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Vol. 195 No. 4263

23 December 2005 - 5 January 2006

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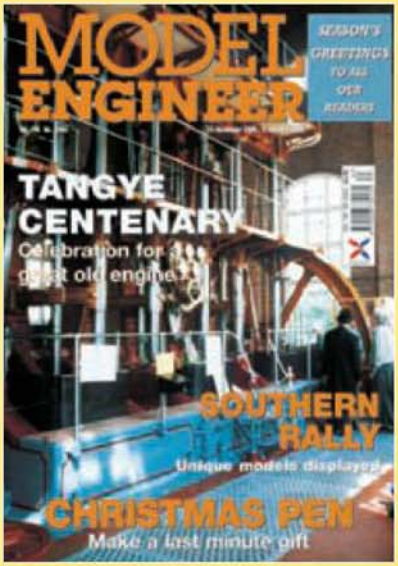

On the cover ...

Gerry Collins re-visits the Brede Pumping Station near Hastings in West Sussex for the celebration of the centenary of the Tangye triple expansion engine. It has recently been restored by members of the Brede Society, and is now finished in the original colours. Also on show was a great variety of stationary engines and tractors, as well as everything that goes with a pumping station such as the water meters. Visitors can now visit the station once a month.

(Photograph by Gerry Collins)

TURN TO PAGE 766 FOR DETAILS OF THE MODEL ENGINEER EXHIBITION

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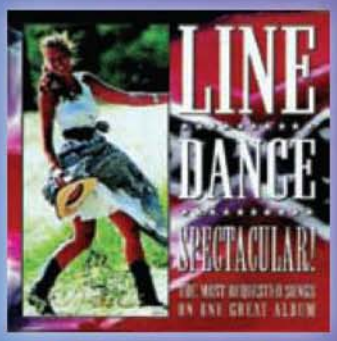

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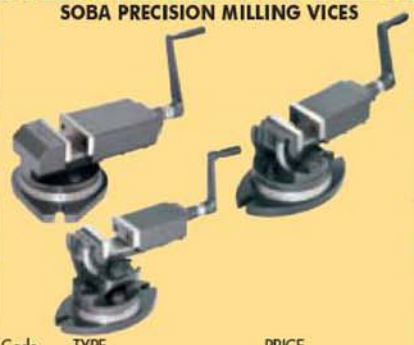

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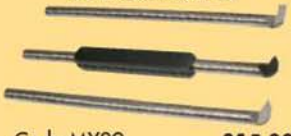

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SMOKE RINGS
With the Editors

Our Model Engineers

Working alone under his workshop light,
A model engineer creates, into the night,
Moving between his bench and the lathe,
That mighty machine is set to behave.

Attentively bent to a piece of turned steel,
He measures with care just how much to reveal,
This piece mixed with others; some made with brass,
To become a small engine, a standard first class.

For these little models are really unique,
Some run on steam, they appear antique,
Linkages, pistons that move up and down,
Drive wheels and gears, go round, and round.

Miniature engines built with great skill
To watch them in action gives one such a thrill,
The sound that they make - one thinks of the past,
When those engines roared, with energy vast.

Enough power to operate factories' or mills,
Water pumps, mining sites or giant drills,
Submarines propelled by an engine that's quiet,
Any form of transport needs an engine to drive it.
Part of a beam engine that really enthrals,
Is the lifting and spinning of the governing balls,
As it regulates speed by controlling the steam,
A sight also worth watching, is the sway of the beam.

One thinks with nostalgia and remembers the smuts,
Of giant steamrollers and train engines that putt,
Thanks to those model engineers out there,
We relive that past now, from our favourite armchair.

Valerie Kerr 04

POST BAG

An apology

In Post Bag, M.E. *4258, 14 October 2005 we published a correction and an apology regarding Mr. P. H. Lewis's letter relating to Doble steam cars. Unfortunately the gremlins have really had a field day because we apologised to a Mr. Newton not Mr. Lewis to whom we now extend our apologies for the original error.*

Mini sprockets

SIRS, - The Mini parts that James C. Wells is seeking are listed in current Moss catalogues, the small crankshaft sprocket is 8G725 at £6.50 and the chain is 3H2127 at £3.41. His nearest Moss branch is in Hanworth, tel. 020-8867-2020. Alternatively he could go to any classic car show and talk to the traders if used parts will do. Usual disclaimers!

H. N. Richmond, Bucks.

Small sprockets

SIRS, - One company Mr. Wells could try to obtain sprockets for his I/C engine (*M.E.* 4258, 14 October 2005) is Moss Europe Ltd. They have several branches throughout UK and Europe and supply components for a wide range of classic cars. His nearest branch would be Hampton Road West, Hanworth, Middlesex, TW13 6DB, Telephone 020-8867-2020, or e-mail **www.moss-europe.co.uk**

A quick look on their website suggests he may need part numbers 12G4337, 8G725 and 3H2127 which would set him back about £30 (inc. VAT). An on-line parts list may be viewed there or downloaded, or a catalogue may be ordered direct from them.

My connection with them is only as a satisfied customer with a 1949 MG TC which, coincidentally, you recently featured in a series of articles by Stephen Atkinson.

Graham Constant, Worcs.

Sleeve valve engines

SIRS, - Re: letter *"Sleeve Valve Aero Engines"* (*M.E.* 4257, 30 September 2005). I read Colin Usher's letter with interest, but alas there is little mystery about the lack of use of the sleeve valve for internal combustion engines. There are several reasons for this, the first is a long lived false reputation for unreliability caused by the use of purely reciprocating sleeves in early forms of the engine – particularly a certain model of 'Bentley' – these pre-1920s engines had a propensity for seizing and breaking off the drive arm. The plain reciprocating sleeve suffers from both lubrication and an over loading problem, the loading caused by the rather sharp reversal in operation.

Lubrication is cured by a part reversing rotation of the sleeve which with reciprocation spreads oil evenly between the sleeve and its cylinder.

Drive over-loading is serendipitously cured in part by the more gradual acceleration of the sleeve in the part rotary sleeves.

The second reason is purely cost as detailed by the tolerances quoted in Colin's letter, these are expensive to produce and the alloys used were also more expensive than that used in ordinary engine blocks. Very much the third reason is that this form of engine runs much more reliably when used at a constant speed, there are other very minor reasons mostly concerned with port timing.

I do not agree with Colin about the lack of oil consumption as many of these engines were rather inclined to smoky exhausts, particularly in road vehicles when on the 'overrun' until a good coating of 'coke' had reduced the clearances.

Readers wishing to read more about these engines are recommended to read: *The internal combustion engine* by Sir Harry Ricardo – still a standard work; *The Ricardo Story*, Sir Harry Ricardo and *Engines and Enterprise*, John Reynolds.

For some reason there is no mention in the book *Fedden* that Sir Harry Ricardo's company was used by Bristol Engine Co. to solve the sleeve valve problems and associated unreliability that arose from the original design. There is anecdotal evidence that the lack of acknowledgement of his contribution was a bit of a sore point with Sir Harry Ricardo, at the time Sir Harry was probably the leading exponent of this form of engine.

To see what was possible with such an engine read the details of the *Crecy* engine designed by Ricardo, it was probably the ultimate high performance aero engine.

There were a number of non-aero sleeve valve engines produced commercially, I have come across a 'Blackburn' 2-cylinder marine engine made circa 1912? A, or the, major lesson with all these 'ordinary' engines is never ever 'de-coke' them, by all means clean the ports but leave the cylinder and sleeve well alone. The usual result of a good clean up is the near impossibility of starting them again due to lack of compression and a horrendous oil consumption and production of smoke.

Peter J. King, New Zealand.

The 5 metre wingspan model of the Wellington DWI on display at Brooklands Museum in Weybridge, Surrey. Seen behind is the full-size 'R' for 'Robert' Wellington, recovered from Loch Ness in 1985 and now on static display.

Bar frames

*We have received a correction to two values in Dennis Monk's letter regarding bar frames (*M.E. *4258, 14 October 2005). The wheelbase for the 15F should be 35ft. 8in. not 35ft. 9in. and the traditional reciprocating masses should be 66 2/3% rather than 66%.*

Wellington bombers (1)

SIRS, - Regarding the recent correspondence about Wellington bombers in these pages, readers might be interested to know that there is a five metre wingspan model of the Wellington DWI, as this version of the aircraft fitted with the mine sweeping device was known, on display at Brooklands Museum in Weybridge, Surrey.

It was designed in the Vickers-Armstrongs Design Department at Brooklands over Christmas and New Year 1939-40! There were 15 such aircraft converted by Rollason Aircraft at Croydon.

George Edwards, latter Sir George, was responsible for both the Brooklands drawing office and workshops for the design, manufacture and installation of the first coils fitted to a Wellington DWI.

The magnetic ring was 'powered' by a Ford (later Gipsy Six) auxiliary power unit and this device successfully countered the threat to British shipping from enemy magnetic mines.

This model and a smaller but more detailed model, are displayed in the Wellington Hangar.

The Hangar also houses the 'R' for 'Robert' Wellington, recovered from Loch Ness in 1985, which has been restored for static display as the result of many hours of work by Museum Volunteers.

The Museum's website is **www.brooklandsmuseum.com**

Julian Temple, Aviation Curator, Brooklands Museum, Weybridge.

Wellington bombers (2)

SIRS, - Further to the recent correspondence in *Model Engineer* I enclose the following extracts from *Men with Wings,* by Sandy Powell, published 1957 by Allan Wingate (Publishers) Ltd., page 107 *et seq.*

"...In the early days of the war Hitler nearly brought Britain to heel with the magnetic mine. With remarkable ingenuity a method was evolved by which such mines could be detonated from the air. A Vickers Wellington was adapted for this purpose. It was known as the 'Halo' Wellington as it had a great circular electrical coil built round the wing tips and fuselage. The electrical impulses from the coil, it was calculated, would detonate a magnetic mine if the aircraft was flown over the mine at a height of some ten feet above the sea surface. The theory was one thing, but two things needed proving. First, the handling of a Wellington with this extraordinary device had to be established, and next, if the machine could be flown, someone

'Bruin' alias Group-Captain Harry Alexander Purvis.

had to find a magnetic mine, fly over it and see what happened. At a height of ten feet there was a grave risk that the mine would destroy the aeroplane when it blew up. The aeroplane went first to Boscombe Down where the handling was checked and from there the aircraft was taken to Manston Aerodrome in Kent. Bruin spent three months proving the device. When all the electrics were working properly there was only one method of finding out what would happen - locating a mine and flying over it at the lowest possible altitude. The Navy gave the experimental unit at Manston an idea where to find magnetic mines, but this was only a general location - there were none marked with buoys to signal their position!

...By great good fortune on one of the early flights Bruin found two and by even greater luck, despite the enormous upheaval when they blew up, the Wellington, though shaken, was undamaged. Those early trials must have required the utmost determination to press on; the risks were difficult to calculate. All the time they were skimming along over the sea in 'mined areas' they must have been waiting for the explosion which might shatter the aeroplane or at least damage a vital part of it, like the tail-plane, so that it flew straight into the sea. For this work Bruin was awarded the Distinguished Flying Cross, a decoration not often awarded for experimental flying."

'Bruin' was Group-Captain Harry Alexander Purvis.
Paul Murray.

More wobbling!

SIRS, - Re: wobblers on a concave surface. Mr. P. Williams wrote on the problem of using a wobbler on a concave surface. Malcolm Stride's comments don't actually address the problem of setting up from a concave surface. I have canvassed this at morning tea time at a track maintenance session, where the following suggestions emerged.

1. Set up from the flat surface (presumably machined) at the top of the diagram. This avoids setting up from the concave surface at all so may be discounted as not addressing the stated problem but would be my preference if possible.

2. While still set up for machining the curved surface, extend the radius and mark dimension A. Depending on the machining set-up this may not be possible.

3. Mark off the curved surface with odd leg callipers and set up to the scribed line.

4. Set up a piece of bar in the position of the edge finder in the diagram and use the wobbler against the outer surface of the bar. Add the bar diameter to A as the offset to use.

5. Use an optical centre finder or an ordinary centre finder plus magnifying glass on the edge of the curved surface and offset by A.
John Caldwell, New Zealand.

Using wobblers

SIRS, - In response to P. Williams and Malcolm Stride's request for reader's comments, I would comment that as a professional jig and tool maker I have several different types of 'wobblers', 'edge finders' and 'contact indicators' that I use at work every day, but only within the limits of their known inaccuracies. Generally they are quite good for finding the centre of a job from two opposite edges because the inaccuracies are cancelled out, but, they cannot be trusted for measuring by co-ordinates from one edge only. There are two main reasons for this:-

1. It is possible (or likely) that the chuck does not hold the wobbler absolutely straight, and that it rotates eccentrically, therefore, the wobbler will touch the edge of the work at one point in its rotation, but may be 0.1 or even 0.5mm away from the edge in 180deg. of rotation, thereby giving a zero point as much as 0.25 away from the true position.

To check this, a true round cylinder (say an 8 or 10mm dowel) should be held in the chuck and rotated by hand against the edge of the work. At one point in its rotation it will just contact the work, but if the chuck is not accurate it will be possible to insert a feeler gauge between the dowel and the work after 180deg. rotation to establish the amount of run out. Things should be better if the wobbler is mounted in a collet, as long as the collet holder or spindle is not damaged or bent.

2. If the column or milling head is not *exactly* 90deg. to the bed in the X and Y directions the edge can be zeroed with a wobbler, but when the quill is extended to allow a centre drill to reach the top of the work the zero could well be in a different place. (Sine of the angle of displacement of the head times the difference in quill extension for the two operations) This can be quite dramatically noted if a small centre mark is made with the quill fully out, then the quill pulled up to allow a long drill bit to be fitted.- It is very likely that the drill point will be offset from the centre mark.
Malcolm Sadler, Somerset.

Anno Domini and lighting

SIRS, - I have been following the various suggestions and ideas on the above subject with very great interest and following your request for suggestions I enclose brief details of my efforts on these lines.

Having purchased a standard long arm magnifying/lamp unit from Maplins, the usual clamping method of attaching the unit to the bench or desk seemed rather crude, so I gave the whole matter further thought.

A local vehicle scrapyard sold me a Mercedes truck wheel hub, which had sheared close the end of the axle where it joined the wheel hub. After heating the whole thing in a bonfire to relieve any stresses I was able to remove the remaining stub axle. Machining and boring a piece of low carbon steel, then welding this to the original hub and finally fitting some castors solved my immediate problem.

I've since realised that I now have a useful floor unit that leaves both my workbench and desk that much clearer as well as making the circuit boards that much easier to see.
James C. Wells.

Power in sheds

SIRS, - *The Tale of a Shed* (*M.E.* 4252, 22 July 2005) contains lots of interesting ideas on equipping a new workshop building and of course the fitting of an RCD to protect the electrics is very worthwhile.

I have RCD protection but I have it installed to protect the power circuit only so that if it trips the workshop lights still stay on, thus I avoid the situation of suddenly being left in the dark if I am working on a winter's evening. The lighting circuit is on a separate feed from the house so the power circuits can be shut off when the workshop is unoccupied, but 'lighting power' is available all the time for security lights/alarm etc.

If the house supply is protected with its own RCD, then the workshop RCD should be of a lower current rating, the theory being that the workshop RCD should operate first before triggering the house RCD thus avoiding plunging the whole house in darkness with resulting domestic agro. Does not always happen that way though but at least one has tried. This would not arise of course if the feed to the workshop has its own RDC in the main house consumer unit.

A Mercedes truck wheel hub from a vehicle scrapyard was the solution to James Wells' lighting problem!

One further thought on this matter which I will get round to myself - if one is installing a new control box in the workshop why not get one which is key lockable so that any unauthorised 'visitors' cannot switch the power on and play with the machinery.
David Bennett, Bucks.

Digital callipers

SIRS, - What is the basic principle used in the length measurement within a digital calliper? A very simple question I have asked myself, and friends, several times. Despite careers spent in high-tech industries none of us are sure of the answer. We can clearly postulate many possibilities but what method is actually used? I am sure that some *Model Engineer* readers will know and save my having to perform a destructive dismantling of a calliper.
Iain Miller, Fife.

Myford 'M' series

SIRS, - Re the latter from Mr. Burton concerning Myford Lathes (*M.E.* 4254, 19 August 2005), I am almost sure that the machine pictured is one of the 'M' series which had a rather limited production run.

This series had a coarse tooth gear train which was not applicable to any of the other Myford lathes. I have in my possession a similar machine, serial number J2002. My machine is lacking quite a few gear wheels and also the gear train cover. Should any spares become available I would restore the lathe. If not I would gladly help others with spares from mine.

So if Mr. Burton or anyone else interested in the 'M' series would ▶

care to write to me, I would be pleased to hear from them.
D. Shelton, Staffordshire.

Metric threads on a Myford lathe

SIRS, - In *M.E.* 4255, 2 September 2005, G. D. Hall seeks the perceived wisdom on the best change-gear combinations for cutting metric screw threads on an imperial machine. The definitive guide to cutting metric, or imperial, threads is *Screwcutting in the Lathe*, by Martin Cleeve (No. 3 in the Workshop Practice series). I sleep with it under my pillow!
R. O. L. Paterson, East Lothian.

More interesting and useful numbers

Inspired by Ted Wale's recent article (*M.E.* 4254, 19 August 2005), here are a few more thoughts on this subject.

First, the number 1.618

This number, known as the 'Golden Ratio' is usually derived from the result of dividing a line of length R say, such that the ratio of the whole line length to the larger part is equal to the ratio of the larger part to the smaller part. If the larger part is 1, then the smaller part must be R-1, so we have $R/1 = 1/(R-1)$. Multiplying both sides of this equation by (R-1) we have $R^2-R=1$ which is the same as the expression quoted by Ted Wale.

The solution to this quadratic equation is $R = (1+\sqrt{5})/2$, or 1.618 which is actually accurate to four decimal places, because the fourth decimal place is 0.

When a rectangle has its long and short side in the ratio of 1.618 it is known as a Golden Rectangle and this shape was seized upon in olden times as the most beautiful shape a rectangle could possibly be, and was elevated to 'Divine' status. Much literature was devoted to explaining that the outline of the Parthenon, the shape of Mona Lisa's face and many other examples confirmed this. The whole subject of the divine ratio is developed in an excellent book by Mario Livio called *The Golden Ratio* and well worth a read for those interested.

One would expect that if this shape is so favoured, then human kind would be drawn to designing rectangular objects to conform to this proportion, provided no other constraints were operating.

The 'A' paper sizes do not conform, having a ratio of 1.414, in order to maintain this shape when cut in half. On the other hand the credit card and the playing card conform much more closely. The old 'Foolscap' paper size was very close, being 8 by 13in. These numbers incidentally are both Fibonacci numbers.

It is the only number that can be squared by adding 1, and that can be turned into it's reciprocal by subtracting 1.

So much for one of the most interesting numbers.

How about some useful numbers?

When I was about ten years old, I was allowed by my father (Victor B. Harrison of gauge 1 fame) to do simple turning jobs on his Wolf Jahn clock maker's lathe. This had a full set of collets from 1 to 72.

I noticed that a 1/16in. drill needed a number 16 collet. This puzzled me. Furthermore a 1/8in. drill, twice the size, needed a 32 collet and so on. Having an inquiring mind at that age it eventually dawned that this phenomenon had something to do with the metric system, and the collet numbers were in fact tenths of millimetres. So therefore 1/16in. must be the same as 1.6mm. This turns out to fairly close, and was a useful rule of thumb during my school days.

In fact 1.6mm is actually 0.063in. whereas 1/16in. is 0.0625.

This relationship still comes in handy. When looking for a 1/8in. drill for instance, and only a metric selection is available, then a 3.2mm will suffice.

As my education progressed the need for a more accurate conversion was needed and the number 25.4 appeared on the scene. This turns out to be a very important number because it is the number of millimetres in an inch to a very high degree of accuracy.

The actual number of millimetres in an inch is quoted as 25.399978, so our figure of 25.4 is accurate within 0.000022mm, easily good enough for every day engineering requirements. So the number 25.4 is well worth remembering.

The next important number I have found to be 454. This is approximately the number of grams in a pound, (Actually 453.592). This sequence of figures turns out to be the number of litres in a gallon (4.54). Turning these figures around, we have a kilogram is 2.2 pounds (actually 2.20462) and a metric tonne is 2204.62 pounds, very close to an imperial ton.

So I commend committing these two sequences of three numbers to memory - 25.4 and 454.

At school when learning about the relationship between the circumference of a circle and it's diameter we come across 'Pi' which we were told was 22/7 near enough. This turns out to be not very accurate, working out at 3.142857, the true value being 3.141593 to 6 places of decimals. It was never the less good enough for working with slide rules as we did in my youth.

When a better value of Pi was needed, the following is a more useful fraction, and easy to remember.

Write down the first 3 odd numbers, repeating each one. This results in the following sequence 113355.

Make a fraction by taking the first three of these digits, putting them under the second three.

We now have 355/113. This works out to 3.141593, accurate to 6 places of decimals.

When setting out a right angle, it is useful to remember the 3-4-5 triangle. A triangle with these sides, or the same multiple of these numbers, results in a right angle at the junction of the sides measuring 3 and 4. This comes in handy when setting out the shuttering for a concrete base for instance. As most readers will know this is because $3^2 + 4^2 = 5^2$.

Incidentally I only recently discovered that $3^3 + 4^3 + 5^3 = 6^3$, which I find interesting, but have not thought of any practical use for it!

The square roots of 2 (1.414) and 3 (1.732) come in handy. 1.414 is of course the length of the diagonal of a square of side 1. When dealing with hexagonal rod, bearing in mind that a hexagon can be thought of as six equilateral triangles nested together, using Pythagoras we find that the distance across the flats is 0.866 (half of 1.732) of the distance across the corners.

The few numbers quoted above have served me well, and continue to do so, saving much looking up in reference books when making calculations.
John Harrison, Essex.

Neat cutting oils

SIRS, - Health and safety in the workshop are very important and a particular concern of mine is the effect on health of neat cutting oils and especially the smokey fumes that are given off during heavy cutting.

When I worked at the Machine Tool Industry Research Association in the 1970s we were asked to design an advanced grinding machine, based on university research. Despite the fact that the grinding ratio (the ratio of metal removed to grinding wheel wear) was significantly better for neat cutting oils, the universities, without exception had used water based soluble oils for their grinding fluids. This was because we were told that neat grinding oils caused cancer.

In the event we did use neat oil but designed a containment casing around the working parts to protect the operators.

My question is, are we at risk if we use neat cutting oils in our home workshops for turning and milling etc?
Neil Heppenstall, Cheshire.

NEW TELEPHONE NUMBERS

Please note that the office telephone numbers have changed.

The number for the editor, **David Carpenter**, is now **01689 899255**

Editorial Administration is now **01689 899222**

Colin Taylor is now **01689 899249**

Tony Robertson is now **01689 899250**

Fax number **01689 899266**

A PEN FOR CHRISTMAS

Anthony Mount
gets readers out of a tight spot at Christmas with an easily made gift

At Christmas time I sometimes make in the workshop, a few simple presents for close friends. Over the last few months I had received through the post a number of charity ball point pens. It crossed my mind that a pen can be quite a nice present if made in say stainless steel. The charity pens would supply the ink refills. Even if these are not available I noticed that in the stationary departments of several stores that plastic ballpoint pens were available at about £1.50 for 15pens, one shop even had 10 pens for 39p.

A few days later looking in the metal rack I noticed I had a few pieces of stainless steel about 150mm long and 8mm hexagon. Just right for a few pen bodies after turning down. It's not worth making a pen in economic terms but it was a challenge that appealed and they could be used as personalised presents for Christmas or birthdays. The result you see in the accompanying photograph. I engraved friend's names on them and they were well received, so I thought a short article in time for Christmas might get a model engineer out of a tight corner if he was stuck for a present for a loved one.

I did a survey of all the pens in the house and found they came in a variety of sizes and materials and most had a click mechanism for pushing the point out from the body, a further click retracted it. Have a look at the mechanism, it is much more complicated than you would think and involves some very clever moulding work in plastic. Something I could not replicate in metal, at least not easily.

The point can still be retracted in this design but the device is quite straightforward and should not present any problems to a model engineer. There are only seven parts in the pen to make, and **photo 1** shows a completed pen.

Let's make a start with the pen cap, as it is the most difficult part to make, all the other parts being quite simple. I have already mentioned that the body is made from stainless steel, I do recommend that you obtain the free cutting variety, as some grades are dreadfully hard to machine, otherwise the job instead of being a pleasure will become a chore.

I would not recommend other metals; mild steel will obviously rust, copper will quickly dull and brass can be affected by moisture on people's hands and can also affect some people's skin. Aluminium will be difficult to work, though Dural might be an alternative.

Ballpoint pen, parts list:

Part No.	Fig. No.	Description	Material	Quantity
01	02	Pen cap	8mm dia. stainless steel	150mm
02	02	Pen point	8mm dia. stainless steel	Part of 01
03	02	Clip lock pin	5mm dia. brass	25mm
04	02	Slider	5mm dia. brass	Part of 03
05	02	Pen body	8mm dia. stainless steel	Part of 01
06	03	Clip	5 x 1mm stainless steel	70mm
07	03	Spring	Bought in	One

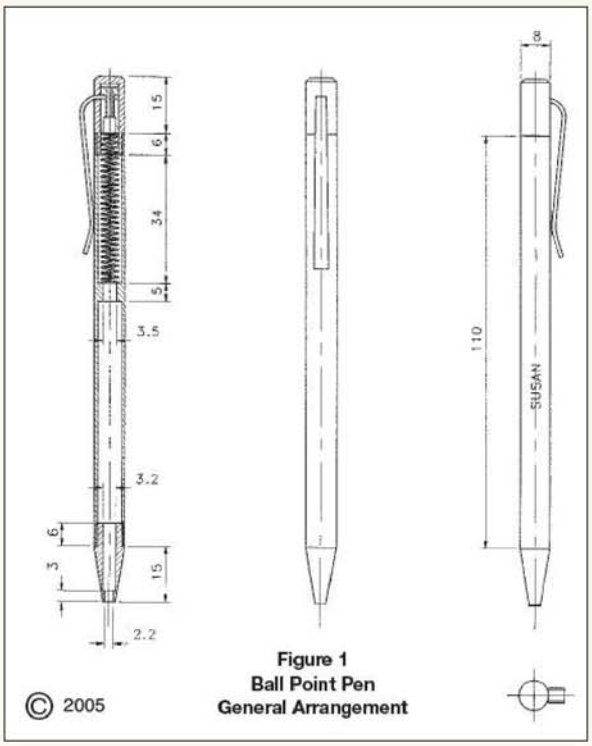
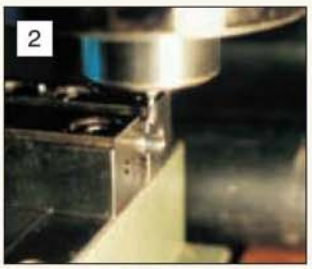
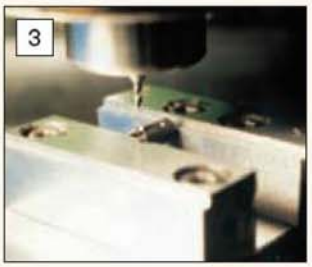


Figure 1
Ball Point Pen
General Arrangement





Part 01, pen cap

Hold a piece of 8mm dia. stainless steel rod in the self-centring chuck and face off the end. Turn down to 7mm dia. for a length of 6mm and thread M7. This is a standard metric non-preferred (third choice) thread and has a 1mm pitch. It is also available in 0.75mm pitch. If you have none of these try a 9/32in. thread, I have them in 40, 32 and 26tpi. Centre the end and drill down for a depth of 19mm at 4.5mm diameter. I have shown the hole as flat-bottomed but it can be left as from the twist drill. Try the spring in this hole; it needs to be an easy fit. If it is tight open it out slightly and adjust other parts to suit.

Part off, reverse and chamfer. Clamp horizontally in the vee of the jaw in the machine vice on the vertical milling machine, as shown in **photo 2**. Locate the centre line of the cap using an edge finder and co-ordinates. With a 2.5mm slot drill machine a slot 16mm long. I hope you are using free cutting stainless steel. But even so only use shallow cuts and cutting oil, as slot drills this size are easily broken. Also set up a stop on the table so you do not have to keep counting the turns and risk over running and breaking the slot drill.

Turn the pen cap through 90deg. and clamp by the ends in the machine vice on the vertical milling machine, this set up is shown in **photo 3**. Turn the machine vice so that it is at 45deg. to the horizontal centreline. Position the pen cap so that the slot drill is offset from the just machined slot by 2.5mm and is lined up with the shoulder, i.e. if you were drilling a hole the sides of the drill would just touch the shoulder and the slot. Machine a slot from this position to the vertical slot as shown on the drawing. Something that is easier to draw than describe. Remove all burrs. **Photograph 4** shows the completed cap.

Part 02, pen point

The pen point is also made from 8mm dia. stainless steel. Hold a length in the self-centring chuck and drill down 2.2mm diameter. Check this size with your own refills as I did find a slight variation of the diameter of the end parallel portion amongst those refills I had from different sources.

Counterbore to a depth of 18mm with a 3.2mm drill. Turn down the end to 7mm dia. for a length of 6mm, and then thread M7 or the alternative thread you may have choosen.

Screw the point into the pen body, chuck by the body and turn the taper. For this operation the top slide can be set over to 9 1/2 degrees. Polish the body and point.

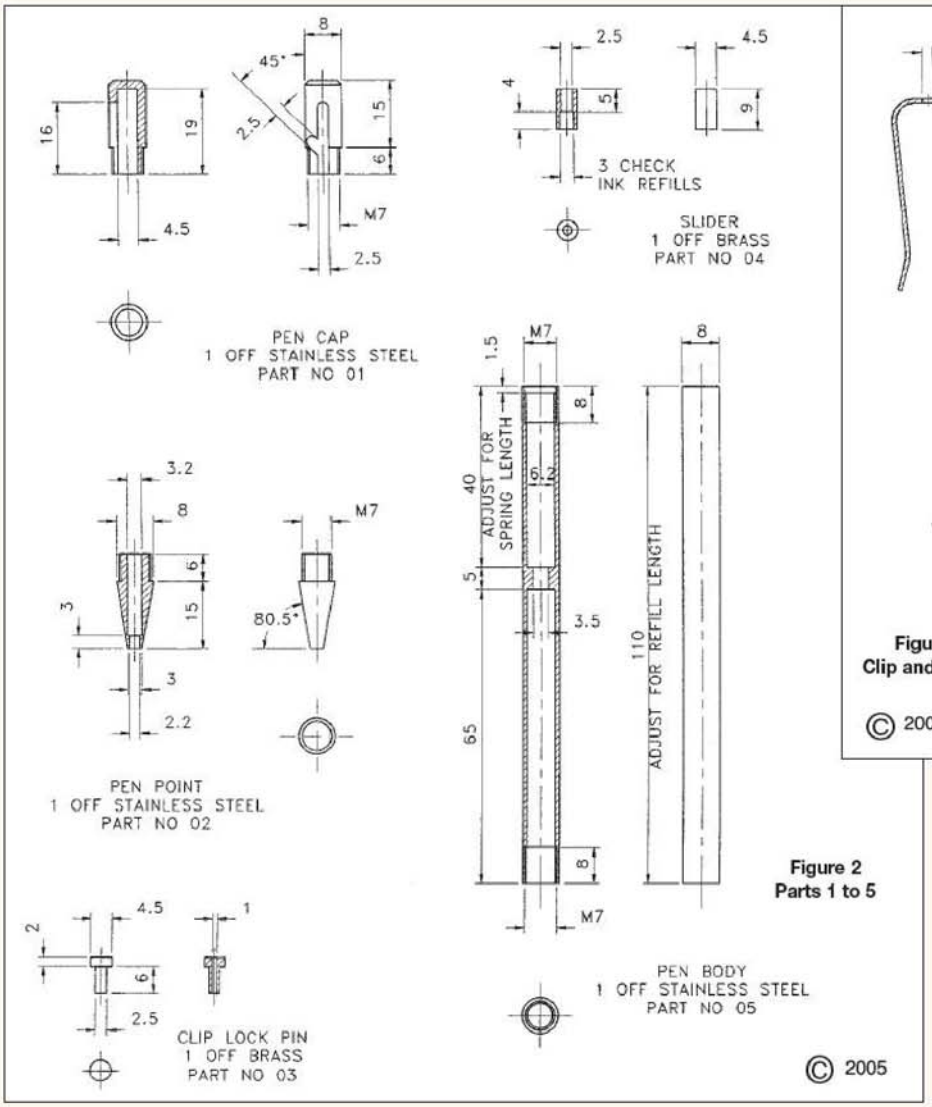


Figure 2
Parts 1 to 5

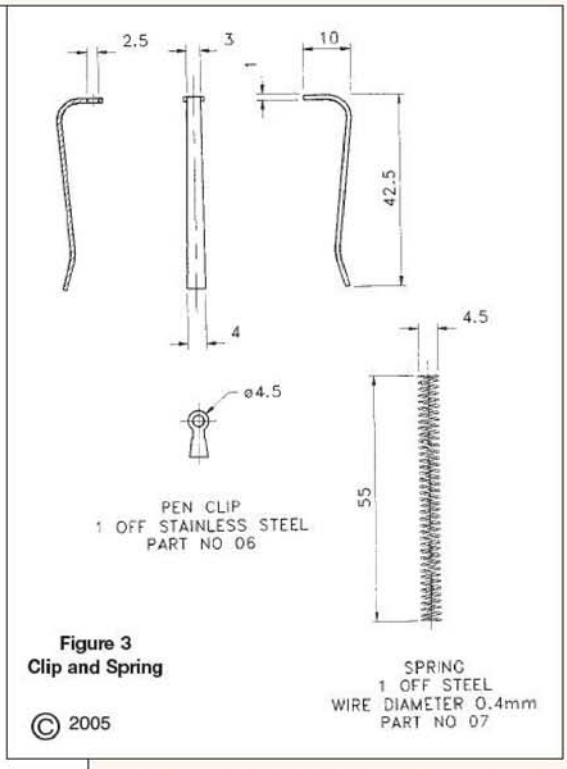


Figure 3
Clip and Spring

Part 03, clip lock pin

The clip lock pin is a simple little turning in brass. Turn down the pin to 2.5mm dia. by 6mm long, the head to 4.5mm dia., or slightly larger if you have had to open out the hole in the cap to clear the spring. Drill through 1mm dia. and part off with a head thickness of 2mm. I did not drill the 1mm hole in my first pen but found the ink sometimes stopped flowing. I think that with the tight fit of the refill in the cap I had created an air lock, whatever the cause the ink kept flowing when the hole was introduced.

Part 04, slider

The slider is also in brass, turn down to 4.5mm dia., or slightly larger if you have increased the diameter of the hole in the cap to clear the spring. Drill through 2.5mm and counterbore to a depth of 4mm at 3mm diameter. Check the 3mm diameter with your own plastic tube refills, they vary slightly. Drill to the smallest; the plastic can always be pared down to fit. The plastic tube needs to be a tight fit in the slider.

Part 05, the pen body

For the pen body we need another length of 8mm dia. stainless steel. Part off the material at 110mm long, another dimension to check, as the refill tubes can also vary in length. But do not make it too long or the pen will be unbalanced.

You will now need a long series drill of 3.5mm diameter. Drill down from both ends to have a clear hole right through. Then open out to 6.2mm dia. from both ends, forming an internal shoulder. At each end counterbore to 7mm dia. for a depth of 1.5mm and thread M7, or drill for which ever thread you might be using instead of M7. The little counterbore is to clear the part formed end of the thread on the cap and point at the shoulder.

Part 06, pen clip

The pen clip is made from 1mm thick stainless steel sheet. Cut off a piece 4.5mm wide and drill a 2.5mm hole at one end. File an eye around the hole, with a 2.5mm wide neck. Obviously the eye goes inside the hole in the cap and the neck slides in the slot. File the sides to taper from 3mm to 4mm wide.

Remove all burrs, lightly round the edges and clean up and polish all over. Bend to the section shown in the drawing. The bending is easily achieved with the aid of a pair of parallel closing pliers. The completed clip and slider is seen in **photo 5.**

Part 07, the spring

I did not want to make the spring and managed to find some at Bruce Engineering now part of Polly Model Engineering, tel. 0115-973-6700, they were of the right diameter but 300mm long so I had to be cut them down to the right length. They are nominally 3/16in. diameter by 0.018in. wire thickness.

Assembly

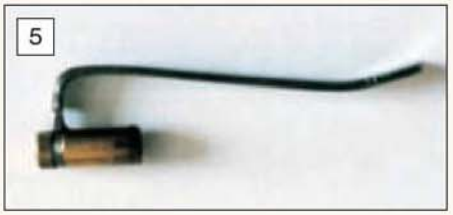
This is self explanatory, all the parts being shown in **photo 6.** Loctite the clip, slider and lock pin together, see photo 5. Push the plastic refill into the slider and try in position. Cut the plastic tube to length so that it is fully retracted when closed and protrudes about 2mm when pushed out. Fit the spring and try it for ease of operation. The thumb can push the clip up and down with the pen held in one hand only.

The finishing touch is to engrave the pen with the recipient's name. If you have an engraver this is not a problem, if you do not have one the alternative is to get it engraved at say a jewellers. But they may not want to do stainless steel.

Another way out would be to use letter stamps. You would need to make up a jig of some sort to get all the letters even and inline as nothing looks worse than lopsided lettering. Also it would be necessary do it before you drill out the body to avoid distorting the resulting tube.

Stamping the letters will raise burrs, so dress these down with a very fine file while running in the lathe. I should not need to mention it but you must use a good fitting handle on the file so that you do not jab yourself in the hand with the tang of the file.

So there we are a simple, but very enjoyable little job that may even earn you some Brownie points or perhaps even a kiss under the mistletoe from the right recipient!



LETTERS TO A GRANDSON

M. J. H. Ellis
measures with a spirit-level, mends a tap, and gives a history lesson
●*Number 83*

Dear Adrian, To begin with, I want to round off the account of the use of a spirit-level to compare the lengths of two bars in my last letter by observing that there are two possible sources of error, both of which can be corrected:

(1) The bubble may not be at the centre of the vial, even though the base of the spirit-level is truly level.

(2) The base on which the two bars stand may not be level.

Either of these errors can be detected by placing the spirit-level on the base-plate, noting the position of the bubble, and then turning the instrument round end-for-end, and observing if the bubble has remained in the same position. If necessary, the base can now be levelled-up until the position of the bubble remains the same; and as the base is now level, the bubble must now be at the true centre of the vial.

A further check can be carried out when the two bars are in place. The spirit-level is placed across the ends of the bars, and the position of the bubble is noted. The bars are now interchanged, and the spirit-level replaced as it was, i.e., without being turned round. Any change in the position of the bubble can result only from a difference in their lengths, since everything else has remained unaltered. In point of fact, the difference will be magnified two-fold, because if one end of the spirit-level is lowered by a certain distance, the other end will at the same time be raised to the same extent.

After-thoughts may occur to me later, but I think that I have now come to the end of what I have to say about what you might call the industrial archaeology of engineering metrology in Great Britain. I hope that you found the story an interesting one. Henry Ford may have declared *"History is bunk!"*, but I take the view that the present is simply the growing end of the past. The flower grows on the end of its stem, and, although it may be the more interesting of the two, without the stem it would not be there at all. Actually, to be fair to Mr. Ford, if it was he who founded the museum at Dearborn, it looks as though he might, not have said those words at all, and even if he did, he might have changed his mind later. If that were so, it would be nothing to be ashamed of. A politician, I don't remember who, was accused of saying something at variance with a view which he had expressed some years earlier. To this he replied *"That is quite true; but the fact that I have altered my mind is evidence that I have improved with further experience, and now have more mature judgement than I had then"*. I believe that he was quite right. You need to be much older than I am, to be able to say that you have nothing more to learn.

As it happens, I can give you a good example from something which happened only two days ago. We have had persistent difficulty with one of the bathroom taps (I think you would call it a 'faucet'). In the US, there seem to be as many patterns as there are bathrooms, but in the UK, for the most part, it is a screw-down valve, in which a hard rubber washer about 1in. dia. is pressed against a circular flat seat. See my sketch (**fig 1**). When they start to drip, it is for one of two reasons, or at least, so I thought. Either the washer has started to break up (most likely, because people have turned off the tap too tightly), or a narrow 'track' or groove has been eroded across the seating. If it is the washer, you replace it, and if it is the seating, you clean it off with a re-seating tool. Well, this particular tap did. not respond to either of the standard cures, which I had never known to fail before. I began to think that perhaps the re-seating tool had been screwed into the tap body on a crossed thread, and that the seating had now been formed on the skew, so that the washer did not seat on it properly. This last time, I had it apart again, and found both the seating and the washer in apparently good condition. I thought to myself, *"I will give it the treatment once more"*, and proceeded to get the washer off the stem to which it is secured by the nut and washer. The face A of the flange against which it was held was rather black and fouled as the result of having been in contact with the rubber, and so I started to clean it off.

Suddenly, the cause of my difficulties became apparent. An irregular track came to light across the face of the flange! Even now, I found it hard to credit that the water had been able to find its way past the washer by such a path, because, apart from anything else, the washer was quite a tight fit on the threaded stem, and I simply could not believe that it had been able to force its way past. But I put the piece carrying the washer in the 3-jaw in the lathe by its parallel stem, and cleaned off the face of the flange against which the washer sits, made and fitted a new washer, and, hey presto!, when I put it all back in place, the trouble had completely disappeared. Very pleasing indeed, but it recalled the words of a writer on the subject of obscure faults in motor car engines. *"Always"*, he said, *"after you have at last discovered the cause of the trouble, you see that all the time, if your thinking had been logical enough, the evidence was there to tell you what was wrong"*. In this instance, I was misled by the false assumption that the leakage must be taking place past the lower face of the washer; the assumption seemed reasonable enough, but it was, of course, false.

After that cautionary tale, it is time to return to the subject of metrology, this time nearer home for you, in the United States. You should know better than I do that they gained their independence from the wicked British government in 1782. No doubt they needed time to get their act together, so it is not surprising that a number of years elapsed before thought was given to the standards of weights and measures.

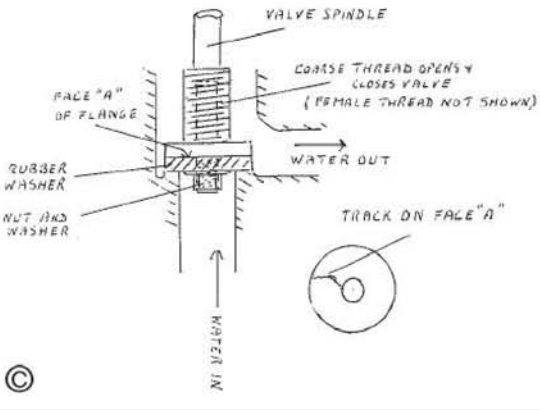
Ferdinand Rudolph Hassler was a Swiss engineer and metrologist who emigrated to the United States in 1805. He was appointed as the first Superintendent of the Coast Survey, which was under the jurisdiction of the Treasury Department. In 1830 he was asked to make an appraisal of the standards of weights and measures used in Custom Houses. At that. time, the standard of length was a brass bar, 82in. length, which had been made by Edward Troughton in London in 1813. It was graduated in inches, and it was believed (I'm not clear, why) that the distance between the 27th and 63rd graduations was equal to a standard English yard. For that matter, it was open to argument exactly how long an English yard actually was. You will remember that in 1760 John Bird had made a new standard bar, but it was not legally adopted until 1824. Consequently, the legal standard in England in 1813 would still have been Queen Elizabeth's brass end-bar of 1588. By 1830, the new bar made by Bird would have been made legal in England, but that was of little help if the US did not have a copy of it. To confound matters yet further, the prototype of the 82in. bar which they did have ceased to be available for purposes of comparison two years after Congress 'approved' the adoption of the 82in. brass bar standard, when it was destroyed in a fire.

There was a further complication, in that by 1792 the Metric System had been adopted in France, and during the following hundred years had spread to nearly all the developed countries of the world, with the exception of Great Britain and the United States. Of these, Britain approved its use in 1864, and the US in 1866, but in both cases its use was no more than optional. The opportunity had presented itself of equalising the British and US yards by adopting identical definitions with respect to the Metre. Unfortunately, it was missed. The Metre was legally defined, however, as 39.37 US inches. Had Britain done the same, much subsequent confusion would have been avoided, and I shall have more to say on the subject in my next letter.

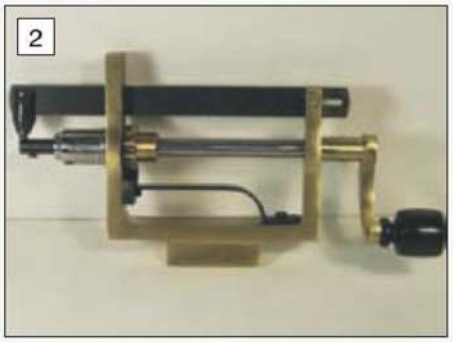
In conclusion, you may like to know that I have started work on my improved design of 'block and pillar' tool-holder for the Myford lathe. I will let you know how it progresses.

Your affectionate Grandpa.

Figure 1
Bathroom Tap



The mainspring winder that forms the subject of this article in its fitted case.



Main spring winder removed from the case and ready for use.

Necessary accessories for use with this type of winder are a selection of pliers.

MAINSPRING WINDERS

Ian Beilby

describes how to handle clock main springs safely.

●*Part I*

I think one of the most rewarding and enjoyable aspects of any hobby are the friends and acquaintances one makes along the way. People whose paths would, in the normal course of events, never cross find themselves meeting up and eagerly talking and sharing experiences all derived from their one common interest.

My main interest lies in clock making and obviously there are links between the clockmaker and model engineer. This link is far deeper than just the materials and techniques exploited by both hobbies. I often meet model engineers who have never made a clock, but possess a very good knowledge of clock mechanisms. I also know quite a few engineers who have carried out some very competent repairs although they would not profess to be all that interested in clocks.

There are occasions when like-minded friends contact me. Sometimes it is just for a chat but at other times it is when they are in the process of making a clock or have been asked to repair a clock. They may have a specific problem which requires an answer, or simply need an explanation or reassurance as to how to safely proceed with a certain task. Sometimes a simple explanation is all that is required in order for the penny to drop. At other times I have to explain that a specific, one-off tool is required. This tool may be well known to the clockmaker but perhaps unheard of by the engineer.

However, there is one question that I find myself being asked time and time again. What is the safest method of removing or inserting springs in barrels and is it always necessary to remove them? My reply is always the same: *"Yes, they should be removed for inspection and cleaning, and the only safe way to handle the spring is with a mainspring winder, a tool specifically designed for winding and unwinding clock springs."*

To the professional or even amateur clock repairer this tool is essential, and is regarded as a key piece of workshop equipment.

For the engineer who is perhaps only interested in making the odd spring driven clock, or who only repairs clocks infrequently, the purchase of a mainspring winder may seem an unnecessary luxury. However, believe me, to anyone contemplating working with clock main springs a mainspring winder is essential. As many model engineers do carry out work on spring driven clocks, or may eventually decide to make one, I thought readers might be interested in looking at some of the commercial mainspring winders available at the present time. This also seemed a good opportunity to discuss some of the issues involved in replacing and cleaning clock springs.

When overhauling a spring driven clock it is essential that the mainspring is removed and inspected. The lack of a mainspring winder often means that repairers ignore this essential aspect of maintenance. I am frequently asked to look at clocks that have been otherwise competently cleaned and reassembled, but still found to be giving trouble. In many cases the fault turns out to lie with the main springs which have not been removed and inspected. An old spring that has been encased in a barrel for perhaps over a hundred years becomes 'set' or 'barrel bound', and no longer performs as intended. A tired spring needs to be replaced if the movement is to function correctly.

The springs should always be removed and cleaned, and oiled when refitted in the movement. The springs should be washed in paraffin to remove any old or congealed oil and wiped with steel wool. Some main springs are very powerful and must be treated with great respect. Naturally, this leads to many people being afraid of working with them. However, with the correct tools and approach a respectful familiarity ensues, and they are no more to be feared than any other clock component.

Many amateurs resort to various dubious and unsafe methods when inserting and removing main springs from barrels, putting both themselves and the clock movement at risk in the process. For example, some amateurs attempt to wind the springs in and out of the barrels by hand. I say winding, but invariably, it is more a question of adversely pulling, pushing and twisting the spring in order to either remove or fit it.

Controversy rages over any likely distortion or damage to the spring that may occur with this method but to my mind there is no controversy over the safety hazards it exposes the operator and clock movement to. The edges or lip of the barrel are particularly prone to damage owing to contact with the very sharp edge of the spring when being wound in this fashion. Also when winding a spring by hand, the spring is in no way contained or controlled at any stage of the process putting the operator at substantial physical risk.

Another very important use for the mainspring winder is in the letting down and cleaning of new springs before insertion into their respective barrels. New springs when purchased from the material supplier are always dispatched safely wound up and contained by strong wire. A lot of people do not seem to realise that the spring must be released from the restraining wire in order to thoroughly clean and check the spring prior to being rewound and inserted into the barrel. Without the use of a mainspring winder to aid the controlled let down of the spring many people do not bother to check and clean the spring and simply half insert the spring in the barrel before cutting the wire. The result is a jammed spring half in and half out of the barrel. Again, without a mainspring winder exceptionally difficult to move one way or the other.

I have read of springs being lubricated before inserting them into the barrel, but I think that is a potentially dangerous practice. My preference is for the spring to be lubricated after being inserted and safely contained in the barrel. Capillary action ensures the coils of the spring will be adequately lubricated.

I cannot emphasise too strongly the need for caution and care when working with even the smallest and weakest of springs, strong gloves and eye protection should be worn at all times. I do not think there is any doubt that unless clock main springs are removed and replaced in a controlled and workman like fashion, at some point either the operator or the spring/movement is going to suffer.

To my knowledge there are three different commercial models available to choose from all doing the same job but each one in a markedly different way. All three different patterns work well and have their own advantages and disadvantages. Naturally, experienced repairers have there own preferences and will use the tool that best suits their methods of working.

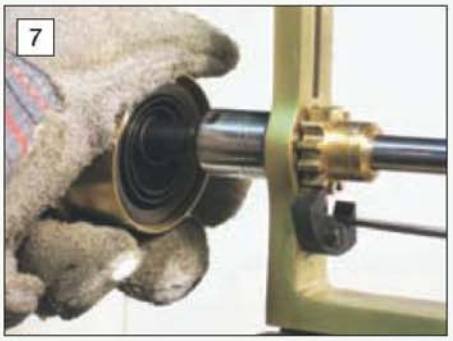
In this series of articles I have chosen to bench test three of the most affordable winders that are likely to be encountered by the amateur. Hopefully my descriptions and comments will convince the reader who carries out this type of work of the usefulness and the need for this tool, and will also be of help in guiding the prospective purchaser when making up his mind as to which tool to buy.

The first clock mainspring winder that I bought, and have now used for over twenty years, is made by Malcolm Wild. The pattern is that of the traditional English type of mainspring winder developed, I believe, from the watchmaker's spring winder. The first thing you will notice from **photos 1** and **2** is the quality of the workmanship that has gone into the making of this tool. The workmanship is such that you are almost reluctant to remove it from its lined box in case you damage it. It is an object of virtue in its own right. This is the case with all the horological tools made by Malcolm Wild. All the tools I have ever bought from him are exceptionally well made

Stout gloves should always be used when winding or unwinding clock springs

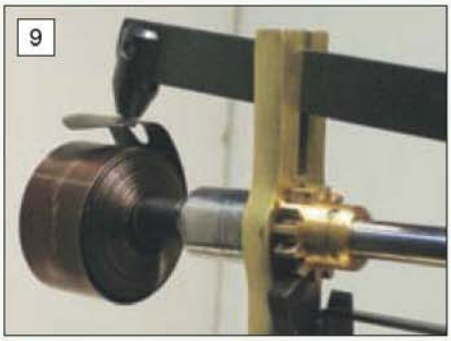
Selection of springs from the author's workshop chosen to demonstrate spring winding.

Specimen barrels taken from a 19th Century German barrel clock.



Winding up the spring in the barrel prior to its removal.

With the tail of the spring gripped by pliers the barrel can be removed and laid aside.



The hole in the spring tail can now be located on the hook and the pliers released.

and finished to a high degree. As you can see the winder has a solid cast brass frame and elegantly shaped handle made in the traditional style. A substantial brass ratchet wheel runs on a polished steel spindle, and a hardened steel click provides a very positive directional lock to the ratchet wheel. The click is in effect a double click, left and right, and is locked in place by a movable sprung lever, thereby allowing the ratchet wheel and spindle to rotate either clockwise or anticlockwise depending on the position of the spring. The steel hooking arm pivots from the back of the frame and is provided with two hooks of different diameters to cater for different sizes of mainspring.

Four winding arbors of different diameters are also provided, these are inserted into the main spindle and secured with an Allen screw. The winding arbors are all provided with a machined flat, and it is very important that the screw locates on the flat for a positive and secure drive to the arbor. When removing springs from barrels with this type of winder, you will require the aid of a number of different sized, fine nosed pliers depending on the size of barrel and spring being removed. A selection of the pliers that I use and also the type of strong gloves that I use can be seen in **photos 3** and **4**.

In order to demonstrate the winding and unwinding of new or restrained springs, **photo 5** shows an assortment of old springs from my workshop that I have previously wound for this purpose. As you will see they are all restrained with either wire or C-clamps, very much in the way you would expect to receive them from the material supplier. Some of these springs are quite old and perhaps past their sell by date but adequate for this purpose. I would reiterate, strong gloves, and eye protection must be used at all times when using any mainspring winder.

In order to demonstrate the removal of springs from barrels I am using a couple of typical barrels taken from a 19th century German mantel clock (**photo 6**). In order to remove a mainspring from a barrel, the winder is securely held in the vice and, depending on the size of spring, a suitably sized winding arbor is fitted to the main spindle and the correct size of hook is fitted to the hooking arm. The ratchet click should be positioned to allow the winding handle to operate in a clockwise direction. The hooking arm is moved out of the way and the spring and barrel offered up to the winding arbor.

The inner eye of the spring should be caught on the hook of the winding arbor. The barrel is then gripped firmly, and the spring wound up (**photo 7**). When the spring is fully wound the ratchet click of the spindle prevents the spring from unwinding. Still holding the barrel securely, a pair of suitable fine nosed pliers is then inserted into the barrel and the tail of the spring gripped firmly. The barrel is then rotated slightly clockwise to release the spring from the barrel hook. The barrel can then be removed and placed on the bench (**photo 8**).

The hooking arm should then be repositioned above the spring and the eye in the tail of the wound-up spring placed over the hook. The eye of the spring must be positively located on the hook (**photo 9**). The winding handle is then gripped and the position of the ratchet click reversed. The winding handle is then allowed to rotate slowly anti-clockwise, allowing the spring to unwind safely and in a controlled manner. A gloved hand may be required to help in guiding the spring (**photo 10**).

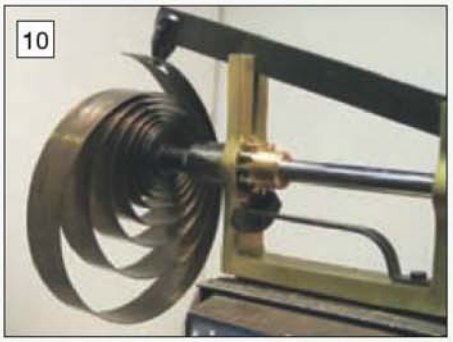
I am sure you will have realised that with this type of winder whilst the spring is held with the pliers the spring is not contained in any other way. You really have to pay attention to what you are doing all the time and not allow your grip to lessen and release the spring by accident. The force of the spring is constant, and your grip and control must be likewise. In all the years of using this type of winder I have never known a spring to break free from the centre. However, in a moment's lapse of concentration, I have known the tail of the spring to slip from the jaws of the pliers with startling and potentially horrific consequences. Whilst the spring is held with the pliers as demonstrated in photo 8 you and anyone else around you is at risk so your must be vigilant.

After the spring has been inspected and cleaned it is re-inserted in the barrel using the same procedure only in reverse order. The centre of the spring is located on the hook of the winding arbor, and the eye in the tail of the spring is securely hooked onto the hook of the hooking arm. The spring is then wound-up sufficiently for it to enter the barrel. Again some guidance with a gloved hand may be necessary to ensure the coils wind evenly. The tail of the spring is then firmly gripped with the pliers and released from the hook on the hooking arm. The hooking arm is then moved out of the way. The spring should be gripped approximately $1^1/2$in. from the end of the spring.

The barrel is then presented over the wound-up spring, the tail of the spring being firmly gripped by the pliers. When the spring is fully contained in the barrel, the barrel should be manoeuvred until the eye in the tail of the spring is hooked onto the barrel hook. The barrel should be gripped very firmly before the spring is released from the pliers.

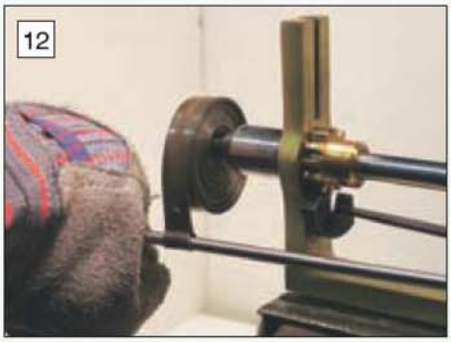
If for some reason the spring has not caught on the barrel hook, the spring when released from the pliers will expand into the barrel very quickly, and you must be prepared for this. The spring will then require winding in a clockwise direction until the eye in the tail of the spring catches on the barrel hook. When you are sure that the tail of the spring has definitely caught on the hook in the barrel, the barrel should be rotated slightly in order to unhook the centre of the spring from the winding arbor. The barrel and spring can then be removed from the winder.

This winder, as sold, is not really equipped to deal with loop ended springs. These are the types of spring fitted to American and some cheaper German clocks. These are open springs, not contained in a barrel. When in use in the clock movement the rivetted loop locates around one of the lower movement pillars, and therefore the tail of the spring is not provided with an eye with which to secure the spring to the hook on the hooking arm of the winder. When these springs are bought as replacements, or removed from the clock movement, they are usually restricted with the use of a C-clamp as can be seen in photo 5.

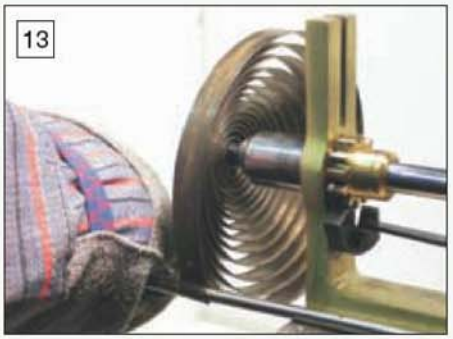


With the spring constrained between the arbor and tail hooks it can be safely unwound.

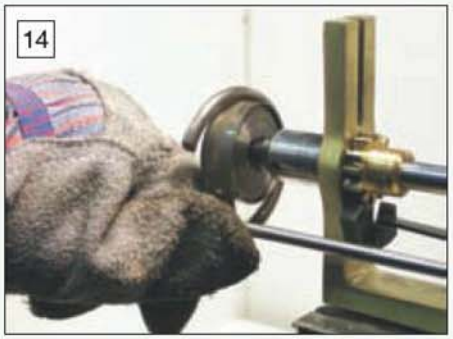
Loop ended springs can be dealt with by inserting a rod in the spring loop.



Once the spring has been wound sufficiently, the restraining C-clamp can be removed.



The spring can then be unwound in a controlled and safe manner.



When the C-clamp is to be refitted, wind up the spring, refit the clamp and reverse the ratchet.

Unwind the spring in a controlled way until constrained by the C-clamp.

The winder can be used to unwind these springs for cleaning and inspection by holding the spring near the loop with a pair of pliers, but a safer way is to insert a steel rod of sufficient length through the loop in the spring. The spring cannot then break free unexpectedly. The rod is firmly held in the hand as can be seen in **photo 11** and the spring wound up in the normal manner. When the spring is wound-up sufficiently to release the C-clamp, the clamp is removed (**photo 12**). Whilst keeping a grip on the handle of the winder and the rod, the position of the ratchet click is reversed and the spring can then be unwound in a controlled manner (**photo 13**). This is a bit of a three-handed job, but it is possible to access the ratchet click and keep a firm grip on the handle at the same time. Needless to say a firm grip must be maintained at all times on the rod and the winding handle until the spring is safely unwound.

The spring is rewound in the same way only in reverse order. The rod, which is placed through the loop of the spring, firmly held in the hand, and the spring wound up sufficiently to enable the C-clamp to be placed around the spring. In **photo 14** you can see the tightly wound spring and the C-clamp. Again, whilst maintaining a firm hold of the winding handle and the rod, the ratchet click is reversed and the spring allowed to expand fully until constrained by the C-clamp (**photo 15**). Only then can the steel rod be released and the spring removed from the winder. As long as you adopt a sensible procedure and maintain your concentration it is possible to safely wind and unwind these springs with this winder.

As I mentioned earlier, a lot of amateurs do not realise that, before inserting a new spring into its barrel, the spring should be let down in order for it to be cleaned and inspected. A new barrel spring when received from the material suppliers is always safely constrained with wire as shown in photo 5. It would be extremely dangerous to simply cut the wire and allow the unconstrained spring to unwind.

To unwind the spring a suitable winding arbor is fitted to the winding spindle, and a suitable hook fitted to the hooking arm of the winder. The eye in the centre of the spring is caught on the hook of the winding arbor and, using strong gloves, the spring is firmly gripped in the hand with the eye in the tail of the spring held uppermost (**photo 16**). Maintaining a firm grip of the spring, the inner coils of the spring are wound up until it is possible for the hooking arm to be lowered and the eye in the tail of the spring to be securely caught on the hook (**photo 17**). At this stage, should the spring slip from your grasp, it would still be safely constrained by the wire. When the spring is securely hooked onto the hooking arm, the constraining wire may then be removed (**photo 18**). The winding handle should then he held and the ratchet click reversed. The spring can then be allowed to unwind safely as previously shown in photo 10. All sizes of unconfined springs may require guiding with a gloved hand during these winding and unwinding operations.

I am sure you will have realised that, in order to use this winder safely, at several times the operator is called upon to hold or control the spring with the use of pliers. The operator must be familiar with all the procedures required and their correct order before setting out to wind or unwind any particular type of spring. It is therefore the skill exercised by the operator, which determines the safe use of this type of winder. This model of main spring winder is available from:

Malcolm J. Wild, 12 Norton Green Close, Sheffield, S8 8BP

It may be of interest to readers who enjoy making tools as well as repairing and making clocks, that in John Wilding's book 'How to make a Skeleton Clock' he details the construction of this type of mainspring winder.

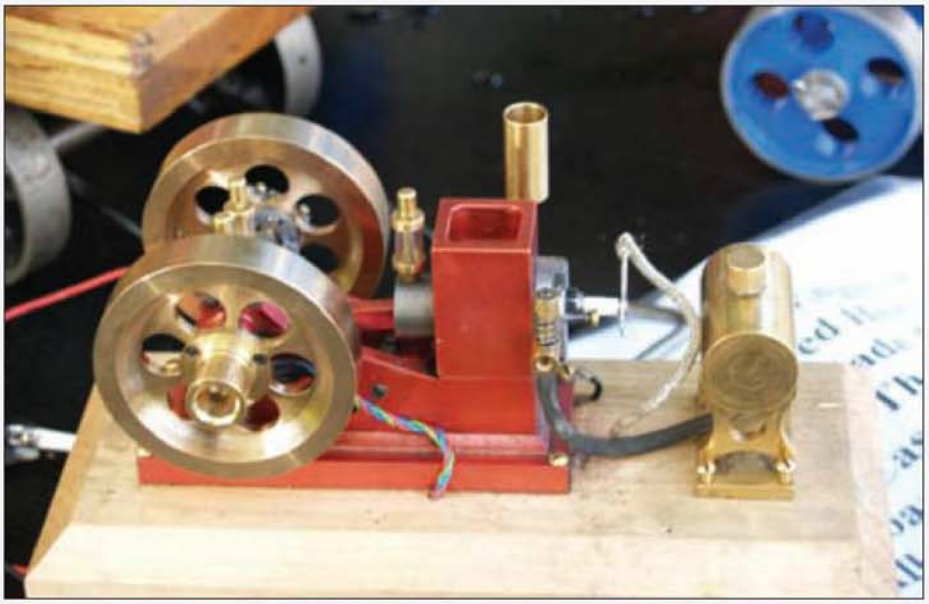
In part two of this series I will describe the use a different type of mainspring winder supplied by Clockspares Ltd.

●*To be continued.*

Fitting a new spring to the winder arbor for unwinding, cleaning and inspection.

Locating the tail eye on the spring winder's hook prior to removing the restraining wire

With the wire removed the spring in still fully under control.



A very small 'gas' engine, the **Little Angel** *by Alan Thatcher.*

SUPER SOUTHERN EVENT AT READING

High speed marine steam plant to the Alan Rayman design.

Malcolm Stride
enjoyed a super display of models at the Southern Federation Rally

This year the Southern Federation Autumn Rally was held at the Prospect Park track site of Reading SME. The host club had combined the Saturday Rally with an open day on the Sunday to make a full weekend of activity. This meant that those staying overnight could take part in the public running session on the Sunday and give the regular visitors a change of locomotives to ride behind.

Space does not permit writing about each locomotive running. There were, as usual, far too many to do that.

We, therefore, concentrate on displaying some pictures of some eye-catchers to remind those that attended of a very pleasant day, and it is hoped that those who didn't will be inspired to attend next year.

The site was a hive of activity on Saturday with both the raised and ground level tracks busy and other attractions set up outside. The latter included a marquee with a display of models of all types organised by John Billard who was the organiser of the model tent at the local Knowl Hill steam rally which has now sadly ceased.

The good weather certainly helped to boost everyone's enjoyment of the day and the usual banter was soon in evidence as people met up with old friends and acquaintances.

The Federation was represented by Chairman, Brian Thompson, and Newsletter Editor, Mike Leahy. This rally is also marked by the award of the Australian Association of Locomotive Society's shield for the best Commonwealth locomotive running during the day.

This year Barry Glover, Chairman of the AALS had made the long trip from down under to attend and presented the award to the worthy winner, Edgar Playfoot from Maidstone, at the end of the day.

Edgar's *Princess of Wales* is a very fine locomotive and was a worthy winner of the competition. It not only looked superb but ran like a sewing machine for several hours.

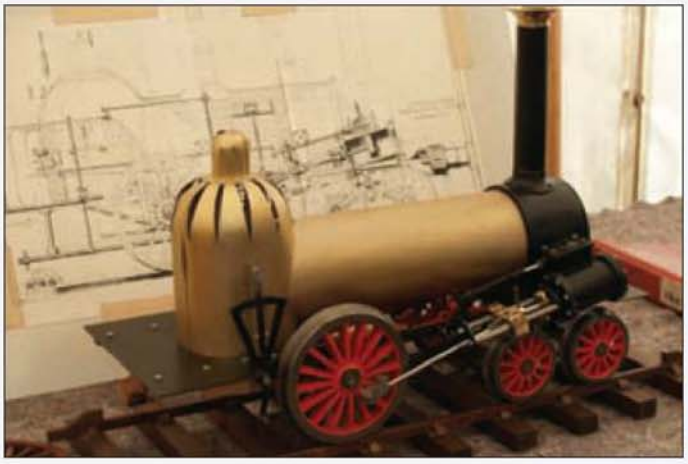
Among the more unusual exhibits was the Bungalyte engine from 1912, originally designed to provide electrical power for bungalows, hence ▶

Fine Burrell traction engine on display in the model tent.

Excellent GWR Saint which ran well on the ground level track.

An Allchin, to the same scale as the Burrell, on display in the model tent.

The unusual Stuart Double 10 powered Sentinel locomotive.



Norris locomotive chassis being built from original drawings.

Locomotive 4-4-0 No. 12 looking splendid in the sunshine.

the name. This engine was running all day in the sunshine and had as a companion a Lister single cylinder diesel engine.

Staying with I/C engines, the diminutive *Little Angel* horizontal engine produced by Alan Thatcher was on display with some of his other, larger, engines.

In the model tent the high speed steam plant from the straight running boats designed by Alan Rayman in the 1960s no doubt seemed unusual to those who weren't around the model boating scene in those days. This was also true of the V-4 flash steam plant in the same group.

It was interesting to compare the Allchin and Burrell traction engines, both built to the same scale. Several people were heard to remark that they were surprised that the Allchin was the larger of the two.

There were also two unusual locomotives on display, one was a Sentinel with what appeared to be a Stuart Double 10 as the motive power and

Bungalyte Engine running well.

LNER P2 **Lord President** *enjoying a run on the ground level tracks.*

Fine 7¼in. gauge Shay, once a mainstay at Knowl Hill.

Unusual 5in. gauge freelance locomotive from Maidstone.

the other was the American designed Norris 4-2-0 locomotive chassis. This had been fitted with a cardboard mock up of the boiler to show what the finished locomotive would look like.

Outside visitors were being entertained by the sound of Thomas Macey's 20 note Buskers organ being operated by Thomas's father Ian.

As for the locomotives on the track, the selection of photographs shows what a fine collection was running during the day. There was not a time in the whole day when there was not a driver waiting to get on one of the tracks for a run.

The organisers are to be congratulated on a splendid day which can be summed up very simply as *"a very enjoyable and good humoured day in the sunshine, doing what we all enjoy"*.

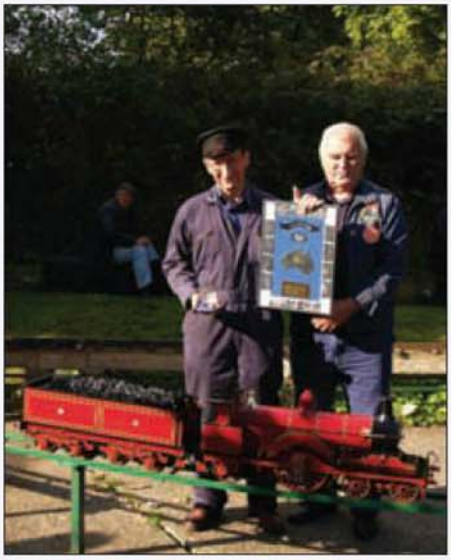
No doubt Brian Thompson and the Federation committee were been very pleased with the day.

As ever, the most important group in all this are those who look after the inner man (or woman) and thanks are due to those ladies (and gentlemen) who provided the refreshments during the day, where would events like this be without them?

Thanks are also due to Brian Thompson and Mike Leahy for their support. Also Barry Glover who came furthest of all to attend. Finally, thanks must also go to all the visitors from far and wide to participate in this excellent event.

Thomas Macey's 20 note busker's organ.

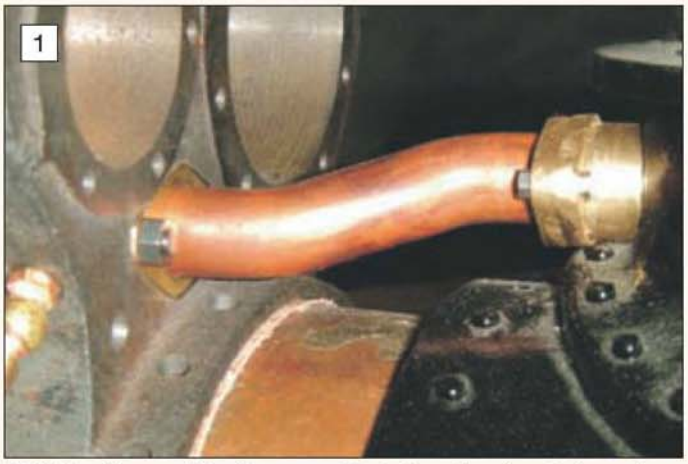
Les Dawson seen with his Atkinson six ton wagon. (Photo: Mike Chrisp)



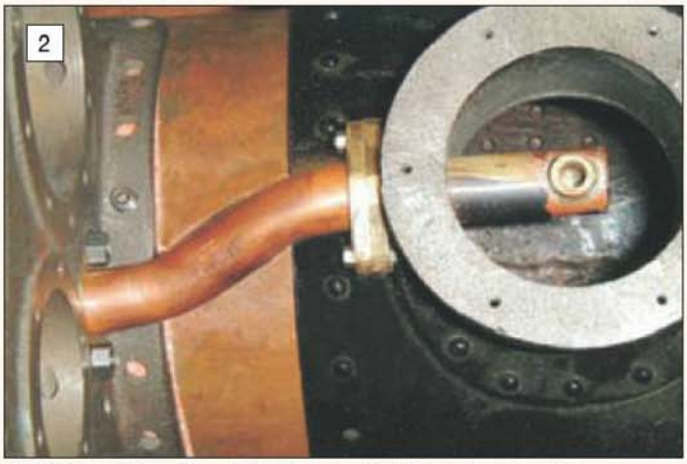
Barry Glover (right) presenting the AALS award to Edgar Playfoot for his fine Princess of Wales.

The nice 7¼in. gauge BR Class 2 tank from the local Amnerfield Railway.

A larger Burrell sitting simmering gently in the sun.



A tight bend accomplished in copper tube to form the exhaust pipe on the author's traction engine.



Aerial view of the exhaust pipe showing that it is, in fact, bent in two planes.

CHANGING HINDSIGHT INTO FORESIGHT

Mick Appleyard

completes his notes on pipe bending before discussing some other model engineering tools.

●*Part V continued from page 637 (M.E. 4261, 25 November 2005)*

My bending arm is made from 1/2 x 5/16in. bar, 6in. long and it has a 1/4in. dia. spindle hole midway across the width and 1/4in. from the end. A 3/16in. wide slot x 2in. long is cut in the arm 1/2in. from the spindle hole to take the roller. The roller is 1/2in. diameter and 3/8in. thick and is held onto the arm with a 2BA countersunk bolt. The bridge clamp is a piece of 1 x 1 x 1/4in. thick bar with a 1/4in. dia. hole in the centre for the clamp bolt. One thing to watch is not to crush the pipe when clamping it down. A packing piece will also be required for the free side of the clamp.

Bending the pipe

I anneal the copper pipe only in the area where the bend will be since, when copper is annealed, it is very easy to bend and any straight sections of the pipe run may not look right with small kinks in it. Fit the former to the table using the spindle; now fit the bending arm over the spindle. Place the pipe in the former and fit the slipper on the outside of the pipe and fit the anti-rotation peg in the hole. Turn the pipe until it touches the peg and fit the clamp if the position of the bend is critical. Now fit another slipper to the outside of the pipe and adjust the roller until it touches this. The arm can now be rotated to bend the pipe to the required angle.

Straightening an incorrect bend

First anneal the copper pipe. Now hold the pipe in the former by hand and gently straighten out the bend. Re-anneal the pipe and place a slipper on each side to the pipe and gently tighten in the vice. Reposition the slippers as required and gently tighten. Repeat as necessary until the pipe is straight.

Silver soldering awkward bits

A useful tool currently on the market for about £5 is called helping hands. It resembles a dial gauge stand and has a couple of adjustable shafts fitted with crocodile clips. It is ideal for holding items while silver soldering (**photo 3**).

Taps and why they break

One of the most annoying things that can happen, during the building of a model is to break a tap in a component which one has spent many hours making. If we try to understand the causes for this it will make you a little more aware and may prevent this from happening. I have detailed my reasons and their solutions below. From my experience the larger the diameter of the tap the less risk of it breaking so this should immediately ring an alarm bell if you are using a small diameter tap. Take extra care of the following points:

1. Taps are supplied by many different suppliers and each will give you the details of the tapping drill required for their tap. From my experience this tapping drill can vary a little between suppliers and just a couple of thousands of an inch can make a lot of difference on the small BA thread sizes. Since most of us (me included) use a standard set of tables for our tapping drill details, it is important that we recognise when this is happening. My rule of thumb is that if the taper tap does not start to cut after a couple of turns in the drilled hole using only light pressure then the hole is too small. Do not force the tap into the hole to start it. Open out the hole with the next drill size.

A helping hands device is an inexpensive but useful accessory for silver soldering awkward parts.

Sawing thin material can sometimes be more readily accomplished by using angle iron as guides and using the saw on its side.

Angle iron can also be used to make useful support bars for bending sheet material. Use different pieces to those for the sawing guide.

It is sometimes useful to grip one handle of tin snips in the vice to help give better control of the cut.

2. If the tap is not started square to the hole then as it gets deeper into the work it will try to re-align itself with the tapping hole. This will put unnecessary side ways pressure on the tap and will also cause larger metal chips to be made which may not pass up the flutes. Take great care when starting to tap the hole.
3. Not to rotate the tap too many times without backing it off to break off the chips. This then causes the flutes to become blocked and causes the tap to seize. With small taps the flutes are very small and therefore cannot pass much swarf. Be patient, half a turn forward and a quarter back and regularly remove the tap to clear out the flutes and the hole. The deeper the hole the more care is needed.
4. If the tap has become blunt it can generally be felt through the cutting action. Instead of feeling metal being cut the tap tends to feel tight even when backing off. It is better to throw the tap away and buy a new one rather than to have it break in the work piece. A blunt tap has no place in the workshop.
5. Metal cutting processes usually require a cutting fluid; make sure that the cutting fluid is correct for the material being tapped.
6. Carelessness, rushing and loss of concentration are the other main factors, which will cause the tap to break. Remember the hands can apply a lot of force to the tap and it is only by fully concentrating on the task that this can be controlled. Do not let the mind wander onto the next task before the tapping is finished. If you find this happening then stop the tapping to break the thought, do something else and then return to the tapping.
7. If the tap becomes jammed then the only way to free it is with gentle coaxing in small rotational movements. If you are getting nowhere then try turning the component upside down and giving the component a gentle tap to cause vibration to try to dislodge the chips. If you get frustrated then it is sure to break, so leave it alone and try again later.
8. Try to maintain an even torque on the tap and avoid bending it
9. The final thing is the tap not being tight in the tap wrench. How many times have we all been tapping a hole and the tap turns in the wrench? It can make you jump and break the tap. Do not be lazy, make sure that you tighten the wrench.

Cutting thin plate or bar

If you have trouble following a straight line while sawing down the length of a piece of flat bar or thin plate then the following sawing guide will assist you (**photo 4**).

Cut two pieces of 1 1/2in. or 2in. equal angle (size is not important) their length about 3in. wider than your vice jaws (this can be wider if required). Place them back-to-back in the vice jaws. The thin plate or flat bar can now be placed between the angles with the line to be cut in line with the top edge of the angle then the vice can be nipped up. You can now use the top surface of the angle to guide the hacksaw when cutting the plate or bar. Use the saw in the horizontal position applying slight downward pressure while cutting. By using the angles you will protect your vice since, with time, the angles will become scored.

Bending formers

Cut two pieces of 1 1/2 or 2in. equal angle iron their length say 12in. depending on the width of plate to be bent. Place them back-to-back and clamp together. Now drill a 3/8in. dia. hole at, say, 1in. in from each end and place a bolt in each hole. If you drill and tap one angle, and fit a stud instead of a through bolt it will help when you clamp the angles to the top edge of the workbench (with the plate horizontal). The thin plate can now be placed between the angles with the line to be bent in line with the top edge of the angle. The bolts can then be nipped up and the device held in the vice if required. You can now bend the plate over the angle. You could also use the formers for cutting plate however the disadvantage here is the fact that the top face becomes scored from the saw marks and this may damage the bent plate (**photo 5**).

Tin snips

If you have a pair of tin snips then cut a piece of 1/2in. bore, heavy gauge rubber hose and loop between the two handles, this will act, as a spring when cutting, opening up the jaws after each cut.

Another method of using these is to grip one handle in the vice at about 45deg. and use the other handle to do the cutting. This will give you more control over the cutting (**photo 6**).

Lapping and honing

Lapping is a process where metal is removed using a lapping compound. It is a very slow process and is used for final bedding of two components. Honing is a process where metal is removed with oil stones mounted in a carrier rotated at low speed. It is used to create a very fine surface finish in, for example, the bore of a cylinder.

Lapping

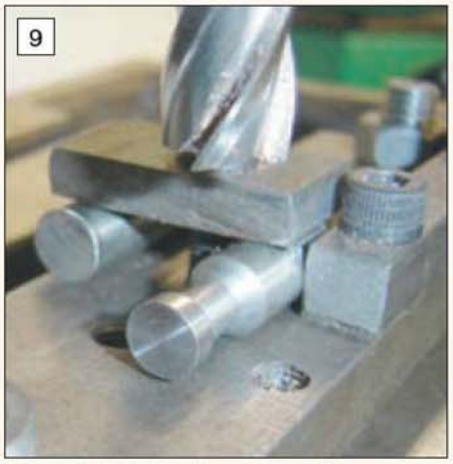
For the lapping process we use a lapping compound between either a component and a flat surface or two components, which require bedding together. These lapping compounds come in various grades and types. The grade will determine the degree of finish whilst the type must be matched to the material being lapped.

The lapping process is a slow one, so the better and flatter the machined finish the quicker it will be to lap the surface. The compound is applied to the surface to be lapped. This is then rubbed onto the lapping plate usually making a figure of eight motion oscillating it over the whole surface of the lapping plate or between the two mating surfaces which are rubbed together. If the process becomes stiff then add a tear drop of oil. Clean and inspect the surface from time to time and, when the surface does not have any machining marks in it and has a matt finish all over, apply the finest compound to finish off.

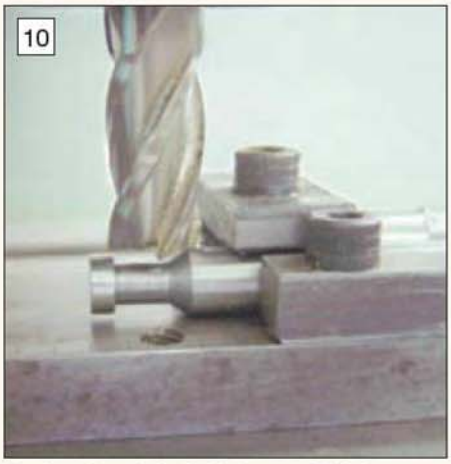
With most of the normal compounds they become exhausted with time and require regular changing. I find it easy to clean the compound off using paraffin. One can purchase a special diamond compound and this has an

Selection of D-bits made by the author. These are kept and carefully stored for future use.

An unusual D-bit devised to remove a broken 1/16in. drill from a work piece.



A view of the D-bit milling fixture with an embryo D-bit in position.



Another view of the D-bit fixture, which is fabricated from mild steel.

exceedingly long life and laps a lot quicker than the others. It can also be reused many times over so scrape it up and put it back in the tin. It is, however, very expensive.

Honing a cylinder bore

This is a process where three or more oil stones are mounted in spring-loaded carriers, which fit into an adjustable mounting frame. This is put into the bore and adjusted such that a light pressure is put on the spring loaded stones.

The carrier and oil stones are then rotated at a low speed of, say 100rpm, and oscillated up and down while honing fluid is applied. This fluid lubricates the stones and prevents them from clogging. Before removing the stones from the bore release all pressure on them otherwise the bore will be scored.

One usually starts off with a set of coarse stones and, once all machining marks have been removed, the stones can be changed to the finishing set. However, this will also depend on the final cylinder bore size. The stones will need to be purchased to suit the material being honed. The honing carrier, will also need to be sized to match the bores being honed, they usually cover a small range of diameters. The manufacturers will usually give full instructions on their use.

Removing a seized or rounded nut

The method I use for this is to cut or file down both sides of the nut taking care not to cut into the stud or bolt. Once the pieces cut off have been removed inspect the remaining part of the nut to ensure that it is not too thick. If it is file it down until you can just see the top of the threads. I then use a small chisel to remove the remaining pieces. You will find once given a sharp tap the nut will split in two.

D-bits

D-bits have many uses and can be made in any manner of shapes and sizes (**photo 7**), however the basic principle of manufacture will be the same. They are quick and easy to make and must be made of silver steel, hardened and tempered. The D-bits detailed are a simple type with no side clearances, they are meant for the odd job, however if one has a lot of work to do it is worth making one with built in clearances.

The cut out section must be half the diameter of the cutter when finished. Turn the outside diameter to that required, mill or file down to half diameter to required length, (I usually leave +0.004in. on the half thickness for honing before and after hardening). Note here that if you mill down the half thickness then use a very sharp end mill, as a blunt one will leave a ragged edge when the D-bit is sharpened. This may cause the tool to leave a poor surface finish and it may not want to cut at all. If you cut in the direction such that the first point of the cut is on the leading edge of the cutter (D-bit sitting on the right of the cutter) then if any burr is left after machining it will be on the trailing edge, which can be removed without effecting the cutting edge of the cutter.

Rub the machined face of the D-bit on an oil stone to obtain a good finish, make sure that you do not go below half diameter. Cut it to length and face off. Heat to cherry red and quench in cold water and clean the face with emery cloth. Re-heat to light straw colour and quench in cold water. Rub the face on an oil stone to sharpen the cutting edge. Grind the bottom cutting edge to give the clearance angle as required (usually 5-7 degrees). They usually work well in the tolerance range of +/- 0.002 on the half thickness. Note the smaller the diameter then the smaller the tolerance. I usually run them at low speeds and feeds and use plenty of cutting oil. I keep my D-bits in a tin for further use.

When making taper reamer D-bits, once the taper has been cut on the silver steel and it is removed from the chuck, then make a blank mandrel for setting up the angle for shaft manufacture in the future. It should be concentric to its centres with a taper say 3-4 times longer than the D-bit taper (this will make it more accurate). It should be made from, say, 1/2in. dia. bar, as this will prevent it from distorting. To use this, set it to run true between centres or in the chuck. Place a dial gauge in the tool post on centre and load it against the mandrel. Adjust the top-slide to the desired angle and run the slide up and down the taper checking to see if it reads zero at both ends of the taper. You are now ready to cut the matching taper. (It is always best to manufacture the shaft at the same time as the D-bit if possible, however by making the dummy shaft you are prepared if anything goes wrong). If you mark the D-bit and the mandrel with a unique identifying mark then they can always be paired up.

The fixture is used to put the flat on D-bits and ensure only the correct amount is removed.

Removing a broken drill using a D-bit

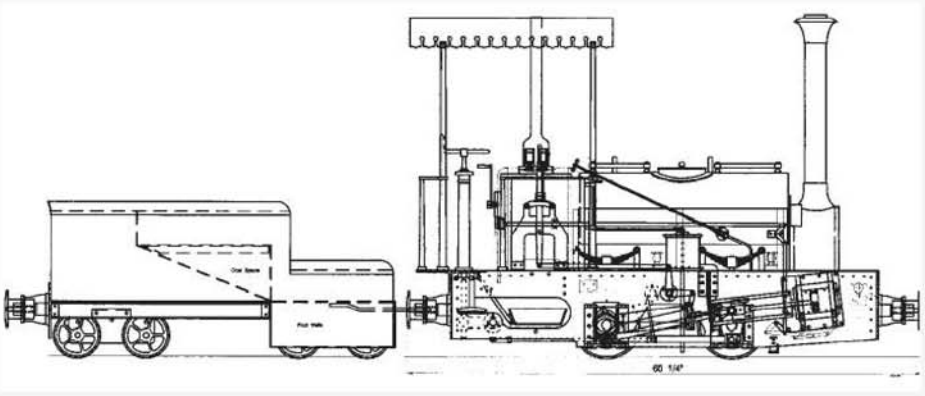
The best D-bit that I have ever made was to remove a broken 1/16in. dia. drill from a casting. I drilled a 0.070in. hole in a piece of silver steel, and then turned the outside diameter to 0.100 inch. The length was the minimum necessary to remove the drill. The D-bit was finished as above. I then carefully set up the D-bit to cut away the area around the broken drill. When cut away to the depth of the broken drill, the thin wall encapsulating it was wriggled around until it broke off with the drill inside. This prize possession is kept in my box of D-bits and brings a smile to my face each time I see it (**photo 8**).

D-bit milling fixture

This fixture needs no set up and is quick to make and use (**photos 9, 10 and 11**). Cut a piece of flat bright mild steel bar 1 1/2 x 1/2 x 6in. long for the base (the size is not important). Drill two holding down bolt clearance holes one in each end 1/2in. in from the end and midway across the width. Make a 3/8in. square stop and bolt it to the edge of the base using suitable bolts. Make a bridge clamp from a piece of 3/4 x 1/4in. bar 1 1/2in. long and drill a 1/4in. dia. clearance hole in the centre. Drill and tap the base 1/4in. BSF to take the bridge clamp bolt. This will be about 1/2in. from the stop such that the clamp aligns with the end of the stop.

To use the device, bolt it to the milling machine table. Place the D-bit to be machined against the stop with the section to be machined protruding past the stop and clamp using the bridge clamp. I usually use a piece of the same round bar used for the D-bit to act as the spacer for the bridge clamp. Now clean the underside of your cutter and lower it down onto the base of the fixture and set your index to zero. Now since we know the diameter of the D-bit round bar we can divide by two to get the centre height and raise the cutter accordingly.

●*To be continued.*



ANNA
A MANNING WARDLE LOCOMOTIVE FOR 7¼in. GAUGE

D.A.G. Brown and Mark Smithers
continue the description of the tender and driving trolley for *Anna* in the penultimate part of this popular series.

●*Part XXIII continued from page 628 (M.E. 4261, 25 November 2005)*

I suppose that you might argue that this description of the tender has been done upside down, since I started not at rail level but with the details of the superstructure. Believe me, there was method in my madness, since what I want to detail in this instalment should fit nicely end to end with the final conclusion of the series which will come in the next part.

Brake discs

The wheelsets, already revealed, must each be fitted with a brake disc, the position of which can wait until final assembly. This is a straightforward job from slices of 4in. dia. mild steel bar. The discs may be fixed to the axles by silver soldering, pinning or by means of grub screws; one thing is clear, however: upon braking with a deceleration of say 0.2g, the torque on each axle is considerable, since the effort is transferred from the discs to the tyres of the wheels. In this respect disc braked wheels are at odds with traditional brake block systems, in which the effort imparted by the brake block on the wheel circumference is transferred straight to the contact point with the track. Having said that, however, disc brakes are far more effective and economical of design.

Bogie components

The Bogie General Arrangement indicates where the various bits belong, so I shall just give a few tips about making them. They are mostly straightforward and a therapeutic exercise in coordinate drilling. If pressed, I might be persuaded to produce some laser profiles, but flat bar stock should be available for many parts.

For the Side Frames 3 x 5/8in. may be available, although you might have to settle for 80 x 16mm, leaving the odd 4mm or so sticking down below the bearings. As mentioned in part XXII, the bearing holes should give the self-aligning bearings a 'light sucking fit', the preference being for them to fit the axles snugly. You will note the two 3/8in. clearance blind holes which form a rectangular pattern with the bearings; these locate the brake mechanism and allow it to conform to the movement of the discs as the wheelsets accommodate to the track.

Next come the Stretchers. These are silver soldered from stock material, a tiny allowance being left for final machining to the length of 5.382 inch. The Stretchers bear on the Bolsters, grease lubrication being indicated for the mating surfaces.

Now we come to a slightly unconventional approach, the use of Disc Springs, or Belleville Washers to provide resilience between the Bolsters and the Bogie Support Beams. These springs are pressed accurately from stainless steel and give quite good damping characteristics. In the chosen size, each disc compresses fully flat to the extent of 0.022in., under a load of 174 pounds. Thus a stack of 10 discs pointed alternately up and down allow a compression of 0.220in. before going flat, a good value for our present purpose. Note: should the washers be stacked in twos, each pair pointing alternately up and down, this would double the load for operation, not relevant for our design (see **fig 1**).

I first used Belleville washers in industry when I was responsible for building pilot plants for ICI's new processes (in the days when they were an innovative company). The two clever chemists John and Dennis had dreamt up a process for making a new polymer, the forerunner of 'Victrex' which is now a successful outfit in its own right. Their brilliance had led them to boil up a mixture of nitrobenzene and sulphuric acid at high temperature and pressure (nasty stuff by any standard). The only material that would withstand the conditions was a glass lined steel vessel - no problem so far. However, this type of vessel could normally be sealed to work at only about 120deg. C, which was just over half of that required. Either the bolts would stretch or the glass lining would crack under compression, leading to particularly long faces of the chemists. Then I suggested Belleville washers as a means of limiting the forces exerted by the flange bolts. They were an immediate success and I was dubbed 'Mr. Belleville Washer' by John and Dennis, a tag which stuck with me until our ways parted.

Close fitting bolts just take up the slack in the washer stack between the Bolster and the Bogie Support Beam, keeping the Washers in edge contact with each other, whilst permitting vertical movement in the supports.

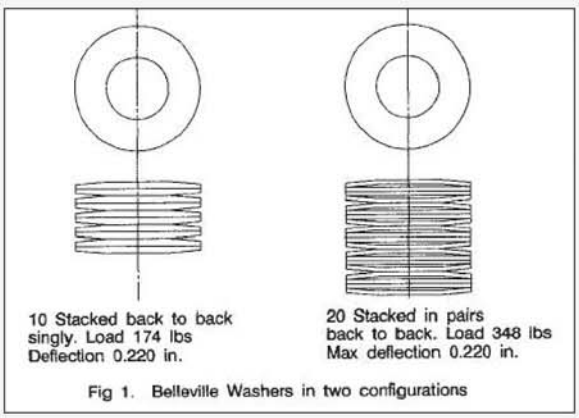


Fig 1. Belleville Washers in two configurations

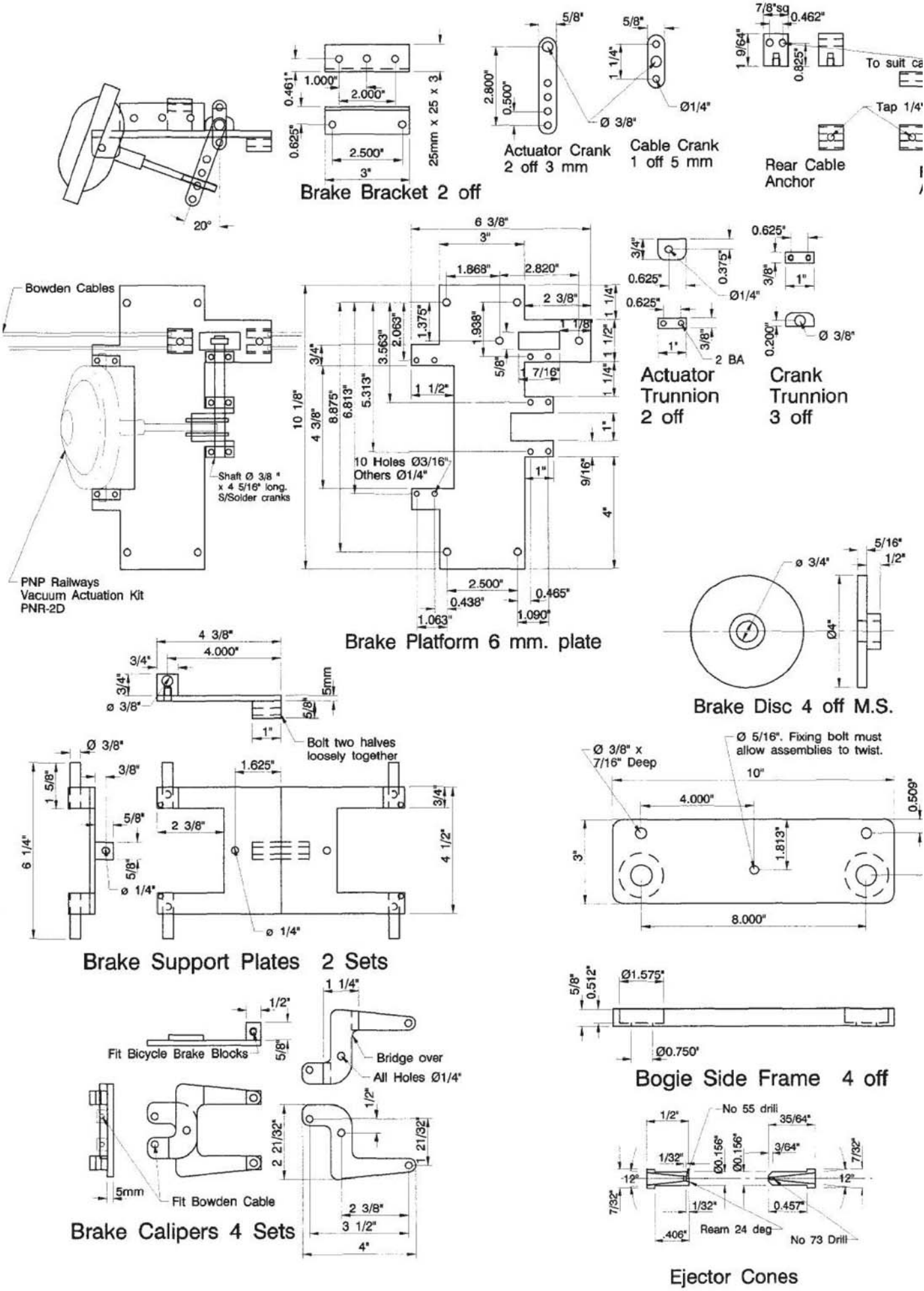
The Front Bogie Support Beam has a centre hole drilled for the Drawbar Pin, and four 5/16in. holes set in from the corners, which take 9/16in. long spacers to mate with the holes in the 3mm Floor Panel of the tender. The Rear Support Beam has no central hole and the 5/16in. holes are nearer the corners for fixing to the Rear Bogie Brackets, which were detailed in part XXII. In fixing the rear bogie Support Beam to its angle, pack up above the Rear Bogie Brackets to leave the same 7/16in. gap as for the front Bogie.

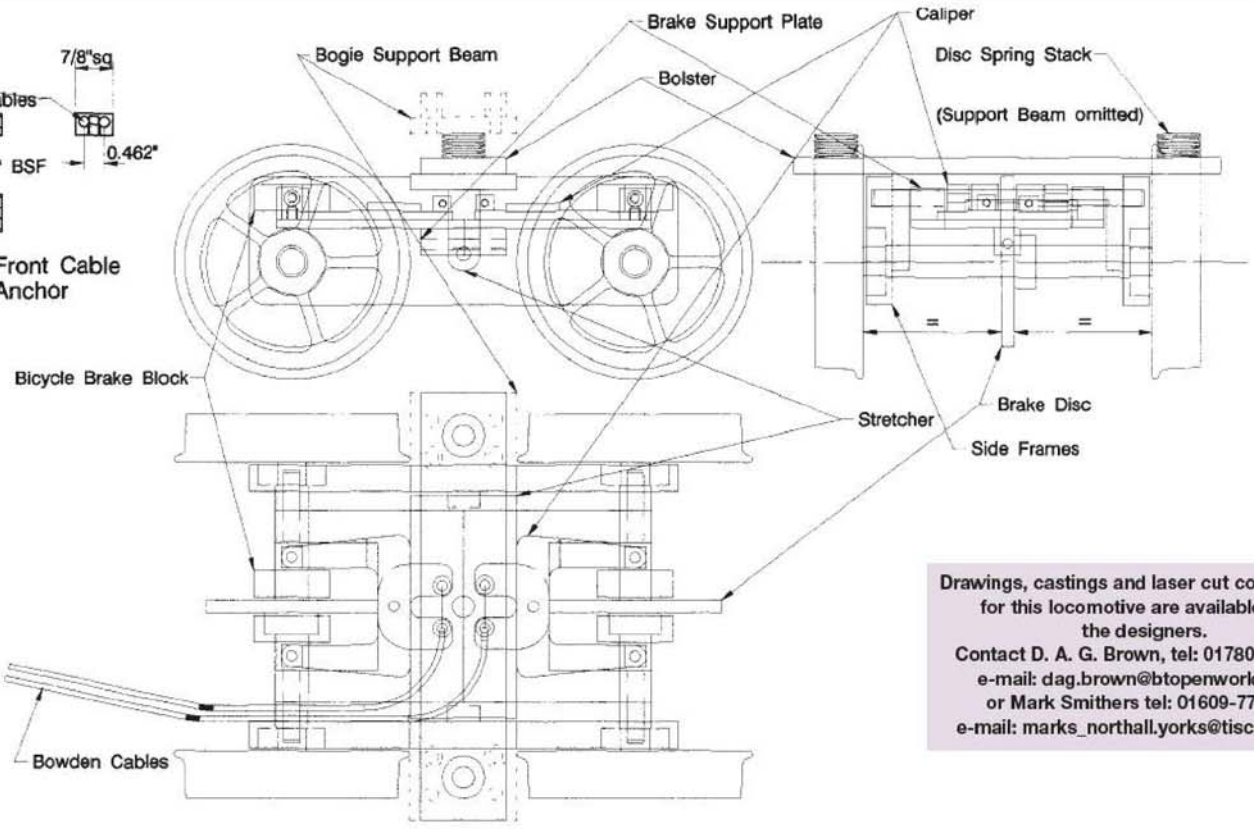
Braking system

I have chosen to use bicycle brake blocks of the most basic modern type for the job of gripping the discs. On a recent visit to Halford's local branch, my eye was taken by a neat, slim, brake disc. This was almost a miniature version of those fitted to my cars; but then I looked at the price tag for the brake blocks - £14 a pair. Alongside were various offerings of more traditional patterns, some claiming to be 'non-fade', specially designed for boy racers. Almost in the shadow was a pair of bog standard blocks at under £2 a pair; I did not have the heart to ask for quantity discount, but it should not break the bank! I leave the fixing to your good selves, according to the actual model on offer, but note that modern blocks are moulded within the metal shoe, or in other words, they will not pop out upon reverse braking, as they would have done on my Raleigh *Lenton*! How times have changed.

Returning to the GA of the bogie, each assembly is fitted with a two-part Support Plate, bolted together so that the two halves can twist as the bogie articulates. Each half is just a U-shaped piece of 5mm plate with the 5/8in. square pivot silver soldered in place, before final machining of the bolting faces. At the other end of the plate, 3/4in. blocks carry stub shafts, which ride in the Bogie Side Frames. At least one of these blocks must be bolted to the Support Plates otherwise it would not be possible to fit them after erection! The 3/8in. dia. stubs must be an easy fit in the Side Frame holes, with a little side play.

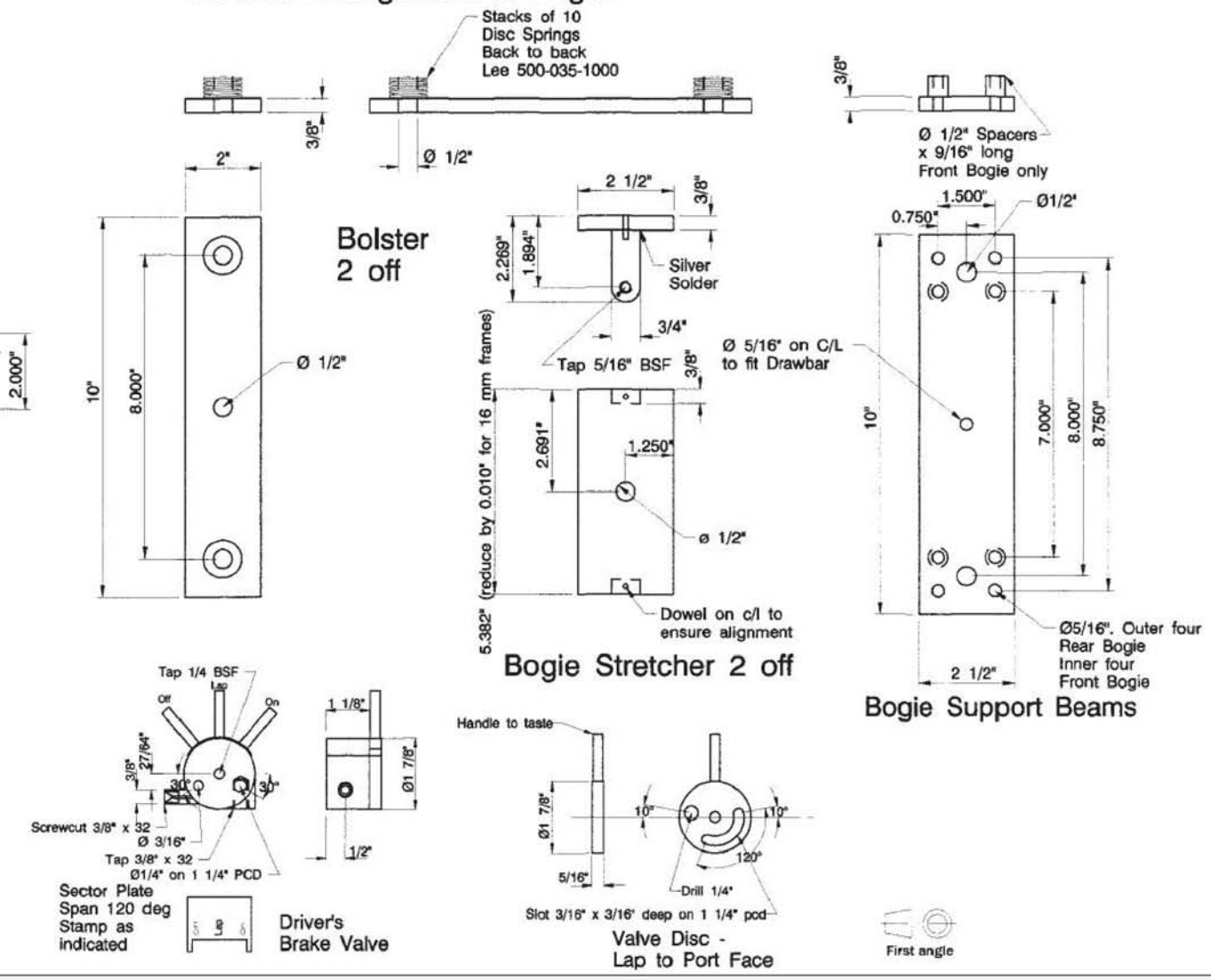
On top of the Support Plates, pairs of Callipers carry the brake blocks, as already discussed, the two halves being subtly different to enable them to nest, as drawn, in the same plane. I would recommend fitting a washer under the Callipers, in order to keep ▶


20°
0.461"
1.000"
2.000"
0.625"
2.500"
3"
25mm x 25 x 3
Brake Bracket 2 off
5/8"
5/8"
2.800"
0.500"
1 1/4"
Ø1/4"
Ø 3/8"
Actuator Crank
2 off 3 mm
Cable Crank
1 off 5 mm
7/8"sq
0.462"
1.9/64"
0.825"
To suit ca
Tap 1/4"
Rear Cable
Anchor
Bowden Cables
Shaft Ø 3/8 "
x 4 5/16" long.
S/Solder cranks
PNP Railways
Vacuum Actuation Kit
PNR-2D
6 3/8"
3"
1.868"
2.820"
2 3/8"
1 1/4"
1 1/2"
1 1/8"
1.375"
2.063"
1.938"
3.563"
5.313"
6.813"
8.875"
10 1/8"
4 3/8"
3/4"
5/8"
7/16"
1 1/2"
1"
9/16"
4"
10 Holes Ø3/16"
Others Ø1/4"
2.500"
0.438"
1.063"
0.465"
1.090"
Brake Platform 6 mm. plate
3/4"
0.375"
0.625"
Ø1/4"
3/8"
1"
2 BA
Actuator
Trunnion
2 off
0.200"
Ø 3/8"
Crank
Trunnion
3 off
ø 3/4"
5/16"
1/2"
Ø4"
Brake Disc 4 off M.S.
4 3/8"
4.000"
3/4"
ø 3/8"
5mm
5/8"
1"
Bolt two halves
loosely together
Ø 3/8"
1 5/8"
3/8"
1.625"
3/4"
6 1/4"
5/8"
2 3/8"
4 1/2"
ø 1/4"
Brake Support Plates 2 Sets
Ø 3/8" x
7/16" Deep
Ø 5/16". Fixing bolt must
allow assemblies to twist.
10"
4.000"
0.509"
3"
1.813"
8.000"
1 1/4"
1/2"
Fit Bicycle Brake Blocks
5/8"
Bridge over
All Holes Ø1/4"
2 21/32"
21/32"
5mm
Fit Bowden Cable
2 3/8"
3 1/2"
4"
Brake Calipers 4 Sets
5/8"
0.512"
Ø1.575"
Ø0.750"
Bogie Side Frame 4 off
No 55 drill
1/2"
35/64"
1/32"
Ø0.156"
Ø0.156"
3/64"
7/32"
12°
12°
7/32"
1/32"
0.457"
.406"
Ream 24 deg
No 73 Drill
Ejector Cones
©



Drawings, castings and laser cut components for this locomotive are available from the designers.
Contact D. A. G. Brown, tel: 01780-753162, e-mail: dag.brown@btopenworld.com or Mark Smithers tel: 01609-773734 e-mail: marks_northall.yorks@tiscali.co.uk

General Arrangement of Bogie



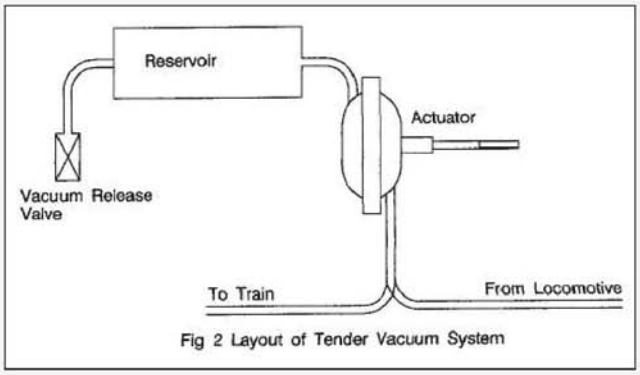


Fig 2 Layout of Tender Vacuum System

them clear of the Support Plates. Again, small cubic blocks are fitted to accommodate the Bowden Cables. Keep the drillings for these cables as close to the calliper surfaces as possible, to minimise torque in operation. The perfect Bowden Cable is available free from your local friendly car repair mechanic. Mine produced a couple of samples scrapped from Nissan clutches, in which the end connections were definitely dodgy. All we need for cannibalisation is a clean section of outer sheath, trimmed to length as appropriate, and a rather longer section of inner core. I leave the attachment to you.

Vacuum Gear - there's nothing in it!

I have admired the work published in this journal by Brian Hughes of the Birmingham Society. I slavishly followed his designs very successfully, but these days some of the proprietary braking equipment available on the market tempts us into making use of it in the current project. I am specifying the PNP Railways' brake actuation kit with Trunnion Mounting as the perfect match for our requirements. So we shall study how this can be incorporated into the chassis in the position drawn in the Tender GA.

The two Brake Brackets indicated in the Tender GA now appear at the top left of this drawing. They are bolted in place with the angle flanges pointing down, the complete gear being bolted underneath by four bolts, making it very easy to remove. The assembly sketch reveals the layout of the whole thing, the power actuator being ghosted in place. First we need the Brake Platform, cut out of 6mm plate, with holes being placed either by coordinates or by laser, according to your preference.

Next there are five trunnions, two for the actuator and the rest to guide the crankshaft. Make sure that the journal holes are true to their bolting surfaces, so that they will perform their guidance without distress. If in doubt, leave the final reaming operation until the trunnions are assembled on the Platform, at which stage the reamer can be guided through the assembly with the Platform supported against an angle plate. Using this technique, you can at least check the alignment of the undersized holes with the milling machine axes, before feeding a reamer through the assembly.

The Actuator Crank is made from two pieces of 3mm material, which bridge a small boss on the Actuator shaft. PNP provide a couple of M6 Nyloc nuts, so I leave it to you to make a flexible assembly with a little slack in it as they recommend. The various holes in the Crank enable us to vary the effort given by the braking system. The vacuum assembly gives a pull of 60lb with half an atmosphere (15in.) vacuum. I cannot, however, estimate the drag that rubber blocks will give at the wheels; it is a matter of trial and error. Suffice it to say that at the maximum mechanical advantage, the system should be exerting an effort about two thirds of the mass of the laden tender. My guess is that this would cause the wheels to stop rotating and become square! Hopefully I shall stay ahead of the game in the construction stakes and prove mine first.

What I have christened the Cable Crank is made from 5mm material. It provides balanced effort to both bogies, so there is no sideways reaction on the shaft at this position, just a balanced torque. The crankshaft is a $4\frac{5}{16}$in. length of $\frac{3}{8}$in. dia. mild steel and the three cranks should be silver soldered in place when you have settled their correct positions, ensuring that they are aligned at 20deg., and not forgetting to include the central trunnion in the stack. It can never be removed, but that should not matter. The remaining pieces for machining are the two Cable Anchors. From the assembly sketch you will see why they have to be quite different in shape. The size of the holes at $\frac{15}{32}$in. centres depends upon the calibre of the Bowden Cable. The outer metal sheath of the example lying in my workshop measures over $\frac{1}{4}$in. dia., but you will have to alter things to suit whatever you use. You will probably find that there is a protective plastic coating over the sheath, which can be pealed away, leaving a spirally wound flexible tube which invites fixing by means of a stout grub screw. It is David Hudson's recommendation that the inner cable be silver soldered into its grommet; but there again, it is up to personal taste and whatever material is available.

I have not provided any form of equalisation between the sets of cables; in our application it is hardly necessary. Just make sure that the cable sets all take up their slack at the same position; all four axles should then brake with equal effect.

Braking peripherals on the Tender

You will also need a vacuum reservoir, for which there is ample room out of view just in front of the operating mechanism. The PNP reservoir is probably a little long to be accommodated without minor surgery on its connections, so you can employ either a home made effort, or an old butane gas cartridge or air brush propellant. Whichever way you do it, remember that, although you are only going to pull a vacuum of less than 10psi, even such trivial pressure differences can cause collapse in the structure of the small vessel. When I was chief mechanical engineer of British Sugar plc., I well remember one of the works engineers ringing me up late one night with a little problem. High up on a windy structure in nasty weather conditions, a vacuum vessel about five feet diameter had suddenly collapsed inwards, bringing the whole of the process to a halt in no uncertain manner.

Having found a temporary way around such a trivial problem, our minds turned to finding out the reason for the failure. We invoked Euler's criterion, an arcane piece of work best known perhaps in the aeroplane industry, which needs to prevent the buckling of struts. Basically, a member under compression is prone to buckling when disturbed in any way if its length to width ratio exceeds a certain value. In our example, the cylindrical vessel had suffered some local corrosion during a previous incarnation and failed the scrutiny when used under compression, although there was more than adequate wall thickness to pass a pressure test for operation at more than one bar of positive pressure.

The backside of the Actuator must be connected to the reservoir to provide the continuous vacuum environment necessary to apply the brakes. When the brakes are applied, the Actuator piston moves, thus reducing the volume under vacuum. So the larger the volume of the reservoir in relation to that of the Actuator, the smaller will be the attenuation of pressure within the system (**fig 2**). Also required is a vacuum relief valve, with a rubber ball or seat, to enable the vehicle to be moved when the locomotive is cold.

On the other side of the Actuator, a $\frac{3}{16}$in. dia. pipe merely leads to both buffer beams. At the rear fit a swan neck and flexible hose for connection to the train; here I would make a plea for uniformity: the almost universal connection in $7\frac{1}{4}$in. circles is the small plastic coupling originating from medical laboratories, but cheap and effective both to couple in operation to the front carriage and to park on a mating dummy at the back of the tender. The front of the tender should also have a similar coupling to connect with the locomotive.

Locomotive Vacuum Gear

I have already mentioned that the vacuum ejector should be supplied from one of the spare connections on the dome bush of the boiler. Use Brian Hughes' details for the ejector and vacuum limiter, but I have a couple of suggestions to make for improvements. First the Ejector Cones drawn out fit into his body without modification and enable you to pull 20 to 21in. of vacuum with just a tiny use of steam, through the No.55 hole in the steam cone.

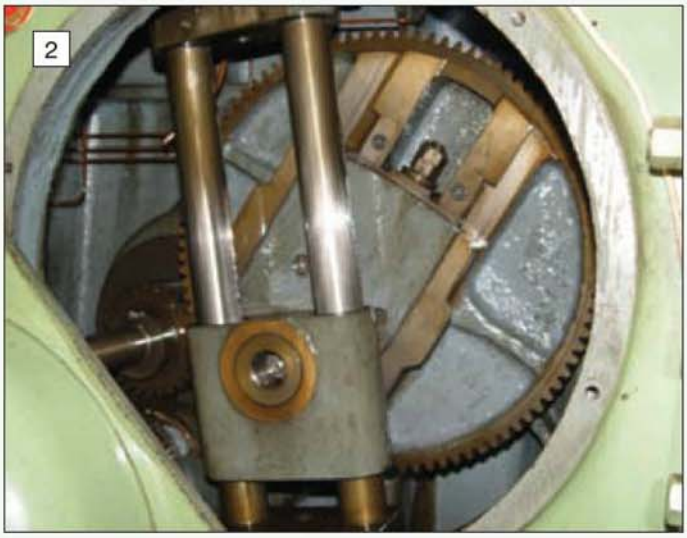
My version of the Driver's Brake Valve needs no amplification and will give good service. It can be mounted on a pillar of hexagon steel in the general area of the reversing gear, with a $\frac{3}{16}$in. dia. hole drilled right through to pass the air as it operates. I have found when working vacuum braked trains at many different tracks, braking is effective and positive. For instance at Leicester, one of their three coach sets takes about seven or eight seconds to make a full 15in. of vacuum when first connected, but thereafter it takes only a couple of seconds to take the brakes off after an application. Air travels very fast through a $\frac{3}{16}$in. dia. pipe, so there is less than a second delay between brake application and full effectiveness at the back end of the train.

Rounding up

There remain only a few pieces of detail to complete the model, with some minor modifications to improve things. These will be the subject of the last article in the series, in which I shall deal with some reader reactions and perhaps show one or two more photographs.

●*To be continued.*

The 18in. stroke Butler Super Shaper, a machine that the author found pleasant to use during his time in industry.



Ram actuation mechanism in the Butler shaping machine permits the stroke length to be rapidly changed.

THE SHAPING MACHINE

Harold Pearson
in Cambodia asks: *"Is the shaping machine an unjustifiably, forgotten machine tool?".*

With the industrial revolution came the need for accurate flat surfaces on metal parts for machines - from lathe bed ways, steam engine slide bars and valve faces, to printing press plates. Such surfaces were largely produced by hand by chiselling, filing and scraping until an accurate flat surface was produced and this was both slow and expensive. As Joseph Whitworth said in 1856: *"Thirty years ago the cost of labour for facing a surface of cast iron, by hand, was twelve shillings per square foot; the same work is now done by the planing machine at a cost for labour of less than one penny per square foot"*

Planing machines operate by moving the work piece on a sliding bed way under a stationary tool. Machines for producing flat surfaces were designed and built by Matthew Murray and James Fox of Derby around 1814. Richard Roberts built the oldest surviving planning machine in 1817. In Britain in1836 James Nasmyth invented his shaping machine, calling it his *Steam Arm*. Whereas the planning machine had a fixed cutting tool, Nasmyth's machine used a moving tool and a static work table.

The milling machine, which has largely displaced the shaping machine in industry, was invented by an American, Eli Whitney, in 1818.

Apprenticeship

In 1956 when I started my apprenticeship as a tool maker at Metro Cammell, Birmingham I reported to the tool room foreman who told me that a machine would be assigned to me for which I would be responsible. I would be expected to take care of the machine, its maintenance and all the small tools with it such as measuring equipment, etc.

This was a standard arrangement in the tool room but did not imply that being responsible for one particular machine limited the individual to operating that machine only, far from it. All my mates in the tool room were able to skillfully operate most of the machines, though, of course some were more skillful than others in the use of a particular machine. A good example was the centreless grinder, which was always operated by the same person, as were the two Cincinnati tool and cutter grinders.

Within a couple of weeks of my starting in the tool room another chap was approaching retirement age. The foreman instructed me to work with the man and gain a little experience. Thus, started a five year association with a Butler 18inch Super Shaper (**photo 1**). The Butler is a lovely machine to operate, somehow I find shapers more user friendly than milling machines, and they are certainly not as dangerous!

One of the first jobs I was given was to make three, large, all steel, rack type machine vices. Rack vices are arguably the strongest form of machine vice available as the screw operates directly through the centre line of the jaw and not below it. The Butler would take cuts 1/4in. deep and produce swarf that came off dark blue and often imbedded itself in the plywood screen set in front of the machine. The shaper was not considered a roughing out machine and I was expected to work to the same tolerances produced on any other of the machines in the tool room, with the exception of the precision grinders of course.

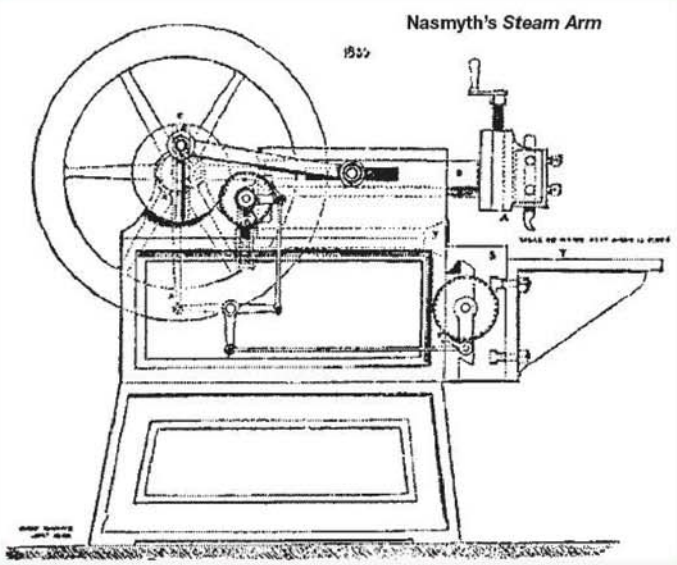
With the invention and development of the milling machine planers and shapers have become less popular in production workshops, though the plano-miller is still in use. Shapers tended to be used more in tool rooms or smaller production workshops but could often be seen tucked away in a corner in larger workshops.

About the machine

A shaper is a machine tool used for shaping metal and other materials. A gear box delivers the power to a pinion which drives the bull wheel. Mounted on the face of the bull wheel is a crank pin, which is incorporated with a sliding block working in dovetail slide-ways running across the face of the wheel. This allows the crank pin throw to be changed, increasing or decreasing the stroke. The connection to the ram is arranged by means of a link attached to the underside of the ram and pivoted at the bottom of the machine. This link engages with a driving block bored to suit the crank pin and having an arrangement whereby it can slide up and down the link. This slotted link form of design has dominated the shaping machine for many years and is known as the slotted link motion. When a link of this type is used there is a distance variation as the link swings through an arc. To compensate an extra short link is employed to take up the movement.

One of the big criticisms of shapers is that they spend half the time on the return stroke, doing nothing. This is, to some extent, true but not as bad as it may appear. The way the mechanism is arranged the return stroke is quicker than the cutting stroke. This is achieved as follows,

Nasmyth's *Steam Arm*



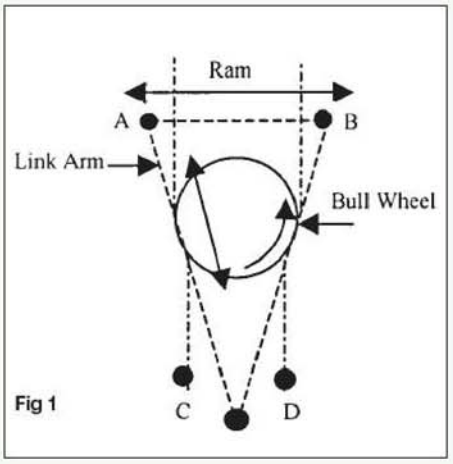
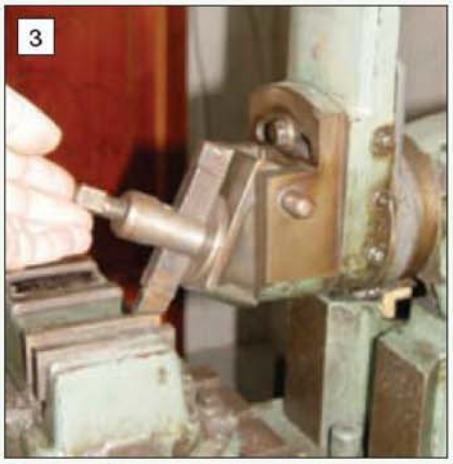


Fig 1



The clapper box prevents the tool dragging during the return stroke.

The clapper box drops down into cutting position under its own weight.

please see **fig 1** and **photo 2**: The rotational distance between points A-B, the forward stroke, is greater than between C-D, the return stroke. Given that the stroke distance A-B is greater than C-D and the rpm is the same it will take longer to move through rotational distance A-B than C-D.

In reality shapers are not so slow, in particular when compared to the average amateur's, bench mounted mill drill. Many small vertical milling machines do not have auto traverse and can only take small cutters. The large face milling cutters, vertical or horizontal, needed for machining flat surfaces are both expensive and require a powerful and rigid machine. Unlike most of the hobbyist style milling machines, all of the smaller powered shapers I have come across are built for heavy use.

On the return stroke the tool lifts and does not cut. The lifting of the tool (**photo 3**) is controlled by the clapper box, so called because of the noise it makes as it drops into place at the end of the return stroke (**photo 4**). On large shapers where the tool and clapper box can have a considerable combined weight, there is a mechanism that automatically lifts the tool at the end of the cutting stroke. The work is either held in a very strong machine vice or clamped to the machine work table. The cutting feed is provided by a screw that traverses the machine table at 90deg. to the tool. On many machines the table movement is provided by a simple adjustable ratchet mechanism (**photo 5**), similar to that on a locomotive mechanical lubricator, that puts on the feed as the ram makes the backstroke. The feed can be changed by increasing or decreasing the crank pin stroke on the ratchet arm. Larger machines have automatic stops that control table travel similar to a milling machine. Smaller machines do not have this but do have a safety feature where the nut fixed to the table simply runs off the end of the screw. There is also a vertical power feed which works by sliding the ratchet mechanism off the horizontal shaft and onto the vertical one.

I own an Elliot 10M (**photo 6**), the 10M refers to the stroke length of 10 inches which is the common method of describing a shaper's capacity, rather like the centre height and distance between centres is used to determine a lathe's capacity. The table movement on the Elliot is 8 inches which means the machine has the capacity to shape a flat surface 8 x 10 inches. The machine occupies a floor space of 38 x 17in. and weighs about a quarter of a ton. Though very suitable for the model engineer's workshop it was originally designed for use in industrial workshops and tool rooms. As such it is extremely robust in construction and capable of heavy duty use combined with great accuracy.

The real bonus with a shaper is that it utilises single point tools. Many lathe tools can be used on the shaper, giving the operator a great deal of independence of tool choice. My 10M takes tools with $^{5}/_{8}$ x $^{3}/_{4}$in. shanks. Gears can be cut on the shaper as well as internal and external key ways. Horns and axle boxes are a doddle as are the flat surfaces on cylinder blocks. If you want to make a vertical slide the shaper is ideal machine for the dovetail slide-ways. Using a shaper is very satisfying as you are in full control and not dependant upon expensive milling cutters that must be exactly the correct profile and running true. You will never be stuck for a special profile tool because with a shaper you can always make your own out of a bit of silver steel. When shaping a large flat area the machine can be left to its own devices, rather like a mechanical hacksaw. All the shapers I have used ran very quietly.

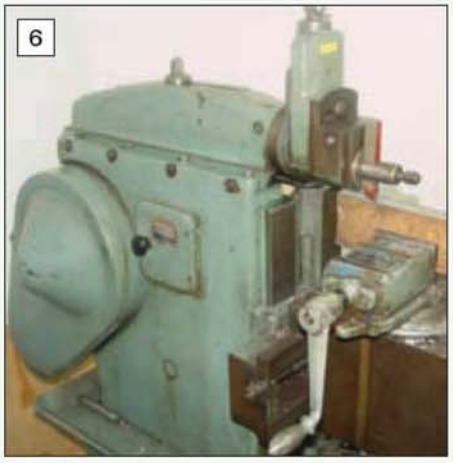
Intricate work

I have often heard the remark: *"Rough it out on the shaper"*, giving the impression that the shaper cannot produce accurate work. Nothing could be further from the truth. With practice, as is required with any other machine tool, accuracy to 0.001in. and less can easily be achieved. The following is an example of a very intricate exercise carried out on my 10M shaper:

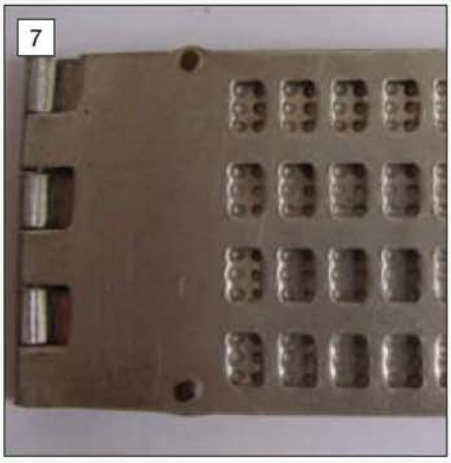
The international organisation (NGO) I work with in Cambodia is involved in small scale industrial development and technology transfer. We react to technical demands from other organisations by developing products for local manufacture. We are involved with various organisations that assist the visually impaired. We were approached with a request to develop the technology to manufacture an instrument called a slate and stylus. This is a device that blind people can carry that enables them to make notes in Braille, the international reading and writing language for the blind. It comprises two narrow strips of thin metal or plastic hinged at one end (**photos 7** and **8**). The one half has small windows or cells that line up with indents or pits in the lower plate, each cell has six pits.

A piece of paper is held between the two strips, the window and pit plate. The stylus is a short round pin the same diameter as the pits,

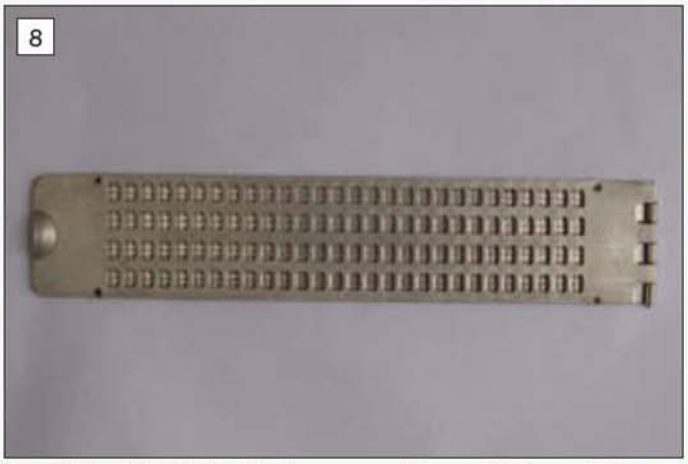
Table feed mechanism on the Elliott 10M shaping machine.



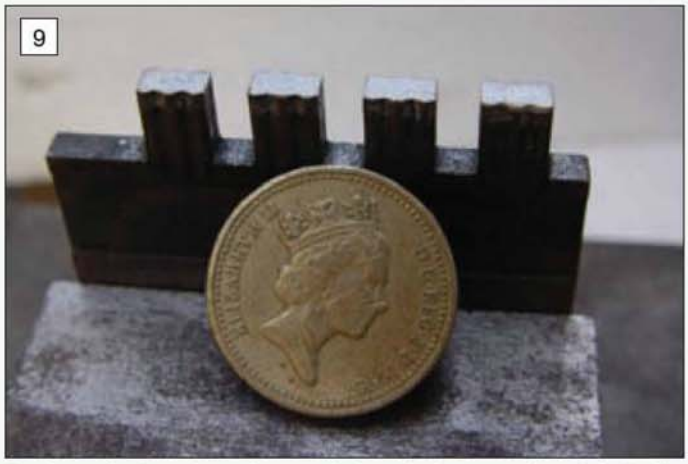
General view of the authors Elliott 10M shaping machine.



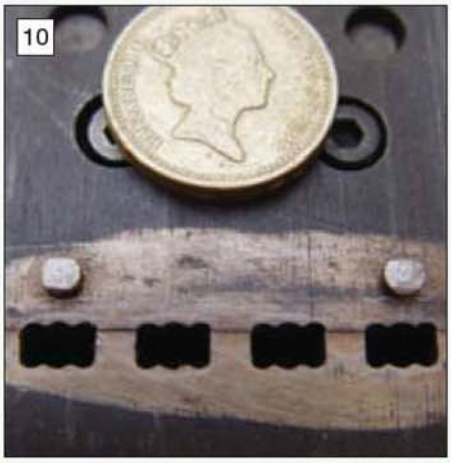
Close up view of a Braille slate, the tooling for which was made on a shaper.



Overall view of the Braille slate. In use paper is trapped between the two halves of the device and indented with a stylus.



Punch used to form the pockets or windows in the upper plate of the Braille slate.



Die used to manufacture the windows in the Braille slate.

1/16in. or 1.6mm, with a domed tip and a short wooden handle. Using the window plate as a guide, impressions are made in the paper with the stylus to form a Braille message.

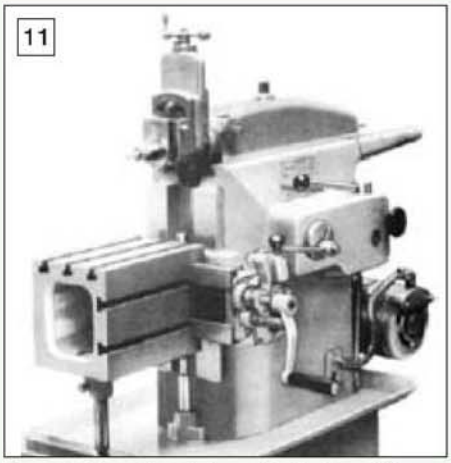
In order to produce the slate a set of press tools was required, the most difficult of these being the blanking tool to create the cell windows. The dimensions of which are: 0.155in. wide at the widest point and 0.250in. long with six 0.031in. radiuses that act to guide the stylus onto the pit plate. The punch and die, made from 1/4in. gauge plate are shown in **photos 9** and **10**. Form tools were made on the shaper and subsequently used to make the punch and die. The accurate spacing was achieved by bracketing a digital readout to the shaper cross-feed.

Variety

There were many different makes of shaper available on the UK market including the Elliot, Victoria and Boxford etc. Below only a few of those available are shown. For more information please contact **tony@lathes.co.uk** or **www.lathes.co.uk** who kindly agreed for me to use material from their web in this article. This is an excellent website for those interested in machine tool history and what is currently available.

Elliott 10 M (photo 11)

This extremely well made and finished 10in. stroke shaper was a development of the Alba 1A and even earlier Royal model (*a 10in.Viceroy Royal shaping machine, contemporary with the Elliott 10M, was also marketed by Denford -Ed.*). It was popular in both training and production workshops and many thousands are still in use. Four speeds were available; the rear-mounted motor had a double-step V-pulley which drove a two-speed gear train and clutch unit. The clutch lever can be seen laying horizontally along the body of the machine and the two-speed gear was selected by moving in and out the black knob immediately above the motor. Automatic cross-feed (with a safety over-run device) was fitted as standard and a vertical feed (with no safety device) was available as an option. The machine box table could be swivelled and featured two T-slotted and one V-grooved side

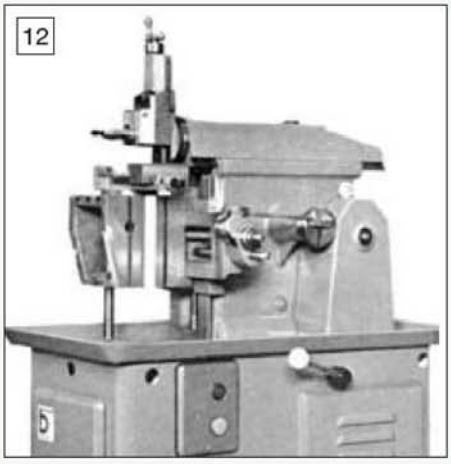


Reproduction of a catalogue illustration of the Elliott 10M shaping machine.

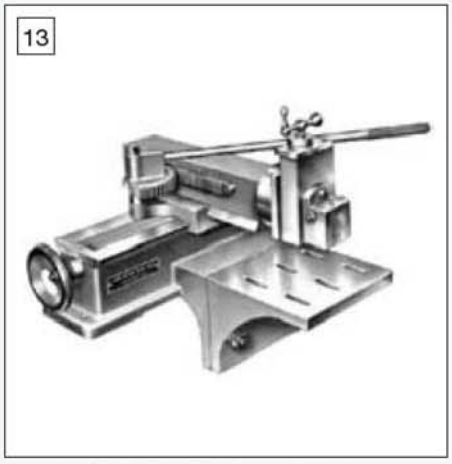
Boxford 8in. (photo 12)

The Boxford was widely employed in schools and colleges and as a result many of them emerged onto the second-hand market in pristine condition - the great majority of them having apparently never been used.

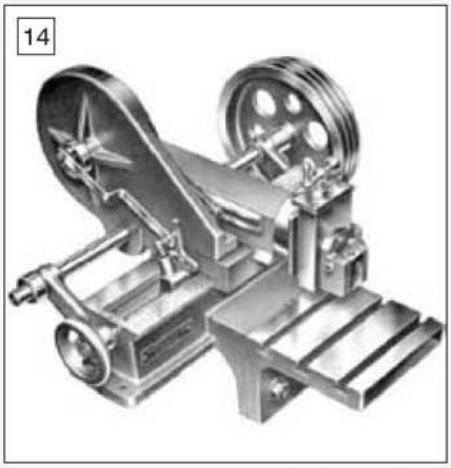
The Boxford was driven by a motor and countershaft unit contained within the base stand and had four speeds. Horizontal power feed to the table was standard and a vertical feed (rarely fitted) was available as an option. When fitted with both power feeds the operating mechanism was cleverly designed to allow its pawl and ratchet assembly to be swung through 180 ▶



The 8in. stroke Boxford shaping machine would be a good choice for the model engineer.

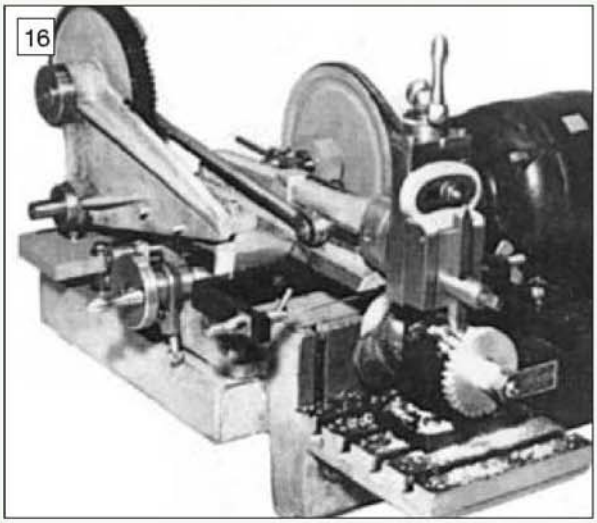


Perfecto Model No. 1 hand operated shaper was based on earlier designs.



Power operated version of the Perfecto shaping machine.

Left: Although small the Adept 1A shaping machine was capable of useful work in the hands of model engineers.



Right: Adept subsequently introduced a powered model of shaping machine seen here machining a spur gear.

degrees to engage either of the movements.

A Boxford shaper is probably the ideal machine for the home workshop - the motor is easily changed to a single-phase unit, the whole machine is light enough to be moved easily yet it has sufficient strength and capacity to tackle even larger jobs successfully.

Perfecto (photo 13)

The 'Model No. 1' of circa 1975 was almost an exact copy of the Tom Senior shaper of 1935. The bed length was 15 inches, the table on early models 6 x 6in. - later ones were rather larger - and could be adjusted through approximately 2in. of vertical movement by repositioning the mounting bolts. The ram was 10in. long, with 5in. of stroke and the swivelling tool post had 2 1/4in. of height adjustment. A reversing, automatic feed was fitted to the carriage. The machine was 17in. long, 12in. wide and stood approximately 12in. high. The weight was 56 pounds. A 7in. stroke hand-operated model and 5in. and 7in. types designed for drive by electric motor were also offered by this company (**photo 14**).

Adept (photos 15 and 16)

The tiny Adept shapers were made, together with a small lathe, by a branch of the Portass family, F. W. Portass of Sellers Street, off Abbeydale Road, Sheffield, England , both before and after WWII. The Adept 1A and 2A were both hand-operated and of similar construction, with the 2A being larger and sometimes fitted with an automatic cross feed.

The table of the tiny 1A was 4.5 x 4in. with vertical T-slots 3 1/2in. high and a ram travel of 4in. whilst the 2A had a table 7 x 6in. with vertical T-slots 6in. high and a ram travel of 6 1/4 inches. During the early 1950s Mr. F. J. Haynes of Audenshaw, Manchester converted his hand-powered Adept No.2 shaper to incorporate a powered ram. So impressed were Portass by this professional looking design that they adopted a modified version of it for production. It is possible that some later 2A models may also have been fitted with a 'geared down' cross-traverse feed to the head.

With sharp tools it is quite astonishing what a variety of useful work these little machines can do - and in harder times they offered model engineers an economical way of accomplishing tasks that would otherwise have involved a great deal of laborious, and usually inaccurate, hand-filing and cutting. Many of these fine little machines are still in use today amongst more knowledgeable enthusiasts.

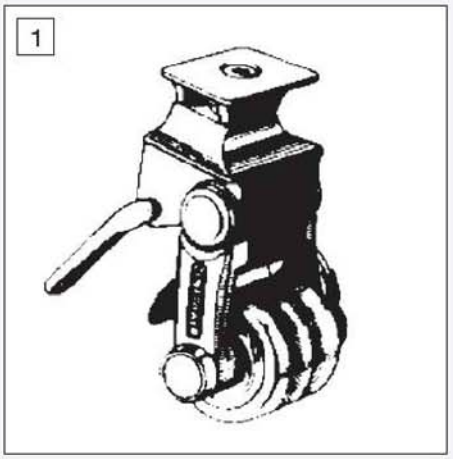
The shaper was also made in (or exported to) Australia and marketed (like the Adept lathes) as the TNC.

Cost

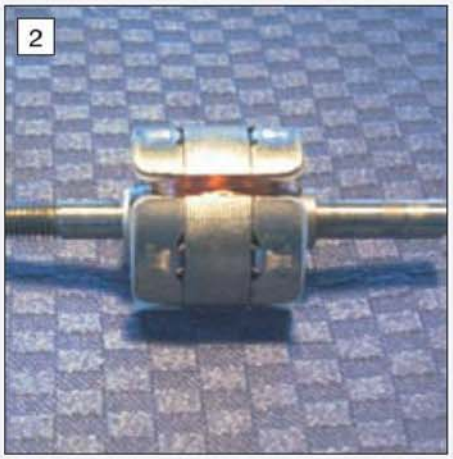
How much should you be prepared to pay for a decent shaper? I found my 10M languishing in a corner of a University workshop having been replaced by a much larger Butler 18inch machine, the very one shown in this article! I enquired if the Elliot was for sale and was pleased to hear it was and would I like to make an offer. The result was that I became the proud owner of an almost new machine for £250.

More recently I have been gathering workshop equipment for the NGO I work with in Cambodia. Amongst the equipment are two 10M Elliott's sourced from dealers in UK and costing £250 each.

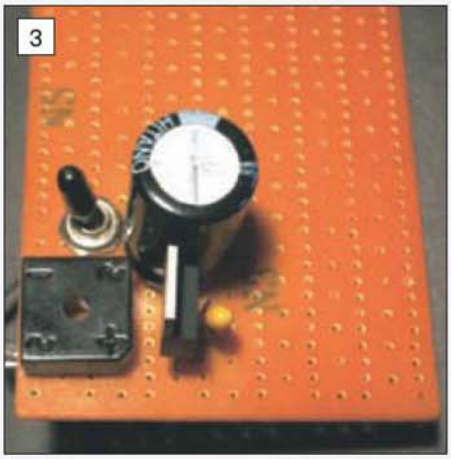
I would suggest that rather than a small milling machine a decent shaper combined with a vertical slide for the lathe would be a very good alternative combination, in particular for those on a limited budget. I do not promote the shaper over the milling machine but would suggest that with the availability of top quality machines at very reasonable prices consideration should be given to adding a shaper to existing workshop equipment. The shaping machine has quite a history and it deserves better than to be a forgotten machine tool of history.



Sanyo bicycle dynamo that forms the basis of this project.



Four-pole commutator extracted from the dynamo unit.



Circuit board built to adapt the output of the dynamo to power the radio.

RHOMBIC HOT AIR ENGINE POWERED RADIO

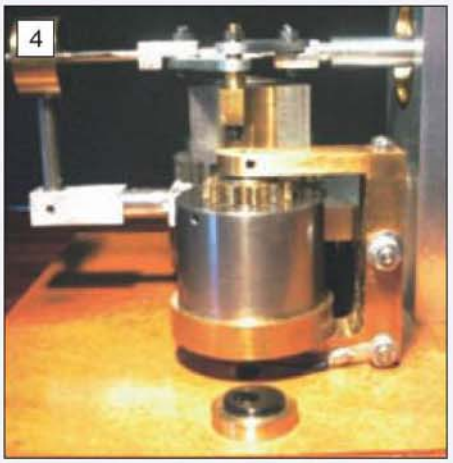
Les Kerr

of Australia supplements his recent series on the Rhombic hot air engine with a description of a novel application for its modest power output.

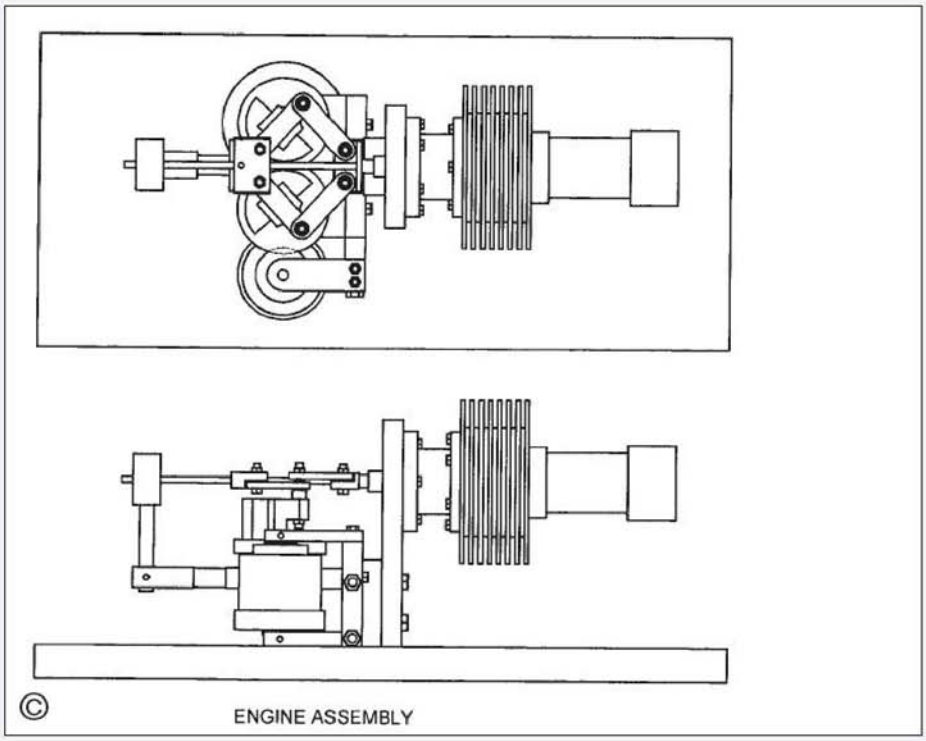
Having made the Rhombic hot air engine recently described in these pages it had me wondering what I could attach to it to produce some useful work. One day, the workshop radio came to mind.

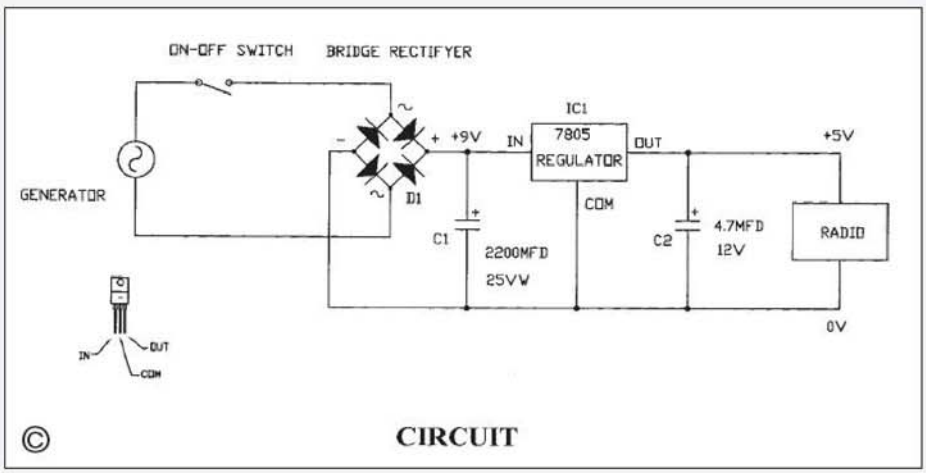
In the local bike shop I purchased a Sanyo dynamo by the name *Dynapower* that had an output of 6 Volts at 3 Watts (see **photo 1**). This dynamo was unusual in that the centre shaft was fixed and the body rotated about it to produce the electricity. As the existing shape was unsuitable I proceeded to pull the assembly apart and after some careful sawing I managed to extract a cylindrical permanent magnet and a four-pole commutator. **Photograph 2** shows the commutator.

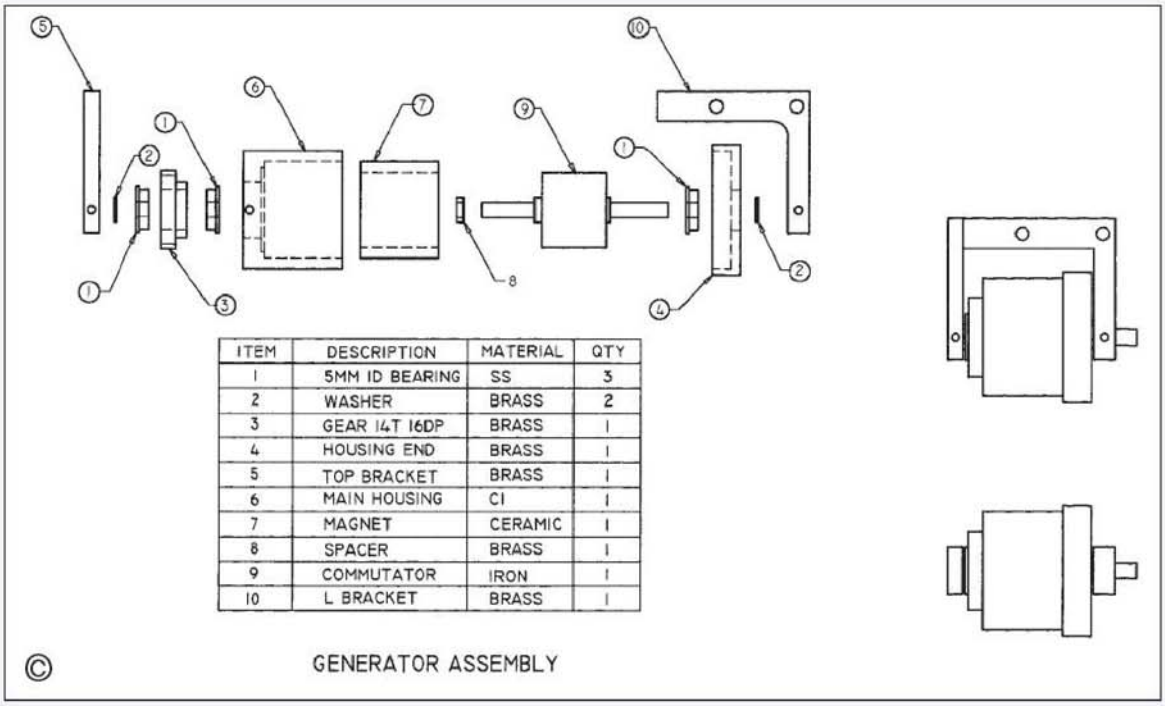
As friction is the enemy of all hot air engines I decided to use ball races for the dynamo bearings. On measuring the shafts I found these to be just



Dynamo fitted neatly to the rhombic drive hot air engine.

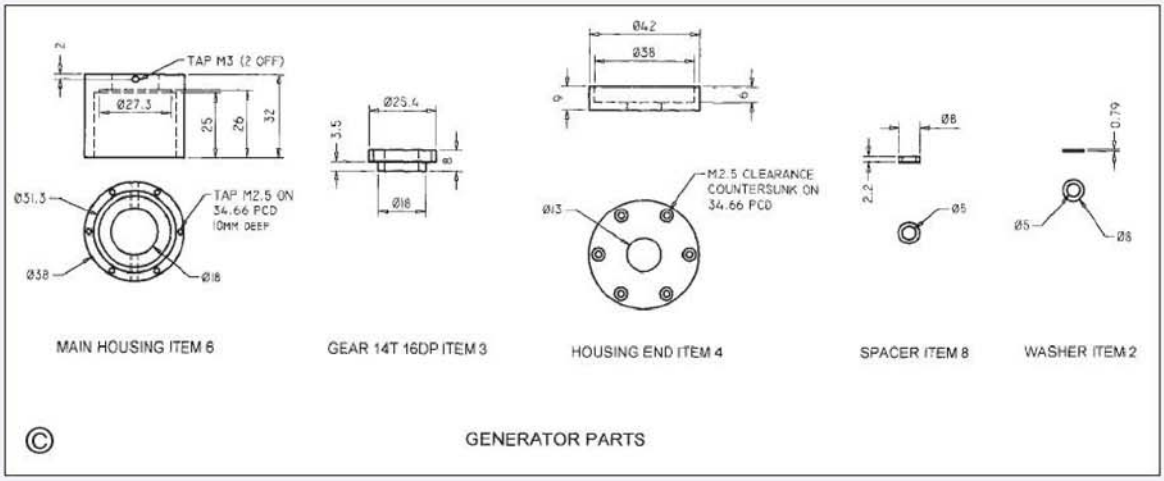






ITEM	DESCRIPTION	MATERIAL	QTY
1	5MM ID BEARING	SS	3
2	WASHER	BRASS	2
3	GEAR 14T 16DP	BRASS	1
4	HOUSING END	BRASS	1
5	TOP BRACKET	BRASS	1
6	MAIN HOUSING	CI	1
7	MAGNET	CERAMIC	1
8	SPACER	BRASS	1
9	COMMUTATOR	IRON	1
10	L BRACKET	BRASS	1

© GENERATOR ASSEMBLY



© GENERATOR PARTS

under 5mm so I selected some ball races with an I/D of 5mm, O/D of 13mm and width of 4mm, flange width 1mm and flange diameter 15mm. These I purchased from Small Parts and Bearings (usual disclaimer) under the part number SF695-ZZMC3 for A$4.70 (£1.90) each. Three were used in the design. The company has a website.

To transfer the power from the engine to the generator it was decided to use a 14-tooth gear to connect to the rhombic cycle gear. You may ask why 14. The answer is that I felt that the generator should rotate at about twice the revolutions of the engine. As the engine gears have 25-teeth this calculates to 12.5 so 14 was chosen. The engine gears are 16DP, 14.5deg. pressure angle so you need a number 7 cutter to make the 14-tooth gear.

The workshop radio is a typical mantle type that is powered from three D-cells in series. It consumes about 300mW so there shouldn't be any problem powering it from the engine. The output of the generator is a sine wave of about 17 volts p-p. The radio needs about 4.5V DC so we need to rectify and regulate the output. To do this we first rectify the voltage with the bridge D1 (see circuit), smooth it with the capacitor C1 and finally regulate it with IC1 to 5V DC. Capacitor C2 provides a short circuit for high frequencies, which stabilises the circuit. Virtually any bridge with a 1 Amp output will do for D1. C1 is a 2200mfd 25VW electrolytic capacitor, C2 is a 4.7mfd 12V tantalum capacitor and IC1 is a 1A 5V regulator with the generic number 7805. I mounted the components on a piece of matrix board (see **photo 3**) and connected it to the generator using a power pack plug and socket. One side of the output of the generator comes from its body. To make this connection I placed a solder lug under its lower M4 mounting nut.

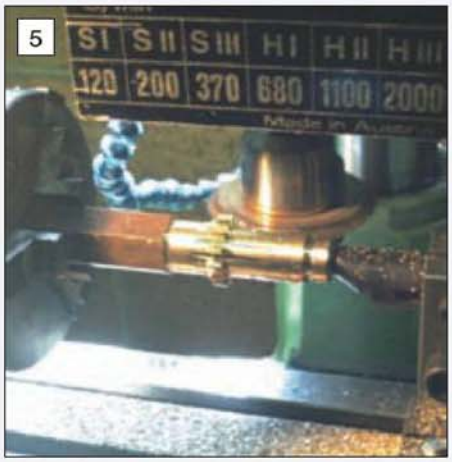
Gear (item 3)

Let us start the construction with the gear (item 3). To make the gear we need to know three things, the diameter of the blank, the depth of cut and the number of times we need to turn the handle on the dividing head between cuts.

Diameter of blank = (N+2)/DP
= 16/16
= 1in.
= 25.4mm

where N is the number of teeth i.e. 14.

Depth of cut = 2.157/DP
= 2.157/16
= 0.135in.
= 3.42mm



Milling the brass 14-tooth, 16DP gear on the milling machine.

My dividing head consists of a Vertex 6in. dia. rotary table fitted with a dividing plate. 90 turns of the handle produces one turn of the table. We need one fourteenth of a rotation so the number of handle turns = 90/14 = $6^{3}/_{7}$. If we select a dividing plate with 21 holes then multiply top and bottom of the fraction $^{3}/_{7}$ by 3.

i.e. (3x3)/(3x7)
= $^{9}/_{21}$

This means that between cuts we have to move the handle 6 turns and 9 holes on the 21 dividing plate. To achieve this set the distance between the two sector arms to 9+1 holes i.e. 10 holes.

Using a length of brass turn up the gear blank (item3) as shown in the drawing. The 13mm centre hole should be bored for a push fit of the bearings. Using a vertical milling machine fitted with a 16DP No.7 cutter, mount the blank on a solid mandrel with tailstock support (**photo 5**). Cut each tooth in turn until complete. As there are several books on the market that go into setting up and cutting gears I won't bore you by repeating all the details here.

Main Housing (item 6)

This is a straightforward turning job in the lathe. Its internal diameter although given as 31.3mm on the drawing should be adjusted so that the cylindrical

magnet just slides in and is flush with the end of the housing. The 18mm hole should be bored for a push fit of the gear. Do not drill the holes for the housing end at this stage.

Housing end (item 4)

Again a simple turning job. Make sure that it is a tight fit on the main housing and the 13mm hole is bored for a push fit of the bearing. Fit the housing end onto the main housing and using the dividing head drill and tap the six mounting holes.

Washers (items 2)

I started with standard 5mm washers which were 1/32in. thick. These were mounted on a mandrel and their outer diameters were turned down to 8 millimetres.

Spacer (item 8)

It is best to leave the making of the spacer till after the assembly of the generator. The reason being that its length takes up any variation in size of the generator components.

L-bracket (item 10)

I used a slitting saw to cut out the L-shape from a flat plate, then milled it to size and finally drilled the holes. The round ends were ground using a bench grinder.

Top bracket (item 5)

Similar process to the L-bracket

Generator assembly

Fit the two bearings into the gear and the third into the housing end. The generator assembly drawing shows the direction from which they are placed.

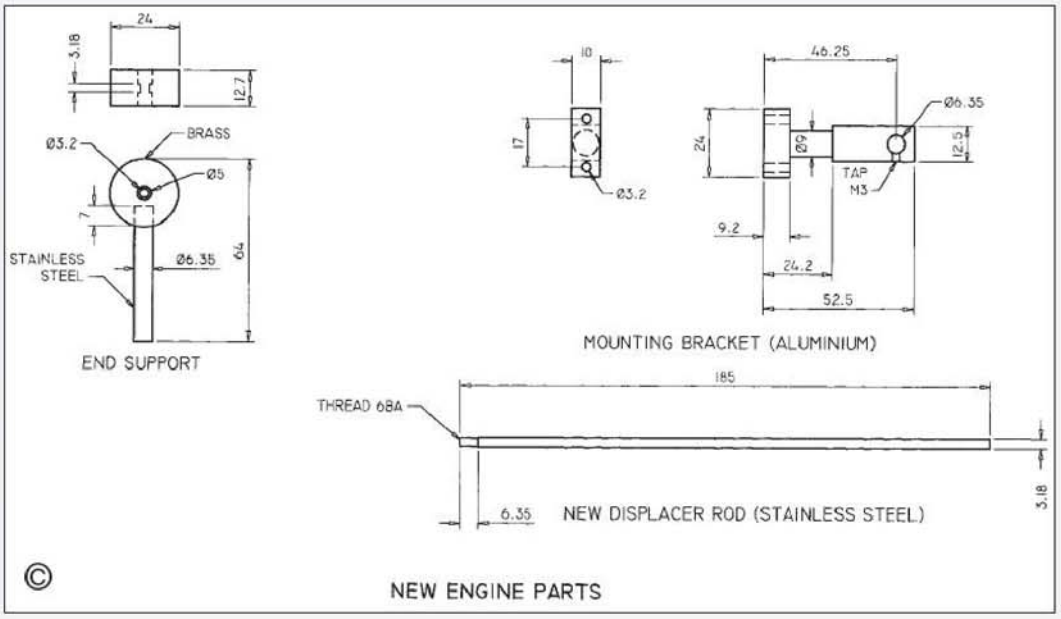
Fit the cylindrical magnet using Loctite 620 into the main housing. Clean away any excess, as the smallest drop will damage the bearings. Screw in two M3 x 3mm grub screws into the main housing and assemble the gear in place.

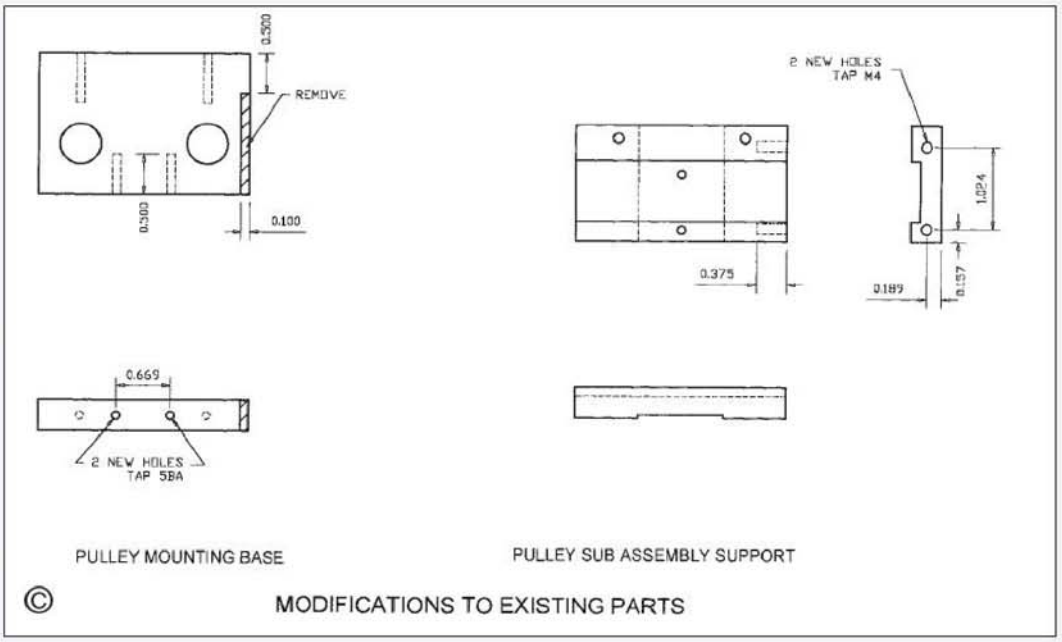
Slide the commutator in and fit the end housing. The commutator should rotate freely without touching the magnet. Measure the amount of horizontal movement in the commutator. This distance is the length of the spacer (item 8). Turn up the spacer to this length and fit it into the housing on the commutator shaft. Using 6 off M2.5 x 10mm countersunk screws attach the housing end in place.

Finally mount the generator assembly between the washers and the L and top brackets, using two 6BA x 3/8in. bolts. The shaft is locked in place using M3 x 3mm grub screws in both the L and top brackets.

Engine modifications (see engine assembly drawing)

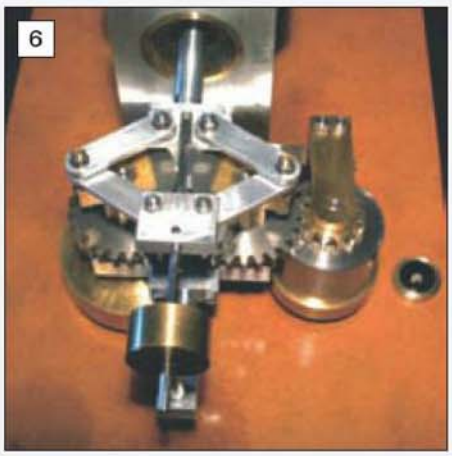
I found that these could be performed without dismantling the engine. However the cylinder and gears were covered with paper during the operations to prevent swarf entry.





Generator attachments (see modification to existing parts drawing)

Remove 0.1in. from the side of the pulley mounting base to allow clearance for the gear. To mount the generator we need to add two additional M4 tapped holes to the pulley sub-assembly support. We also need a spacer the details of which are shown in the generator mounting bracket drawing.



Aerial view of the rhombic hot air engine and dynamo unit.

Displacer rod support

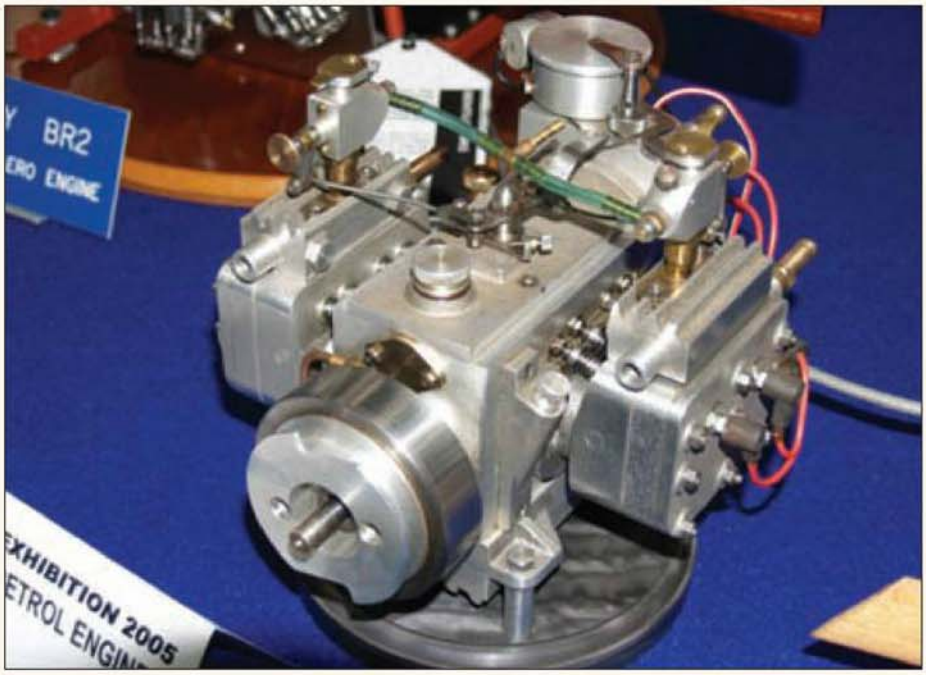
In running the engine I felt that the displacer rod needed support at the end to prevent wear as it passed through the cylinder. This was achieved by adding a longer displacer rod and two new parts that are shown in the new engine parts drawing. As these parts are simple to make no description is given. They are held together by a M3 x 3mm grub screw. To attach these parts two further 5BA tapped holes are added to the pulley mounting base.

Conclusion

The engine will run for about 10 minutes on a burner full of methylated spirits. It easily provides enough power to operate the radio at full volume without distortion. Surprisingly an engine that runs a radio is much more interesting to the general public than one that stands alone.

I/C TOPICS

Nemett
goes to see the Gerald Smith engines at the Midlands Show, and gives advice on how to start a difficult engine. *NUMBER 7*



1. A fine example of the **Mastiff** *flat four petrol engine built by Keith Harrison*

An engine not seen very often these days is the flat four *Mastiff* petrol engine designed by L.C. Mason. the fine example in **photo 1** was built by Keith Harrison.

There has been some correspondence recently in *Post Bag* concerning sleeve valve engines and I found several miniature examples on display. The first was the single cylinder version by John Scott-Scott (**photo 2**).

The Bentley BR2 designed by Lew Blackmore is a very popular rotary engine and the version on display (**photo 3**) was built by Barry Venables.

An engine that many have marvelled at at previous shows is the very impressive Rolls Royce Merlin constructed by Barry Hares (**photo 4**). For those with internet access, there are some very good photographs of this and other fine engines on the Aircraft Engine Historical Society at **http://www.enginehistory.org/**

A past contributor to this magazine, the late Professor Dennis Chaddock constructed the superb BRM V8 engine (**photo 5**) on display on the SMEE stand. There were several engines on this stand including another V8, this time the 98cc engine (**photo 6**) by Ron Harris based on the 1924 Airdisco engine from 1924. Alongside this was Ron's nine cylinder Pratt and Whitney Wasp radial engine (**photo 7**).

At the other end of the stand and under the stewardship of David Boote was a collection of smaller engines including the flat twin engine (**photo 8**) by Bob Dunn. This featured magneto ignition. I mentioned sleeve valve engines earlier and David had several examples on display together with some parts to show visitors how they work. I have chosen his single cylinder engine (**photo 9**) for the photograph.

2.John Scott-Scott's 6.5cc sleeve valve aero engine

The Birmingham SME stand included the magneto ignition V-twin (**photo 10**) and the very nice DOHC four cylinder engine (**photo 11**). Unfortunately neither of these was credited to any individual.

Many made this trip to see the collection of engines built by the late Gerald Smith from Nuneaton. This was to be the last time the engines would be seen together as by the time you read this they will have been auctioned.

Gerald Smith built engines of various types over a period of many years (at least 65) and his work is superb. More photographs in a future column but for now we show example of his Wizard 10cc single two stroke (**photo 12**). Versions of this engine (as were several of his engines) were built for aircraft and marine use. One of the earliest of the Gerald Smith engines was the 18 cylinder radial engine built between 1924 and 1930 according to the maker's plate. This double row engine features four valves per cylinder (**photo 13**) and interesting valve gear to drive the four valves from two pushrods. Most of us with modern equipment would be hard pushed to come any were near the quality of this model.

The final engine from this collection is the 58cc Buzzard five cylinder radial (**photo 14**) .

A Reluctant Engine

Many builders of I/C engines will have come across engines that are reluctant to start and run. Often this just a question of finding the correct settings and once the first run has occurred the engine will then happily start and run.

Ken Dines in Western Australia has such an engine. Ken has built a five cylinder radial glow plug engine (**photo 15**) to the design by Richard Green.

Since the engine is glow ignition we do not have to worry about spark timing and I assume that Ken has checked the valve timing.

One comment to make is about the compression ratio of the engine. Glow engines need a higher compression ratio than spark ignition engines and I would expect a ratio of around 10:1.

The next thing is to ensure that the glow plugs have an adequate power supply. This means using a two volt battery such as the Cyclon or similar. Five glow plugs will need around 20 amps to drive them properly.

I would also use the "hottest" glow plugs obtainable. In this country I would use the Model Technics Firepower F7, but a check with a good model shop will provide something suitable.

We then come to the fuel. I would stick with a commercial "sport" fuel at the first attempts and make sure it is fresh.

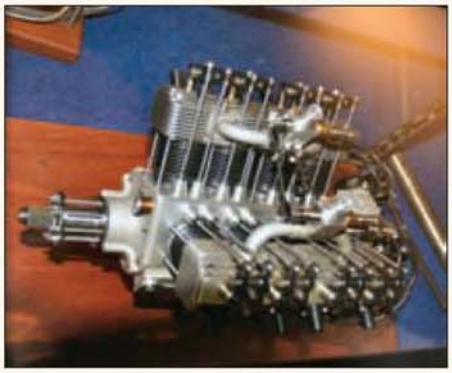
As a starting point I would set the top of the fuel tank on a level with the carburettor jet. This will give the engine the best chance of running.

We then need to consider how we turn the engine over. I have found that life is made much easier by using a commercial electric starter. These are powered from a 12 volt accumulator and will spin the engine over fast giving things the best chance of getting going. Engines such as

3. Barry Venables' fine Bentley BR2 in 1:4 scale

4. Barry Hares' superb 1:5 scale Rolls Royce MerlinXX aero engine

5. The late Professor Chaddock's 1:4 scale BRM V8 engine on the SMEE stand



6. Another V8, this time Ron Harris's 98cc engine based on the 1924 Airdisco engine.

7. Another engine by Ron Harris, this time the 9 cylinder Pratt and Whitney Wasp radial engine.

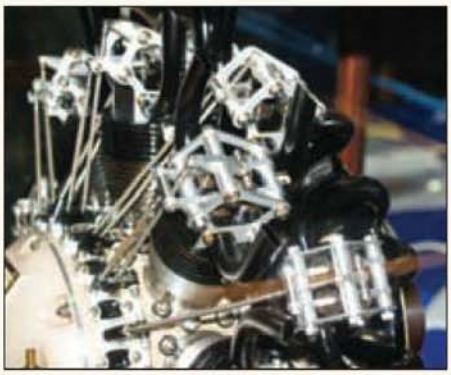
8. Another engine on the SMEE stand, Bob Dunn's interesting flat twin aero engine with magneto ignition

9. David Boot's single cylinder sleeve valve engine on the SMEE stand

10. A nice V-twin engine on the Birmingham SME stand

11. Another fine engine on the Birmingham stand, this time a DOHC four cylinder spark ignition petrol engine.

12. The Gerald Smith Wizard 10cc single cylinder two stroke engine.



13. Cylinder head detail on the Gerald Smith 18 cylinder radial engine, built between 1924 and 1930.

these often need to be spun over quite fast in order to get them going.

So, with the right fuel in the tank and all the above in place open the fuel needle about two turns and with the glow plugs disconnected and the throttle wide open turn the engine over a couple of turns by hand with a finger blocking the air intake. This will draw some fuel into the engine.

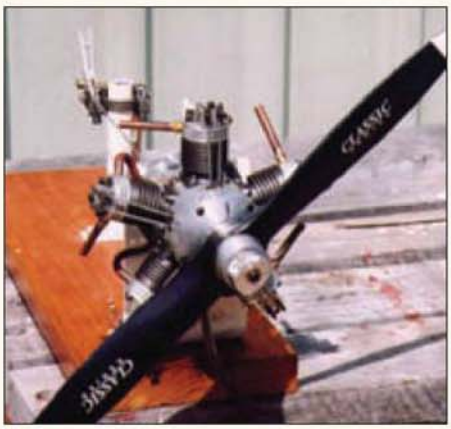
Then with the throttle open just a fraction, connect the glow plugs and then spin the engine over with the starter. This ought to result in some signs of life, hopefully the engine will run, if only briefly. If it runs and then dies, it is probably too lean so richen the mixture and try again.

If there is no sign of life at all, then remove one of the glow plugs and look for signs of fuel around the place. If the plug is clogged with unburnt fuel then replace it, reconnect the battery and allow the excess fuel to burn off before trying again with the mixture slightly leaner.

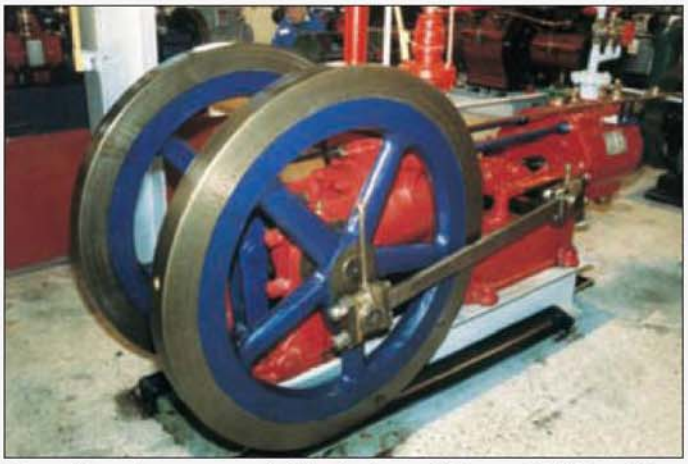
Once the engine is running then let it settle for a few minutes with the glow plugs still connected and then open the throttle gently and adjust the mixture for best running.

I hope that this will have provided some help but any specific advice from readers on this particular design would be welcome. Make contact via the I/C Engine Builders group web site (http://iceba.mysite.wanadoo-members.co.uk/) using the contact button on the first page or directly via e-mail on iceba@fsmail.net

14. Another superb Gerald Smith engine, the Buzzard radial from around 1987



15. The five cylinder radial engine from Ken Dines in West Australia



Steam driven air compressor built by the Ingersoll-Sergeant Drill Co. of New York. With a steam cylinder bore and stroke of 10in. the air cylinder bore is also 10 inches. The extended oil pipe is noticeable.

Horizontal Triple Expansion Duplex Pumping Engine built by J. Simpson of Pimlico in 1889. It is reputed to be the first triple expansion engine built by this company. The cylinder seen above the twin rams is the condenser.

BREDE TANGYE TRIPLE CENTENARY

Gerry Collins
re-visits the Brede Pumping Station to celebrate the hundredth birthday of the restored Tangye Triple.

It is several years since I visited Brede Pumping Station and reported on the Society of Model & Experimental Engineers visit in 1999 (*M.E.* 4108,) so when our worthy editor rang to ask me to attend the Centenary celebrations for the Tangye Triple Expansion Engine I jumped at the chance to be re-acquainted with the members of the Brede Stem Engine Society and to see the latest improvements and additions to the collection since my last visit.

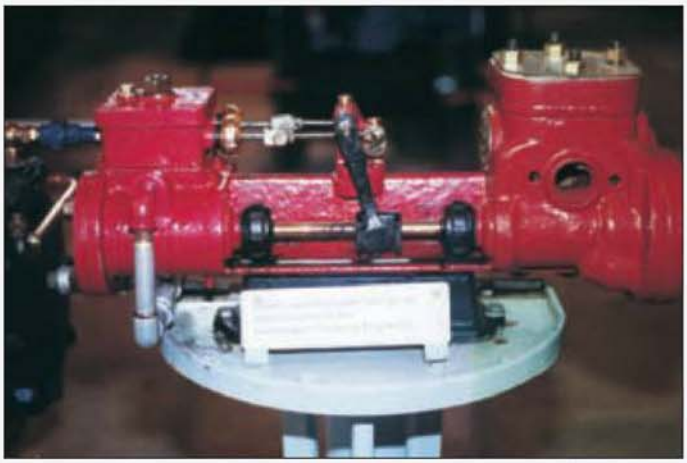
The pumping station is situated about a mile from the main road in a quiet valley north of Hastings in East Sussex. I do not intend to say much about the station, or the pumping engines, as I covered this very fully in my 1999 article. On arrival a troop of boy scouts very efficiently found me a parking space not far from the entrance and I went to find our host John Foxley, the chairman of the Brede Steam Engine Society. Dressed in a frock coat and top hat he was the epitome of a Victorian engineer of the period. John was not the only one entering into the spirit of the event, many of the other members of the society were dressed as firemen, enginemen and labourers with the ladies dressed in costume of the period with mop caps and shining white aprons. After a brief rundown of recent work undertaken by the members I was invited to see for myself the improvements.

A 1931 Tangye Sludge Pump used at Lewes Treatment Works until 1998.

Going from the Tangye engine house I was amazed when I walked into the exhibition hall to see the area almost full of restored engines. At my last visit this area was the stores and workshop for Southern Water Ltd. who own the site, the society having access only to a small area for storage. In the meantime the water company have relocated the workshop and stores elsewhere so the society have taken the advantage to house more exhibits, and to create a workshop to assist with the restoration of the engines.

The first engine that I saw was a Tangye Sludge Pump built in Birmingham in 1931. Not a very glamorous piece of machinery but it carried out vital duties at Lewes Treatment Works until 1998. Lewes Pumping Station was converted to electric pumping in the 1950s and the last beam engine on site was scrapped about 1964. Fortunately I was able to take a number of photographs of the engine before the scrap man got to it. Standing next to the pump was a very rare engine, a horizontal triple expansion duplex pumping engine built by James Simpson of

Another Worthington-Simpson engine on display is this Horizontal Compound Engine of 1918 as supplied to Denge Pumping Station.



A common sight in many boiler houses, a boiler feed pump built by the Worthington Pumping Engine Co.

Exterior view of The Worthington-Simpson Engine House which is is situated in a quiet valley north of Hastings in East Sussex.

Well-restored early 20th century vertical engine. The oil box fitted to the top of the connecting rod is noteworthy.

Celebrating 100 years the Tangye engine newly painted in the original colours. A fine piece of restoration work by the members of the society.

Pimlico. One of a pair they were reputed to be the first triples to be built by the company in 1889. The works numbers were 2379 and 2380. Both engines were installed at Cherry Gardens Waterworks, Folkestone where they remained until removal in 2001. The other engine went to Kew Bridge Museum in West London. To give an idea of the size the high pressure cylinder bore is 7in. the intermediate cylinder is 10in. bore and the low pressure cylinder bore is 17½in., the stroke is 15in. and the working pressure 80psi. The exhaust: steam was condensed in the horizontal condenser mounted above the twin rams, the cooling water being the treated water passing en route to the public supply.

A smaller exhibit was a boiler feed pump manufactured by the Worthington Pumping Engine Co. Many models have been made of this style of pump and it is interesting to note that the full size engine is finished with paint straight onto the as cast surface. There is no sign of filler or rubbing down to give a smooth surface before applying the paint. I know that the question arises over 'scale' finish and that the judges at the various exhibitions know the difference between rough paintwork and scale 'rough' paintwork but supplying a photograph with your competition entry will show that you too know the difference.

Steam has many uses in the water industry, and to provide air is just one of them. A piece of equipment on show is a steam driven air compressor built by Ingersoll - Sergeant Drill Co. of New York. The date of manufacture is unknown. Used in well work at Standen and Drellingore Pumping Stations to provide air and ventilation the engine was displayed at the Cherry Gardens Museum, Folkestone until 2001.

In my previous article on the Brede Pumping Station I described and illustrated the large Worthington-Simpson engine in No. 2 engine house. Another engine from the same maker is now on display, this time a horizontal compound engine rather than a triple. With a Works No. 35385 it was supplied to Hastings Corporation Water Department in 1918 and installed in Denge Pumping Station. With a high pressure cylinder bore of 8¼in. and a low pressure cylinder bore of 13in. the stroke is 13in., this engine drives a pump with a bore of 6¼ inches. The engine remained at Denge until 1976 when it was moved to the Cherry Hills Museum. The move to Brede took place in 2001.

At this time my internal clock indicated lunchtime so I made my way to the barbecue where delicious burgers and hot dogs were available made from Sussex beef and pork and cooked to perfection. the charge made was extremely reasonable. Having satisfied the inner man it was time to look at the outside exhibits. One of the local society's giving their support to the event was the Sussex Engine and Associated Machinery Society and they showed an interesting collection of stationary engines. A Hartop 'S' type engine of 1923 was driving a early dynamo from around 1890-1895. Built by the Dymo Crypto Works Co. Ltd., it develops about 12-18v DC. It is often nice to see working engines in their original paintwork even if it is rather careworn. An exhibit that came under this description was a 2½hp petrol engine built by the United Engine Co. of Lansing Michigan. Although it was built in 1925 at the Enterprise Works, Waterloo, Iowa, it ran very sweetly as if it had just left the factory.

The one car that my father always wished to own, but never did, was an Austin Seven. On display was a 1937 Saloon that would have brought a gleam to his eyes. Bought by the current owner in 1964 for £35 it has clocked up 80,000 miles, including many continental trips. Standing alongside was a very unusual car, a Hudson, built by Essex Motors of Detroit. This car was found in Australia and is beautifully restored and maintained. While we are talking ▶

Left: Bringing back memories, a collection of vintage motor oil cans. Most of the manufacturers are now, sadly, consigned to history.

Right: Hartop 'S' Type engine of circa 1923 driving a Dynamo from around 1890-95. This develops 12-18 volts D.C. and was made by the Dymo-Crypto Works Co. Ltd. of London.

Passing the Tangye Engine House is the Fowler traction engine Berkshire Queen/Gysbertina of 1909.

Field Marshall Tractor heading a line of tractors which included two types of John Deere.

Two Kennedy Water Meters, the right-hand one has its casing removed to show the working parts.

about road vehicles parked outside the No. 2 engine house was the Fowler traction engine No. 11814 of 1909 *Berkshire Tariff Queen/ Gysbertina* owned by local enthusiasts it was only a short trip to the celebrations. To complete the outside display there was a line up of tractors including two types of John Deere and the ever popular Field Marshall.

At this point outside the main engine house visitors who were interested in seeing the modern electric pumping station met at regular intervals for guided tours of the installation led by Southern Water guides. These tours proved very popular. Another regular tour, this time organised and staffed by Brede Society members was for youngsters (although I understand the upper age limit was 90 plus!) This tour started from the Tangye Engine House and included going under the engine where the various pumps and rods wore explained to the visitors.

The subject of the weekend's celebrations, the Tangye engine has been repainted in the original colours. Great care was taken removing the layers of old paint to find the original finish. The volunteers are to be congratulated on the standard of the restoration. I made my way back into the main exhibition area to continue looking at the new (to me) exhibits. On the south wall were displayed gauges and display boards from stations that are now unmanned. Also attached to the south wall were a number of smaller engines used throughout the Hastings system. Another example from the firm of Worthington Simpson was a vertical Duplex Pump This pump was purchased by the Eltham Valley Water Co. for well sinking drainage in 1938, it was last used during the drought of 1949. Another type of pumping unit displayed is a Pulse Meter Pump by J. T. Williams and Son of South Bermondsey, in London. As most visitors may be unaware of the operation of this type of pump the covers are open and a very informative drawing and description completes the display. If you have ever wondered how an old-fashioned gas meter worked then you have the chance to find out at Brede. Two T. Kennedy gas meters are on display, the larger one of the two having the cover removed. Inside are a system of levers, and gears recording the amount of gas used. To bring the display up-to-date a Harland Ulectriglide Pumping Unit. This equipment was made by the Harland Engineering Co. Ltd., of Alloa, Scotland in 1965 and will pump 310 gallons per minute. The unit has been sectioned so the you can see the internal motors and pumps.

Most people will think that all steam engines in pumping stations are used for pumping water. A beautifully restored and presented Reader Compound Enclosed Engine proves otherwise. Coupled to a large dynamo producing 440 volt D.C. the generator was used at Denge Pumping Station to provide power and lighting before mains electricity was available.

Mr. John Foxley, chairman of the society, explains details to visitors while dressed in the style of a Victorian engineer.

Totally enclosed Reader Compound Engine coupled to a dynamo generating 440v D.C.

That was not the end of things to see though. The Sussex Industrial Archaeological Group put on a most interesting display of research, and drawings of local windmills and an example of the use of mathematical tiles. (a form of building construction that is peculiar to Sussex). Also on sale was a large range of publications and journals in which papers written by the members detailing the result of their researches are published.

Talking about research, a leading member of the Brede Society Mr. George Coleman has written a large number of books detailing the history of Hastings Borough Water Department and the various pumping stations and pipelines the area. George was in attendance and was signing copies for the visitors. Finally in the exhibition hall the ladies (and gentlemen) of the society were providing teas, coffees and cakes at very reasonable prices. Alongside the refreshment area were books, jigsaws and other items being sold to raise funds for the society One thing struck me during my visit was the fact that no one was being taken advantage of, admission was free, catering and refreshments were very reasonably priced and less than those charged at comparable events.

Congratulations are due to John Foxley and the members of the society for a splendid weekend. Situated six miles north of Hastings on the A28 road to Ashford, the engines are on view on the first Saturday of every month. More details are on the society's website **www.villagenet.co.uk/rotherlevels/attractions/content/brede-giants.html** If you have not been before you are in for a treat; if you have then go again as there is lots more to see!

KEITH'S COLUMN

LILLIAN
A NARROW GAUGE LOCOMOTIVE
for 7 1/4in. gauge

The smokebox and smokebox door of **Lillian** *add character to to this handsome locomotive.*

Keith Wilson
describes the smokebox for this delightful locomotive.

●*Part XVI continued from page 640 (M.E. 4261, 25 November 2005)*

The smokebox is in one sense one of the character-ensuring parts of a locomotive; imagine an A4 without front streamlining, or the majestic appearance of a King or Duchess or a Merchant Navy with a different box.

I used to make these animals out of 18 gauge mild steel, as my facilities for rolling up sheet in those days were somewhat limited. However, it is a strange happening that in such a case the barrel part seemed to rust long before the cast iron door or the door ring. I don't know why this should be so, but nowadays at least 13 gauge brass is the rule. Probably the difference in 'rustability' between mild steel and cast iron has something to do with it.

I show the development of the box, as it is (obviously!) somewhat easier to mark out and drill 'in the flat'. With this thinner material (relative to the boiler barrel) there is not so much need to leave the big holes until rolling is complete. The reason for this is at least twofold. Firstly, the hole in the boiler barrel must be circular; and it wouldn't be after rolling, it would be elliptical and will need extra trimming. Also, depending on the strength and rigidity of your rolling machine, the barrel might end up rather 'uncircular' where the big hole is. In the case of the smokebox this (w)hole ellipticallity (another useful new word) is not so important, for the chimmock base is somewhat larger in diameter than the hole.

I wonder if one or two of the above-invented words will make it into the dictionary? The fabulous Goon show got at least one, 'lurgi' and incidentally got away with a very vulgar four-letter word that I have never heard anywhere else on radio or television.

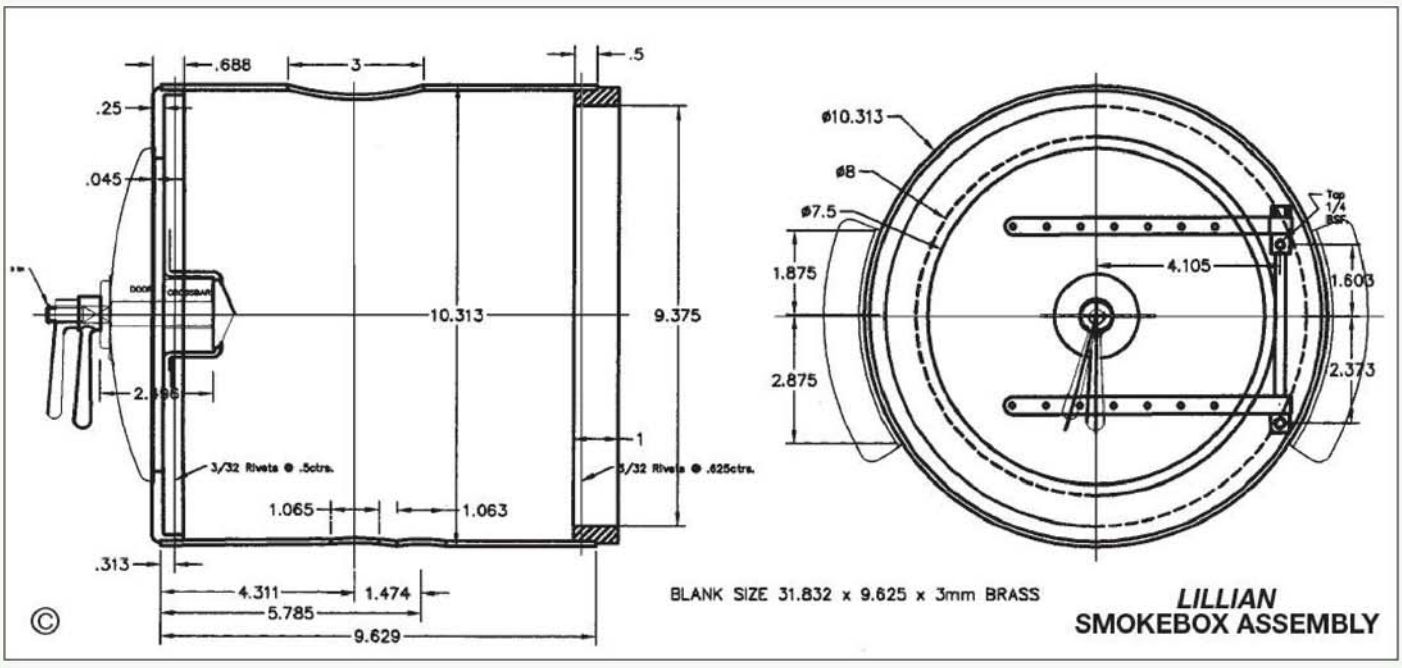
It is, perhaps, unnecessary to warn about avoiding any rivet-heads on the outside where they could impinge on the saddle. 'Tis most annoying to have to chip the darn heads off to 'make ends meet', better to avoid the problem in the first place.

It is most important that the smokebox is airtight, and it is just about impossible to test for this. Fortunately, the pressure concerned is very low. The use of Plastic Padding (car body work repair paste) is okay, likewise Gun Gum purchasable for repair of silencers works well. Both must be applied to dry, non-greasy surfaces, dust free to boot, but the Gun-Gum is applicable to water-wet surfaces. In the old days, white asbestos (the relatively harmless one) kneaded to a thick paste with water did very well, but today, nowt doin'.

It would appear that soft solder (plumber's variety) might do, but watch it! The melting point of this material is just about high enough, but at a much lower temperature corresponding roughly to 150psi. in the boiler its strength is greatly and suddenly reduced. So use rivets on joints. I found that out the hard way! Not that we expect '150' in our kettle, but smokebox temperature can be lots higher than boiler temperature. So be warned, not that any harm is likely.

John and I were steam-testing a Simplex boiler about 30 years ago, taking the temperature up with 'the torch' whilst the big hole for the dome was sealed by a soft-soldered copper disc. The earlier hydraulic test to just over 200p.s.i. was perfect, but as the steam test pressure got to 150, an almighty swoosh and large amounts of steam and hot water, cooling extremely rapidly due to old 'latent heat', pervaded the ambient (you can look that one up for yourselves). The pressure gauge was an ex-GWR one, dated 1904 and bearing present and past red arrows at 225 and 250. So it was almost certainly on one of the semi-experimental 4-cylinder 4-4-2s (the early 'Stars') later on a King, and then on a dead Hall, from whence I acquired it - 'nuff sed! Having some years ago made a dead-weight tester, I have checked this gauge carefully and found that it constantly reads about 20 low all the way up, so this can be allowed for.

This worthy relic was screwed directly into the aforementioned copper disc, and it took us a long ▶



The smokebox barrel can be rolled from 3mm thick brass. Here the butt strip is about to be fitted.

Turning the smokebox door ring from solid bar. The centre was salvaged to form the top of the steam dome.

while to find it/them. Eventually it was located up in the workshop rafters. And it was not a lightweight object!

A dead-weight pressure-gauge checker is quite simple. A brass cylinder, 3/16in. I/D is mounted vertically with the lower end connected to a water-pump and to the gauge to be checked.

A weight of 5.522lb mounted on a 3/16in. dia. rod will cover a pressure of 200p.s.i.; other pressures are on a linear ratio i.e. 2.761lb is equivalent to 100p.s.i. A cubic inch of mild steel weighs 0.2818lb, so I will not over-insult my reader's intelligence by further calculations.

When testing, as you pump up the pressure (keeping one eye on the gauge) when you reach your required pressure suddenly the weight will lift off the bottom of the cylinder. There is no need to put a seal (O-ring) in the system, but in case you suspect any friction, give the weight a good spin whilst holding it clear of the bottom with the pump.

Appearance does help!

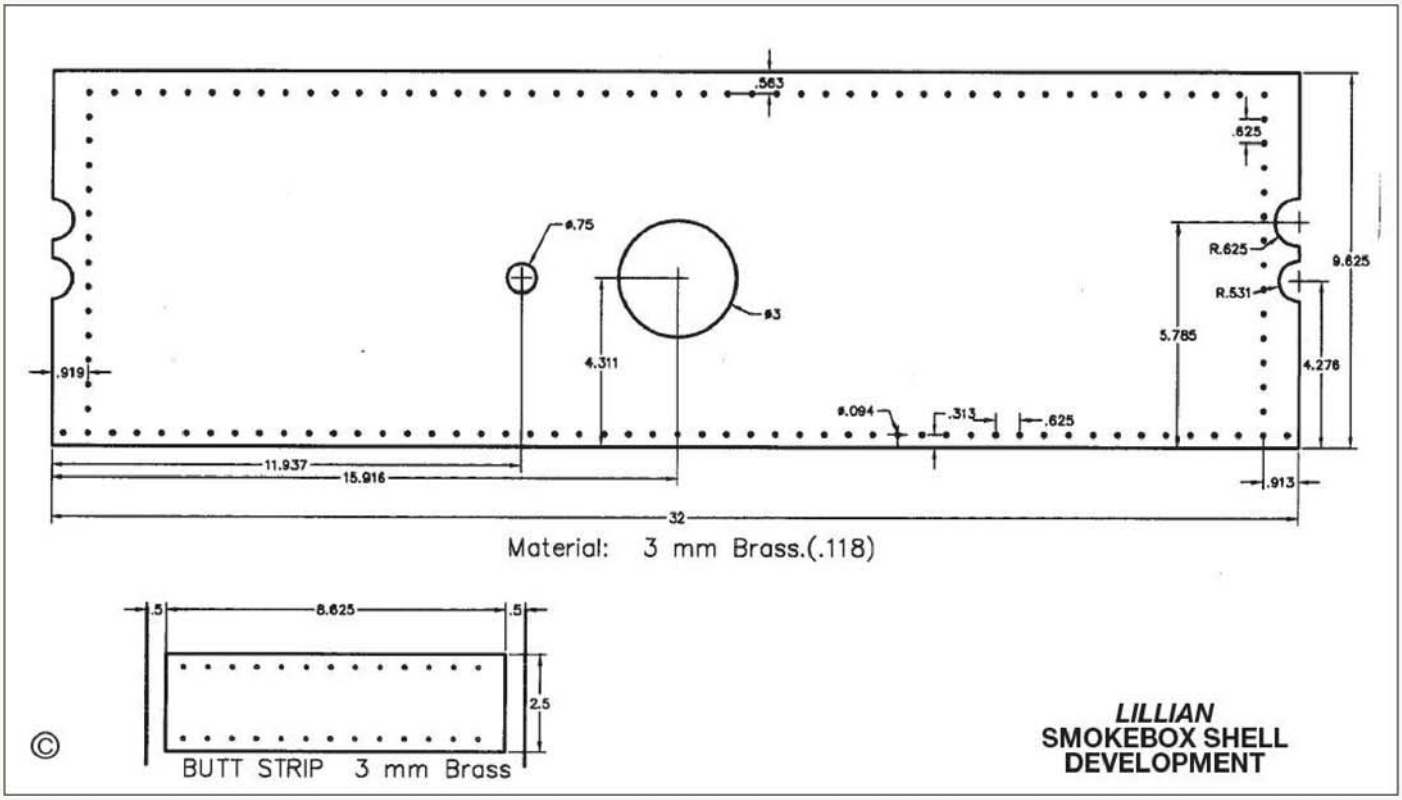
Perhaps it is not really worth mentioning, but a great deal of pleasure over and above normal driving of a steam locomotive is the usage of a really smart-looking puffer, nice lines of rivets on tender and smokebox/running plates etc. Admittedly, 'our' lines of rivets are frequently straighter than those on full-size locomotives (if you don't believe this, go to a railway museum and look *along* a line of rivets instead of looking *at* them. You would become wiser, but not necessarily sadder!)

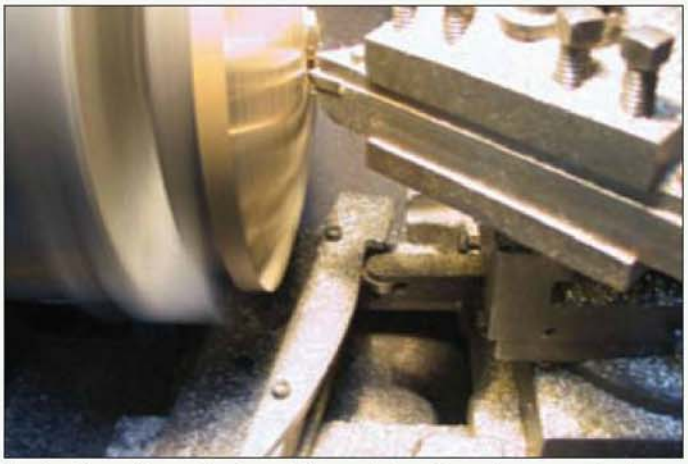
I may be wrong, but most 'prototype' smokeboxes seem to be made in two portions, parallel to the centreline, two side-pieces rather than top and bottom sections. This means two neat rows of rivets along the top centreline, remembering to leave clearance for the chimney (chimmock?) base.

There is a minor difficulty here, as it is not over-easy to ensure that the circular appearance is maintained; rolling smoothly right to the edge is not one of the lighter matters. One way out is to roll two halves, making each one about 5/8 instead of 1/2, and trim them down a bit before rivetting. Another way is to roll the complete box, keep the joint at the bottom, and make a nice deep scratch along the top so that at least from the outside it looks like the real joint. It works. (sssshhhh!).

I think I have located all the holes needed in the smokebox, but it is no insurmountable matter to drill some later. It is an idea to use what are known as 'bulkhead' fittings in penetrating the smokebox wall, they reduce the chance of leakage into the box. A useful variety is to make an ordinary 'connector' fitting and silver-braze it into the box. I have used this on my last batch of Kings (4 off), it makes life a lot easier when installing or removing a boiler, there is no need to faffle around re-stuffing crevices with one or other type packing.

My locomotive building list is now a bit longer than it was when I started the 'How to make 'em' series several years ago. Add (in order of construction) four Romulusses, four Kings, a pair of 7 1/4in. Hunslets, two Dean Goods (under construction at present) a *Lillian*, plus a *GWRillian*. Brings the total built up to 62. I am starting to learn a little about building puffers.





Turning the radius on the face of the smokebox door using a copy turning device attached to the lathe bed.

The finished smokebox door fitted with its hinges is a heavy item. Castings for the door and smokebox ring should be available in due course.

I think it was Riddle's requiem for the steam locomotive. Not sure of exact wording, but:-

Has served man well
Loved by many
Understood by none
R.I.P.

Please note *"understood by none!"* Amen indeed to that!

For those two somewhat vital (!) amenities, the door and door ring, castings should be available. It doesn't matter much whether they are of brass, gunmetal, or cast iron. Even aluminium is okay, but I have never tried it. In the case of our two, a friendly supplier flogged us two $10^1/2$ x 1in. discs and two 8 x 1in. discs, all brass (whoopee!) at about scrap prices. Didn't 'arf have a load of brass swarf that week! In fact we gained nicely, for the big cut-outs in the door rings left us with the material for the tops of the steam domes. Lots more swarf, but the job a bit further forward.

I have described a suitable tool for the lathe that will set it to cut the spherical door front by itself (sigh of relief).

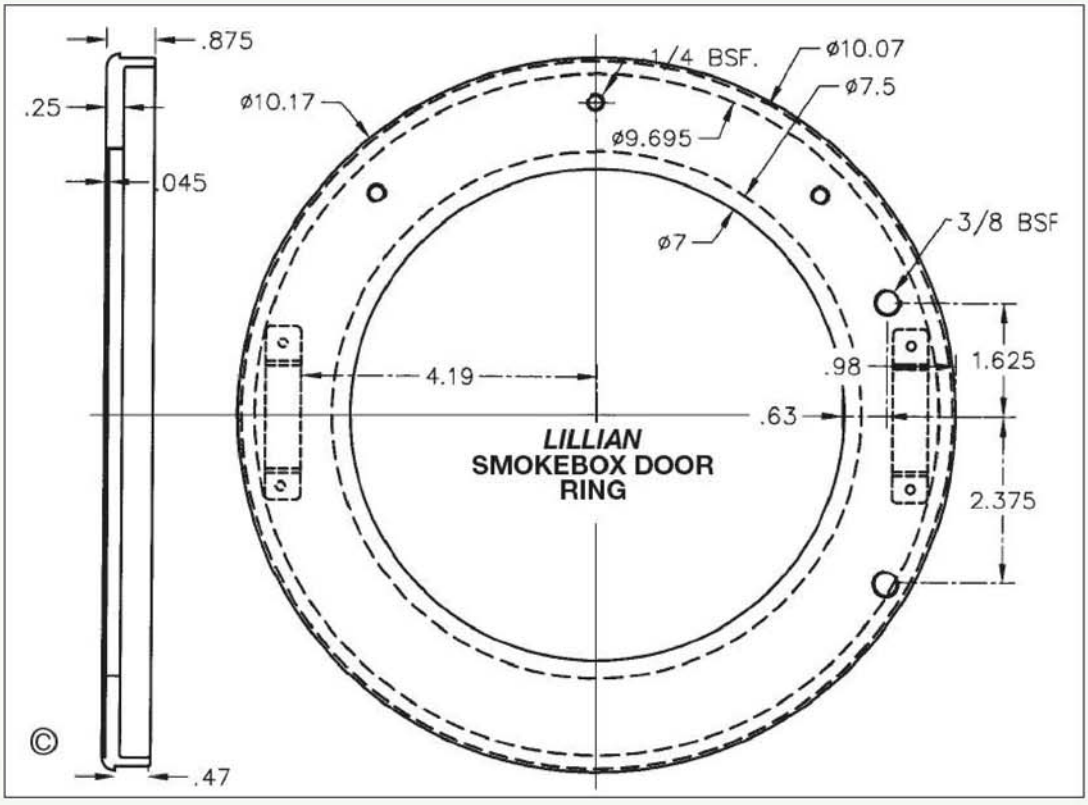
It is somewhat a source of sorrow that the final details of my Bulldogs have held up the *Lillian* work. My own fault, I had not fully appreciated the difficulty of just how many bits had to be crowded into the gap between outer and inner frames, mainly at the back. Spring columns, wheels (complete with balance weights) brake gear and not by any means least, drain cock operating lever and rod and injector pipe work. All in one almost inaccessible place. A nightmare, considering that obviously working parts need operating space. This of course means 'orrible bends in pipe work, and recalling that access is useful (to say the least) for the pipe work, not of easy solution. However, all is now well (touch wood) and with luck we will make faster progress - and doubtless spot more errors! These words are being written 21 July 2005.

Some railways had smokebox doors held closed by 8 or more 'dogs' (why so-called?) tightened by an equal number of bolts. These of course would take some time in releasing, so as far as coal-fired locomotives are concerned, avoid. I don't recall off-hand if these type doors were hinged, it would certainly cause problems of hoisting into place if they weren't. I think that the most common (in this country) method is a pair of long hinges, with a 'dart and crossbar' closing mechanism. Admittedly, many of these crossbars were not cross but vertical, however due to more limited sizes for us the movable horizontal bar is probably best - although it was not very pleasant to enter the box full-size, it is certainly impossible for us, pleasant or no.

Wilson's Words of Wisdom:
Man has a long and savage history. He has killed other animals not only for food but for the sheer pleasure of it; he has cheerfully enslaved his neighbours, murdered his opponents, and obtained the most unholy sadistical joy from the agonies of others.

Some miniature railways have a big fat vacuum cleaner installed, the ex-Stoneleigh Echills Wood certainly had, and equally certainly it made daily smokebox cleaning an easier operation. A reasonable compressor provides a convenient aid to lighting up, and an air-jet tube cleaner is also a welcome addition, it saves a lot of shoveling. After dropping the fire, it makes some sense to blow all the tubes through into the firebox whence the soot etc. drops to the ground. Keeping firebox door during this operation shut helps; anything to make daily drudge tasks a bit easier! I find an industrial vacuum cleaner is a great aid in the workshop, the larger flexible tube makes swarf-garnering easier. On the average domestic cleaner is a smaller tube and this is easily choked by mild steel swarf coils. They are darn sharp too, and can rapidly provide extra ventilation along the flexible pipe.

It would be rather difficult to bash out a door ring of this size, if of sufficiently hefty material, so a casting is the easiest way. But, with the



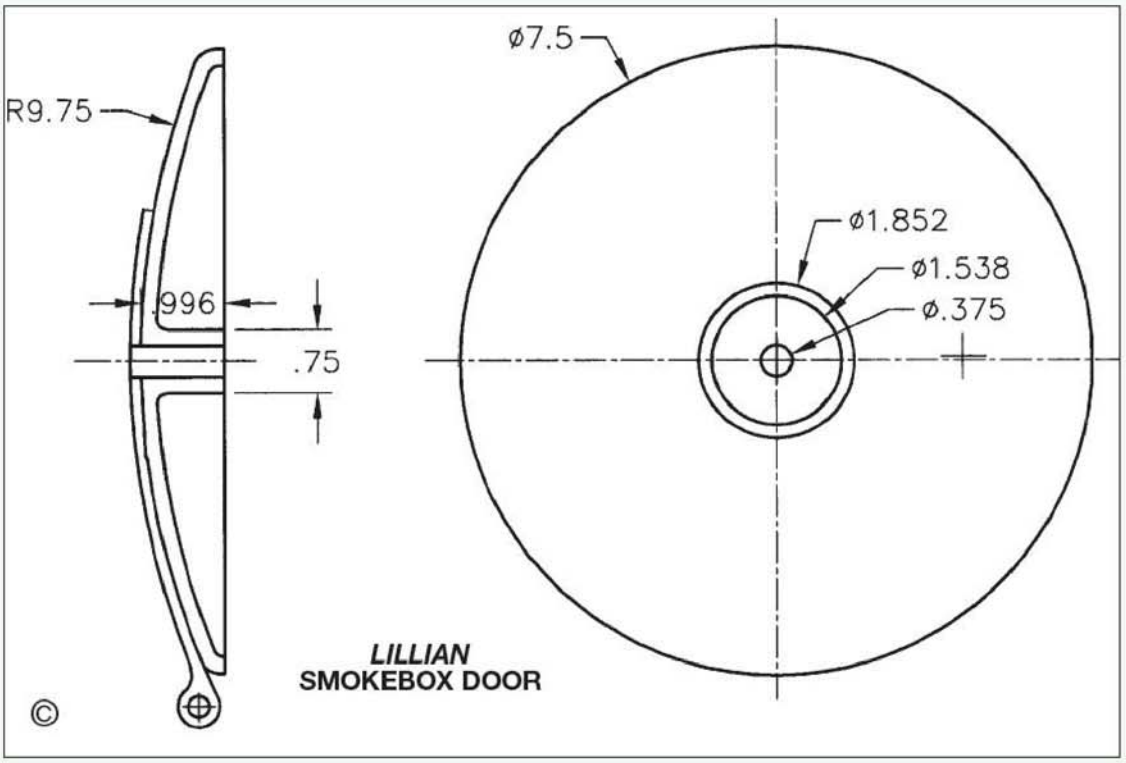
joint betwixt smokebox and boiler, this is rather easy to roll up out of a couple of pieces of brass sheet, for machining a ring of this size and profile presents problems. Won't go into a chuck, and dogging it to the faceplate needs some setting! The largest setting-up job that I am aware of, relative to the size of the lathe, was at Swindon. When they installed their de-lousing carriage system 'way back when' the door for this was about 16ft. diameter, and had to be pressure-tight. It took a week to set it up - I have seen the photograph, with the operator standing beside it. On the largest faceplate, big angle-brackets were set up, rather like huge chuck jaws. If memory is correct, it was on a big wheel-turning lathe. I am not sure how they got the rotation speed low enough, for it had to be something like 2 to 3 revolutions per minute. I have seen much larger lathes; we had a school trip to Fraser and Chalmers, I think they were at Erith in Kent. They were vertical lathes rather than horizontal like ours, but clearly mounting a casting of some 20 tons or so would be a bit of a *** on a horizontal lathe. I cannot recall if it was bolted down or not - it probably was - but I do remember that for a little time whilst we were watching the operator stood on the table (faceplate) barely needing to duck his head as it passed under the 'bridge' type tool post.

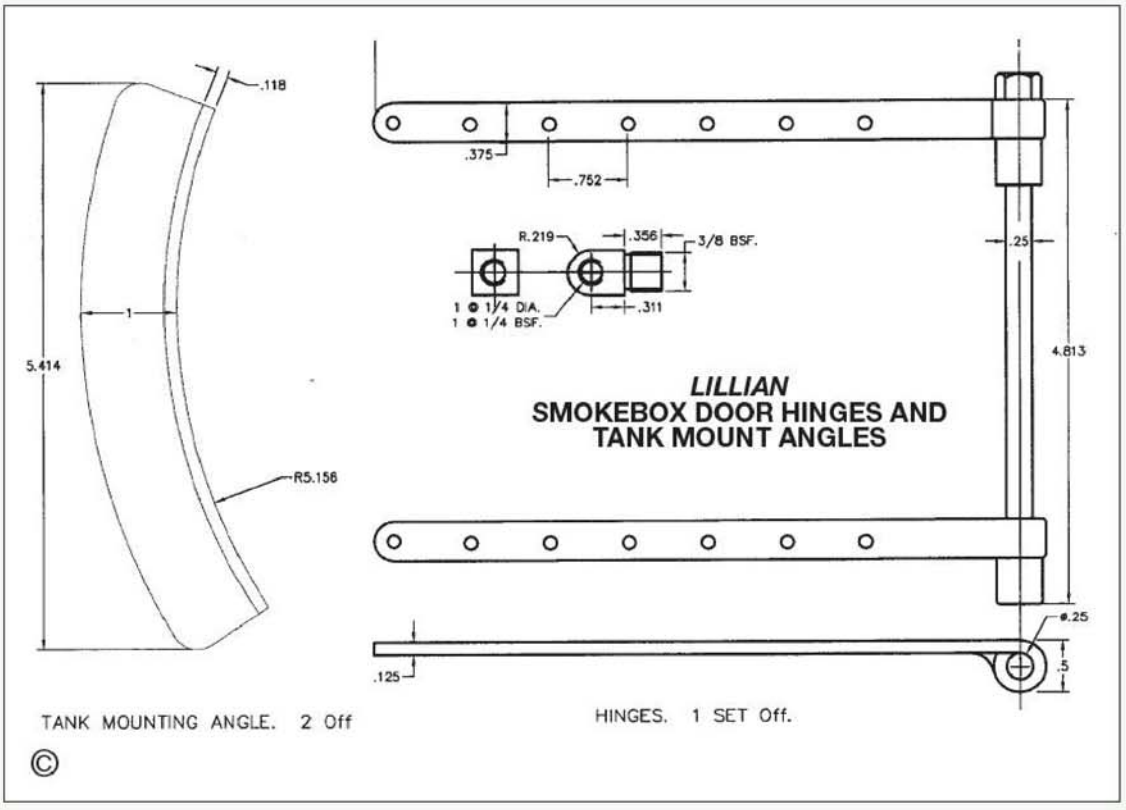
Note that the smokebox is larger than the barrel, this allows for lagging and cladding. The gap of 1/4in. gives 18g. cladding plus 3/16in. lagging. I don't know the best material for this, although the insulation of the outside of space-ships might do nicely - if we could get it. Glass wool seems excellent, as does kapok. Old blankets are not too bad, but one problem that raises its head is to keep the darn stuff in place until you can get the cladding sheets in place. Sellotape comes to mind, and no doubt those who have lagged their teapots have methods of their own. I have never bothered with actual lagging myself, for the air-space between boiler and cladding or cleating (or cleading) acts quite well as an insulator. Another suggestion was old cornflake boxes; cut up with scissors and these could be pasted on in layers.

I cannot see any point in showing a drawing for the cladding, for it has to be 'fitted' to the boiler concerned. If you aim for 18g as suggested above, then some strips 3/16 x 1/2in. of brass can be rolled up to space out the cladding from the actual kettle. They can be soft-soldered to the cladding. I recommend brass for cladding; reason - rust is rather hard to guard against in such an application.

I suggest avoiding stainless iron for this purpose because it does not hang onto paint very securely. This would result in a rather sad-looking locomotive.

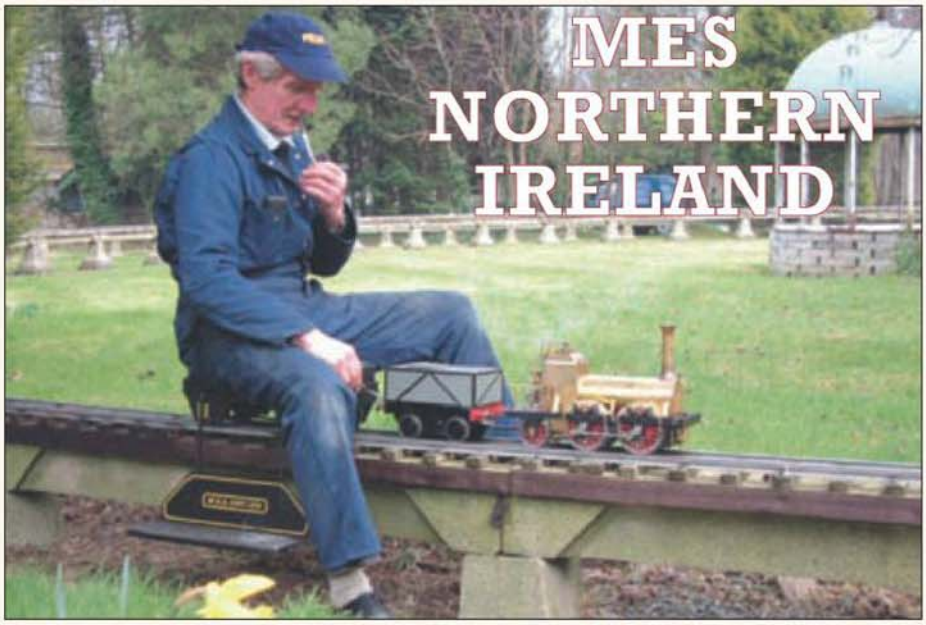
●*To be continued.*





CLUB PROFILE

MES NORTHERN IRELAND



Terence S. Aston
outlines this society which recently celebrated its Diamond Anniversary.

The Model Engineers' Society Northern Ireland was founded in 1944 by a group of dedicated model enthusiasts who saw the need for an organisation to encourage the skills of miniature engineering and its associated crafts in the home workshop. The main activity of members in intervening years has been the construction of miniature coal-fired, steam powered locomotives in various scales. These models are operated on our multi-gauged society track in the grounds of the Ulster Folk & Transport Museum, Cultra, Co. Down. Society members operate their locomotives at this venue on Saturday afternoons from April to September and on most public holidays. The principal gauges catered for are 7¼in. ground level and combined 5in. and 3½in. elevated track. In 2004 we introduced a new G gauge raised track.

A number of members construct and operate traction engines and steam wagons as well as internal combustion and stationery steam engines. There is also a strong interest in model ship and boat construction including, of course, their motive power. We have recently constructed a boating pond to cater for this aspect of our hobby. A devoted section of the society also constructs clocks of many diverse types. The production of machine tools, jigs, artefacts which aid the construction of models is another aspect of the skills exhibited by members in their own workshops.

The society publishes a monthly newsletter, appropriately named *The Link,* which keeps the membership advised of society affairs, meetings and interesting and informative jottings. Regular monthly meetings are held from September to June, when topics include talks and discussions, film and slide shows and displays of members work. Currently meetings are held in the the classroom of The Ulster Folk & Transport Museum, situated beside the Manor House, on the first Thursday of each month, where visitors will receive a warm welcome.

CLUB DIARY

A minimum of 6 weeks notice is required for diary entries. Clubs and Societies are asked to include a telephone number for the assistance of would-be visitors.

DECEMBER

23 **North London SME.** *Workshop Evening.* Contact David Harris: 01707-326518.
24 **Bournemouth DSME.** *Humbug Day.* Contact Dave Fynn: 01202-474599.
24 **Hornsby ME.** *Boiler Inspection.* Contact Ted Gray: 9484-7583.
24 **Nottingham SMEE.** *Santa Specials.* Contact Gerry Chester: 0115-9259096.
26 **Cambridge MES.** *Boxing Day Steam-Up & Get-together.* Fulbrooke Road. Contact Rex Mountfield: 01284-386128.
26 **Canvey R&MEC.** *Boxing Day Steam-Up.* Contact Brian Baker: 01702-512752.
26 **Cardiff MES.** *Steam-Up and Family Day.* Contact Trevor Jenkins: 029-2075-5568.
26 **Guildford MES.** *Boxing Day Steam-Up.* Contact Dave Longhurst: 01428-605424.
26 **High Wycombe MEC.** *Boxing Day Steam-Up.* Contact Eric Stevens: 01494-438761.
26 **Leeds SMEE.** *Boxing Day Steam-Up.* Contact Colin Abrey: 01132-649630.
26 **Leyland SME.** *Boxing Day Mince Pie & Steam-Up.* Contact A. P. Bibby: 01254-812049.
26 **Maidstone MES (UK).** *Boxing Day Run.* Contact Martin Parham: 01622-630298.
26 **Stockholes Farm MR.** *Steam-Up.* Contact Ivan Smith: 01427-872723.
26 **Sutton MEC.** *Boxing Day Run.* Contact Bob Wood: 0208-641-6258.
27 **Bradford MES.** *Mince Pie Steam-Up.* Contact John Mills: 01943-467844.
27 **MELSA.** *Tuesday in the Park.* Contact Graham Chadbone: 07-4121-4341.
27 **Staines SME.** *Post Christmas Steam-Up.*Contact Stan Bishop: 01784-241891.
28 **North London SME.** *HO Group Afternoon.* Contact D Harris: 01707-326518.
29 **Cardiff MES.** *Club Chat.* Contact Trevor Jenkins: 029-2075-5568.
29-31 **THE MODEL ENGINEER EXHIBITION, Sandown Park, Esher, Surrey**
29 **Sutton MEC.** *Wind-up/Wind-down Night.* Contact Bob Wood: 0208-641-6258.
31 **New Jersey Live Steamers, Inc.** *Midnight Run.* Contact Karl Pickles: 718-494-7263.

JANUARY

1 **Brighton & Hove SMLE.** *New Year's Steaming.* Contact Mick Funnell: 01323-892042.
1 **Chesterfield MES.** *Arctic Running.* Contact Mike Rhodes: 01623-648676.
1/2 **Claymills Pumping Engines.** *Open Days.* Contact B. Eastough: 01283-812501.
1 **Frimley & Ascot LC.** *New Year's Day Run.* Contact Bob Dowman: 01252-835042.
1 **Leyland SME.** *Chairman's Run.* Contact A. P. Bibby: 01254-812049.
1 **New Jersey Live Steamers, Inc.** *New Year Run Day.*
1 **Nottingham SMEE.** *New Year's Day Run.* Contact Gerry Chester: 0115-9259096.
1 **Peterborough SME.** *New Year's Day Run.* Contact Tony Meek: 01778-345142.
1 **Portsmouth MES.** *Frostbite Run.* Contact John Warren: 023-9259-5354.
1 **Romney Marsh MES.** *New Year's Day Track Meeting.* Contact John Wimble: 01797-362295.
1 **Saffron Walden DSME.** *New Year's Day Steam-Up.* Contact Jack Setterfield: 01843-596822.
1 **Sutton MEC.** *New Year's Day Run.* Contact Bob Wood: 0208-641-6258.
1 **Tyneside SMEE.** *New Year Run.* Contact Ian Spencer, 0191-2843438.
1 **Westland & Yeovil DMES.** *Frost Bite Run.* Contact Gerald Martyn: 01935-434126.
3 **Romney Marsh MES.** *Bobby Jones: Bob Jones' Travels.* Contact John Wimble: 01797-362295.
3 **West Wiltshire SME.** *16mm Live Steam Running.* Contact R. Nev. Boulton: 01380-828101.
4 **Andover DMES.** *John Marquis: Micro Engineering.* Contact John Berry: 01960-882616.
4 **Bradford MES.** *Meeting.* Contact John Mills: 01943-467844.
4 **Guildford MES.** *Talk on The Darjeeling Railway.* Contact Dave Longhurst: 01428-605424.
5-9 **Hutt Valley MES.** *CANMOD Convention.* Contact Gavin McCabe: 567-4487.
5 **Leyland SME.** *AGM.* Contact A. P. Bibby: 01254-812049.
5 **Sutton MEC.** *Bits & Pieces.* Contact Bob Wood: 0208-641-6258.
6 **Aylesbury (Vale of) MES.** *Ray Orth: Restoration of the Wendover Canal.* Contact Andy Rapley: 01296-420750.
6 **North London SME.** *Bring & Buy Auction: Tool and materials etc.* Contact David Harris: 01707-326518.
6 **Portsmouth MES.** *Members' Videos.* Contact John Warren: 023-9259-5354.
8 **British Columbia SME.** *Frostbite Meet.* Contact S Laurence: (604) 931-1547.
8 **Sutton MEC.** *Track Day.* Contact Bob Wood: 0208-641-6258.

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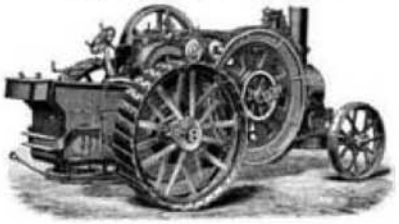

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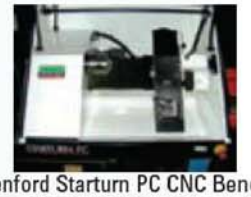

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Magnetic Chucks

100x175x60mm - 60N/cm²*	£155.00
100x220x40mm - 80N/cm²*	£185.00
120x245x60mm - 60N/cm²*	£180.00
125mm Dia x 56mm High - 80N/cm²*	£89.00

(* Holding Force)

Just Arrived: HSS BA Taps & Dies

HSS BA Taps 0BA - 16BA (Price per 3pc set)

0 - 6BA	£4.95	7 - 8BA	£7.50	9 - 10BA	£8.50
11 - 12BA	£14.00	13 - 14BA	£18.00	15 - 16BA	£21.00

Complete Set - 0 - 16BA - 51pc set £140.00

HSS BA Dies - 13/16" Dia (Price each)

0BA-6BA	£3.75	7BA-10BA	£4.95	0BA-10BA Set	£30.00

HSS BA Dies - 5/8" Dia (Price each)

6BA	£5.95	7BA	£6.95	8-10BA	£7.50	6BA-10BA Set	£25.00

Keyless Engineering Drill Chucks

1-13mm JT33 £18.00 3-16mm JT3 & JT6 £19.00

Drill Chuck Arbors - JT33, JT6 & JT3

(Drawbar or Tang) MT2 £3.50 MT3 £4.50 R8 £5.60

Lathe Collet Chuck Set

(Choice of Metric or Imperial Collets)

C3 - 80mm Dia	£89.50
C6 - 125mm Dia	£93.50
Spare Collets	£7.25 each

Cross Slide Digital Readout for Myford ML7 £125.00

Complete assembled unit comprises:

- Rotary encoded Digital Display Unit
- Ball Handle and Cross slide end plate
- 2 x Needle roller thrust bearings and 1 x ball raced bearing for smooth running and to remove end float.
- A new 20 TPI EN8 leadscrew and bronze nut will minimize backlash and prolong life.

Suitable for Myford ML7 only.

HSS 90deg. Countersink / Deburring 5pc Set £13.95

ER Spring Collets

ER11 Collets 1-7mm & 3/64"-17/64"
in 0.5mm or 1/64" increments £8.50 each

ER32 Collets

2-3mm	£6.00 each
3.5-20mm	£5.50 each
21 Pc Collet Set 2-20mm in 1mm increments + 2.5 & 3.5mm	£105.00

ER32 Milling Collet Chuck Set
with 6 Collets MT3 or R8 £89.95

ER32-T2 Standard Nut £9.95

MT2 Indexing Tailstock Turret System

(6 Way) for 16mm Spigot Tooling

Turret Only £45.00

Tooling for above Turret

Live Centre	£10.00
Tapping Collet Set	£35.00
Die Holder	£25.00
Drill Chuck Arbors (JT0, JT1 & JT2)	£2.75 ea

Complete MT2 Turret Set £110.00

Boring Heads

50mm Boring Head Supplied with 9pc Carbide Tipped Boring Set (12mm or 1/2" Shank) but without Arbor £48.00

Boring Head Arbors

MT2 (M10 or 3/8" Whit thread)	£9.75
MT3 (M12 or 3/8" Whit thread)	£10.75
R8 (7/16" UNF Thread)	£12.00

Carbide Tipped Boring Cutters

(12mm or 1/2" Shank) - 9pc Set £12.00

Please note that we are closed for Christmas from 16th December to 8th January incl.

Order on-line at: www.arceurotrade.co.uk to see the full range

Or phone us on 0116 269 5693 for Catalogue No. 4
10 Archdale Street, Syston, Leicester, LE7 1NA

All prices include VAT. P&P is extra and based on order value:
£0-£5 = £1.25, £5-£10 = £1.75, £10-£20 = £2.50, £20-£50 = £3.50, Over £50 = Free

Arc Euro Trade

END OF YEAR SALE

HOME AND WORKSHOP MACHINERY

QUALITY USED MACHINE TOOLS

144 Maidstone Road, Foots Cray, Sidcup, Kent, DA14 5HS.
Telephone 020-8300 9070 – Evenings 01959 532199 – Facsimile 020-8309 6311
www.homeandworkshop.co.uk stevehwm@btopenworld.com

Opening Times: Monday-Friday 9am-5.30pm – Saturday Morning 9am-1pm
10 minutes from M25 – Junction 3 and South Circular – A205

Myford / Boxford equipment just in from retired engineer, hardly used

ALSO DOWN IN PRICE

Marlco notch broaching fixture from £425 to £200
Meritus 8KVA spot welder Was £425 Now £299
Meddings MK4 fretsaw Was £345 Now £249
Eagle surface grinder + magnetic chuck Just £725
Verical bandsaw adapted for low speeds, 240 volts £425
Myford vertical slides (Not Copies) from £140
Boxford collets (Not Copies) each £12
Boxford coolant system (original) three phase £345
Loads of machines and parts 'in house to callers only' including steel stock

Elliot powered suface grinder "as good as it looks"

A selection of tinmans stakes

Colchester Master 2500, 61/2" x 40" lathe + gap and full power feeds and well equipped

Harrison 140, 5 1/2" x 24", gearbox, power feeds, gap bed and almost immaculate

We have a good selection of bench vices from £12.50 including the Record No.23 at £75 each

BCA jig borer/ milling/ drilling machine complete with collets & cabinet stand

Colchester Chipmaster 5" x 20", a very nice example with dual dials

Harrison vertical milling machine, 30 INT head + 30" x 8" powered table & coolant

Eagle surface grinder + 14" x 6" magnetic chuck

Boxford VM30 milling machine, 30 INT head + 3 Way DIGITAL READ OUT

BCA 12" rotary table

Tom Senior 'E' type milling machine, extremely rare and sought after

Jones and Shipman bench centres 4" x 24" between centres

Houser 12" rotary table in very nice order

Easi Blaster (sand) cabinet + 2HP compressor

Henry Milns 6 1/2" x 48" geared head, gearbox and gap bed + tooling just in off the lorry

Elliot 8" pedestal grinder

Boxford 1130, 5 1/2" x 30"

Boxford CUD Mk III lathe 5" x 22" in very order

Harrison M250 lathe complete with 3 and 4 jaw chucks, extra gears, with the high 2000rpm top speed almost as new

Eclipse De-magnetisers

RJH 4" linisher complete on dust extraction cabinet stand

Viceroy pedestal buffing machine

Mercer dial gauge imperial reads to .0005" Ex Mod complete still boxed (last few available)

Boxford pedestal drill

Small tooling! at 'Home & Workshop Machinery'

Marlow vertical milling machine complete with 28" x 61/2" table

Lorch precision lathe complete with collets

Q & S 6" Terrier sawmaster hacksaw, very late machine just off the truck

Myford Super 7B precision (gearbox) screwcutting lathe + power crossfeed, cabinet stand, drip tray & blocks and rare Hardened Bed

Crompton Parkinson Motors NEW 3/4HP ideal for Myford & Boxfords etc.

Myford ML7R 3 1/2" x 19" + clutch / lever tailstock

Transwave agent for static and rotary converters

Raglan 5"x24" lathe complete with gearbox, variable speed & power cross feed

Tom Senior ELT Universal swivel variable power feed 36"x8" model complete with knuckle head

Norton No.6 flypress complete with Hunton bolster

PLEASE PHONE 020 8300 9070 TO CHECK AVAILABILITY OR TO OBTAIN OUR LIST

DISTANCE NO PROBLEM!! DEFINITELY WORTH A VISIT ALL PRICES EXCLUSIVE OF V.A.T.

We also have a massive range of small tooling far too much to list!!

Just A Small Selection Of Our Current Stock Photographed!!

Chester UK Ltd

Conquest Lathe

£345

Features
High Precision Bearing
Variable Speed
Thread Cutting

Standard Accessories
80mm 3-Jaw Chuck
Quick Change Toolpost
Set of 5 Lathe Tools
and more...

Specifications

Swing Over Bed	180mm
Dist. Between Centres	325mm
Dimensions	770x254x300mm
Net Weight	38kgs

Conquest Mill

Features
Dovetail Column
Variable Speed
Angled Milling

Standard Accessories
1-13mm Drill Chuck & Arbor
Milling Drawbar
Variable Speed

Specifications

End Mill Capacity	12mm
Table Size	90x404mm
Dimensions	490x445x860mm
Weight	55kgs

£450

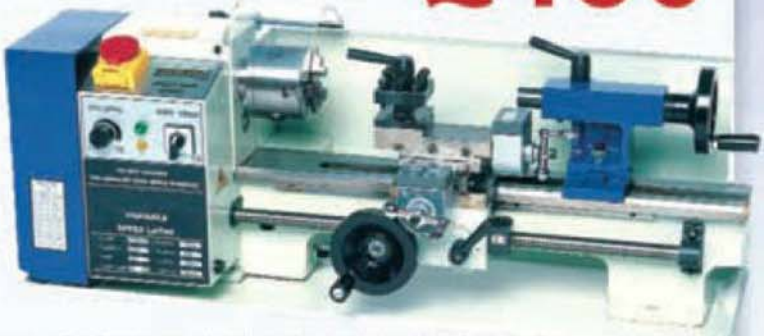
Conquest Lathe Super

£450

Features
Digital Display on Cross/Compound Slide
Digital Speed Display
Variable Speed

Specifications

Swing Over Bed	180mm
Dist. Between Centres	355mm
Dimensions	770x254x300mm
Weight	38kgs



Standard Accessories
80mm 3-Jaw Chuck, Quick Change Toolpost, Set of 5 Lathe Tools, and more...

Chester UK wishes all our customers a merry xmas

FREE DELIVERY

UK Mainland Only

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