer to the top of the guide bar rail. With the raising or jacking screw behind the bearings it extends the range of the rollers so they can get to the ends of the guide bar rail if required.

The main body was marked out just behind the rollers and a hole was drilled for an M8 screw this was then tapped for the screw, **photo 10**.

With the hole threaded the screw was inserted and adjusted to raise the bearings up a little. **Photograph 11** shows the thread on the underside of the tool and **photo 12** shows the top of the tool with the setscrew and locknut in position.

The reason for using a screw was it can be adjusted for height and as it will get worn running up and down the chain bar it can be replaced with another one when needed.

Finishing

At first, I was going to paint the base and then blacken the handle and bearing push screw but I decided to paint these as well to stop rusting. The setscrews and nuts were plated and the bearings could have oil put on them to stop rust.

To paint the parts they were washed in white spirit to remove any oil or tapping fluid then wiped dry with a cloth.

To hold the screw and the handle for painting I drilled a piece of scrap wood with three 8mm holes and pushed the threaded ends of the handle and the bearing pusher in the holes. I then sprayed them with grey primer, to hold the base for priming I used a piece of M8 studding in the jacking screw hole and held the rod. It was then put in the block of timber to dry, **photo 13**.

The next day I sprayed the parts with orange gloss and left them to dry for a further day after spraying. The orange spray gloss was as I wanted something different to the normal paint I use, not realizing until after the paint dried that it was a good match for a German chainsaw manufacturer's tools.

Assembly

When the paint was completely dry I assembled the rail closing tool. I first put the roll pins in from the under side with a hammer and made them flush with the top face of the tool. Next was the fixed bearing with its setscrew and nut onto the base, I checked the bearing was still free to rotate. It was, then on to the moving bearing. This was then fitted with thread lock on and hand tightened and checked for free movement. Next part was the jacking screw with locknut fitted, this was roughly positioned as final adjustment is done when the is being used. The handle and bearing pushing screw were then fitted and the assembly is now finished. **Photograph 14** shows the underside of the tool with bearing and the guide pins at the back.

How to use the guide bar rail tool

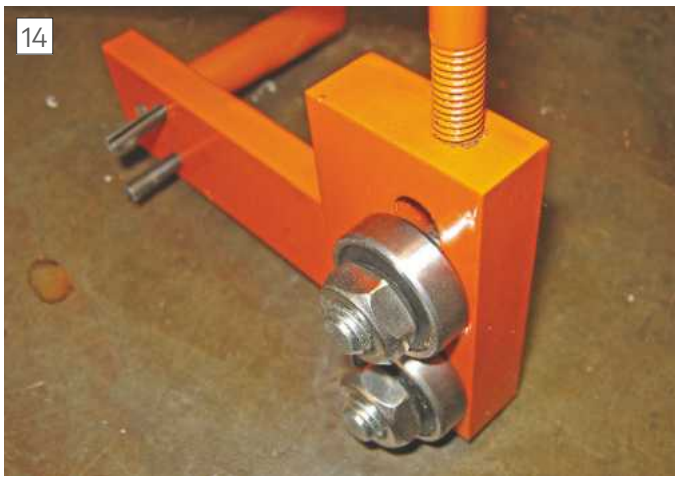
The first thing is to put on some heavy gloves - I use leather ones. This is important to stop getting your hands cut with the sharp edges of both the blade and the chain.

Now put the guide bar rail in the bench vice with the bar roughly centred in the vice as **photo 15**, and place the cutting chain in the blade's groove and check for rock of the chain in the middle part of the bar rail. This is where most of the wear will be as this the part that the chain runs on when it is cutting. Only a small amount of movement is required. If it is excessive then the blade tool will be required to close the groove.

To close the groove remove the chain and place the tool over the guide bar rail with the bearing open enough to fit over the rail then adjust the height screw so the front of the tool is just above the top of the rail, say 2mm to start as **photo 16**.

Now tighten the bearing screw so the bearing is tight against the bar rail then pull and push the tool up and down the

The parts primed and in the wooden stand



Underside showing bearings

bar rail if there is not a lot of resistance when moving the tool tighten the screw half a turn and go again do this until the bar rail groove starts to close. The end sprocket tip section will not require this, as the loading on here is not the same as the middle of the bar. Also, the end where the chain lead-in is will not require work as this is supposed to be more open to get the chain to run in the bar correctly.

Once the bar guide groove starts to close check the gap with the chain, if it is still loose tighten the clamp a little more and move it up and down again until most of the movement is gone. Don't make it to tight as this causes other problems, when you are happy with the first side turn the guide bar over and check the other side and if necessary, do the same on that side.

Tip: when using a chainsaw turn the guide bar over from time to time this will prolong the life of the bar and put off as long as possible the requirement for replacing the guide bar.

Warning it is very important that good gloves are worn to do this work as the edges can be very sharp and will slice a finger.

The guide bar in the bench vice

After closing the bar groove you may need to dress the edges of the inner groove this can be done with a flat file rubbing the inner the edges with it to remove any burrs. Do the top and the outer edges of the bar as well, a tool like in **photo 17** will do the job and keep the faces level and square.

Conclusion

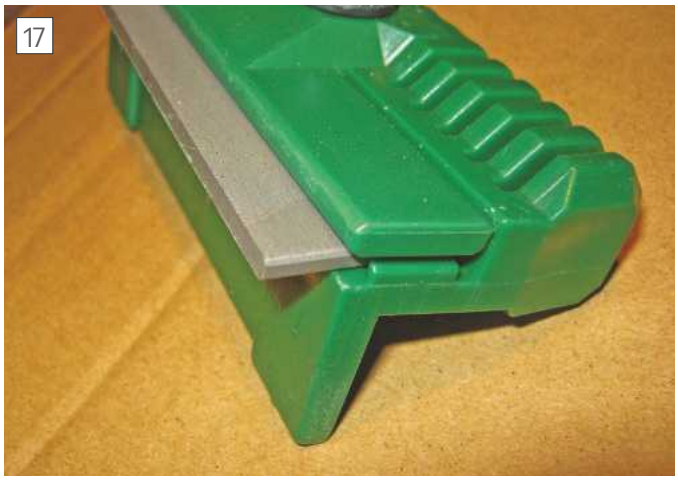
To make the tool I used a metal cutting bandsaw to cut the parts to size a welder to join the two parts together and a mill/drill to do the machining drilling and slot cutting.

It would be possible to make it without a metal cutting bandsaw a welder and a mill/drill if the metal was bought at size or near to size and the slot could be done on a lathe. The time it takes to make the tool is not a lot as I did it in between other work, I would estimate a morning to make it if you don't include the painting.

As to whether it is worth making for me it was (see the costing below) as I saved one bar that I was going to scrap also several other bars that would normally be replaced with new ones this tool saved the cost of a new bar for another few months.

The base material was from stock as was the round material the new parts that I bought in were two M10 nuts and bolts, two 2 bearings, primer and gloss paint a total cost of £13.95, so as you can see even if you factor in buying all the material, it would still be under the cost of a new bar. ■

Ready to start with height set



Bar file and holder

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Make a Lantern Chuck

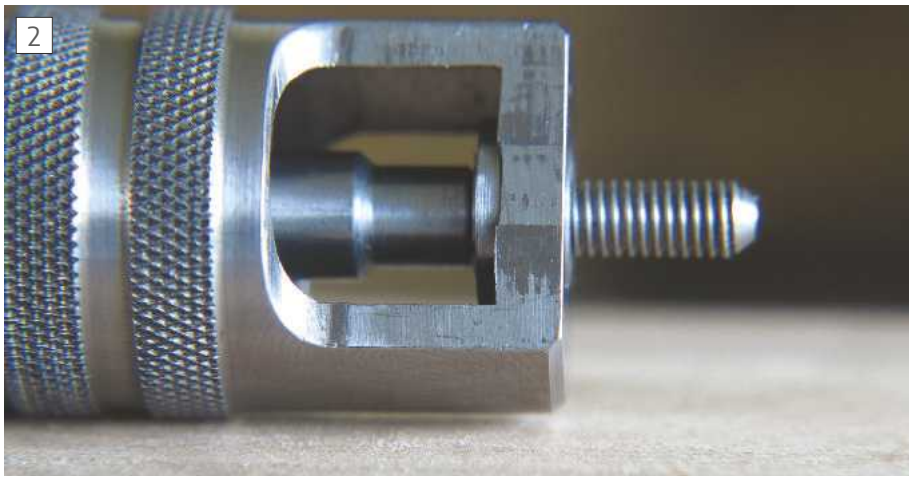
Bernard Towers explains how he got a grip on awkward small workpieces

Lantern chuck without a backstop or adaptor fitted.

This lantern chuck is an easily made accessory which will repay your time making it many times over, **photo 1**. The front part of the chuck screws on and clamps the head of a screw between a shaped backstop and an adaptor with a sized central hole, **photo 2**. If any of you have never had to modify or shorten screws and bolts and can't see yourself doing it then stop reading now! If both main parts are screwcut the chuck will hold screws with virtually no runout, **photo 3**.

The shank of the chuck is your choice, Morse taper or plain shank to fit in a collet, it's up to you. If you decide on a plain shank make the diameter to the larger size of the collet you use, I think you get better grip, **photo 4**. If you make the male part of the chuck body first, you will have a screw plug gauge when internally screw cutting the outer part of the body, **photo 5**. Make these as close a fit as you can. Do as many operations as possible on each part without disturbing it in the chuck to maintain concentricity.

The ability to use the main body of the chuck all the time and only have to fit different backstops (flat, concave etc.) and front adaptors has its advantages especially as the front adaptors are only a five-minute job to prepare and once made can be kept for future use, **photo 6**.



Screw fitted between backstop and adaptor.

An accurately sized adaptor ensures concentricity.

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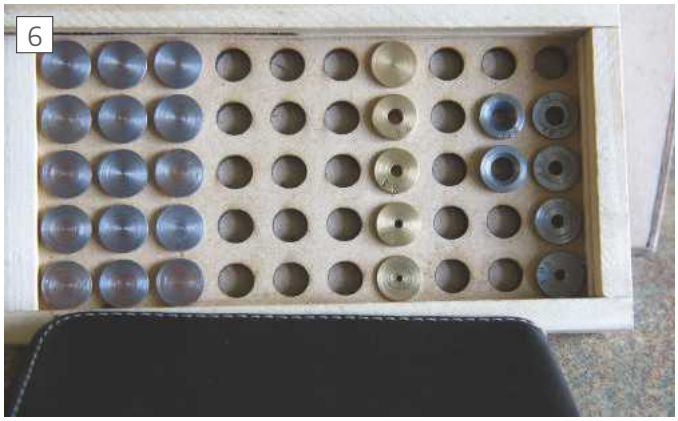
The shank's end hole takes the backstops.

The chuck body needs to be accurately screwcut to fit the shank.



Various adaptors, some not yet drilled to size.

The 5/16" reamed hole in the shank was done with a machine reamer so the hole is parallel to the bottom but if not available the first ¼" to 5/16" can be reduced by a few thou so the backstop goes to the bottom of the hole. Backstops can be double ended with either flat, concave or semi concave ends to suit the screws being worked on. Make the screw holders/adaptors, **photo 7**, a standard size so you can then measure off the front face of the chuck making the allowance for your adaptor and the front face of the chuck and machine your screws to the correct length without having to remove them to check the dimension. The big advantage of the backstops is that every screw gets locked in the same place so take note of the saddle reading and they will all be the same!

Just out of interest the material used is USACUT55 which is a more easily machined version of EN16T. The general dimensions are 16 mm shank (ER25 max) with a ¾" x 32 screwcut thread, the whole shank being 2⅝ins long. The screw cap has a matching internal thread and 1" diameter x 1 ¾" long. The use of a fine thread means that hand pressure is enough to hold the screw for what will be a light machining job. I do have a drawing, if anybody requires an email copy please contact me via the editor. ■

Adaptors hand stamped to show their size.

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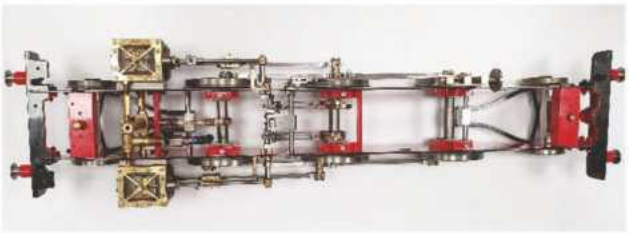

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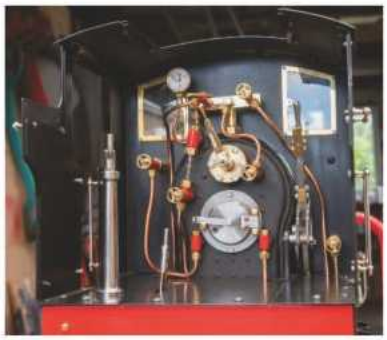

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