# MODEL ENGINEER

Vol. 191 No. 4201

8 - 21 August 2003 £2.30


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*Hosted by*
*Reading SME*

*Sunday*
*12 October*

*Prospect Park*

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Handy workshop unit

## ART AND THE ARTISAN

Chuck goes philosophical

## CROSS-SLIDE MILL/DRILL

Compact, convenient control

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Welcome to the real world



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# IN THIS ISSUE

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***On the cover ...***

*In competition at the 72nd Model Engineer Exhibition at Sandown Park, this first class example of a Wimshurst machine is the work of young James Finch in Surrey who designed and built it at the age of 17 years as a GCE A-Level Design & Technology project.*
*In awarding it a very well deserved Gold Medal in Class J3, the Judges were particularly impressed by the very high standard of James' workmanship, his close attention to the details of design, and the impressive finish with which the fully operational Wimshurst machine, capable of generating 45kV, was presented.*

***(Photograph by Gary Sinfield)***



***TURN TO PAGE 166 FOR GREAT OFFERS ON SUBSCRIPTION RATES!***

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# SMOKE RINGS
## With the Editors


A detail of Alan Walker's 2in. Burrell scenic road locomotive photographed at Harrogate. Readers in the south of the UK will be able to enjoy the quality of this superb miniature in the model engineer exhibition marquee at the Knowl Hill Steam Rally 9/10 August

### Scorcher!
These notes are being written immediately following IMLEC 2003 at the Ashton Court tracks of Bristol SMEE, held on what for most of the UK could well have been one of the warmest weekends of the year so far. Members of BSMEE had worked long and hard before the event to prepare their splendid track and site for the competition; they also gave unstintingly of their efforts to ensure that the event ran smoothly throughout the weekend. Particular mention must be made of the Bristol ladies who spent their entire weekend preparing and serving a range of delicious food and drink to visitors and members alike and managed to remain cheerful throughout! Special note must also be recorded of the team who operated the ground level $7^{1}/4$in. gauge railway during the weekend, providing everyone with the opportunity to ride while the competition proceeded. A varied and most interesting exhibition of members' work was set out for our enjoyment and several friends in the trade supported the event.

This being the fifth occasion IMLEC has been run by Bristol members, they have become extremely expert in the matter; the organisation was very slick and no hitches or delays occurred which could be attributed to the organisers. With the availability of digital technology, and the expertise to use it, each competitor was presented with a personalised Certificate recording not only his or her part in IMLEC 2003, but listing the relevant data relating to their performance and bearing a colour image of themselves photographed during their run.

Our thanks to all competitors and to everyone who contributed in whatever way to the undoubted success of IMLEC 2003, one of the social highlights of the year, and one which invariably causes much ensuing debate and discussion. Our formal reports will follow soon, when all the details are to hand.

Make a note in your diary for next year that IMLEC 2004 will be held at Kinver over the weekend 10/11 July 2004.

### LBSC Memorial Bowl Competition
We welcome entries for this year's competition which will take place on the superb elevated $2^{1}/2$, $3^{1}/2$ and 5in. gauge track of Rugby MES Ltd. on Sunday 14 September 2003.

It is doubtful that the hobby which we enjoy would be as widespread and as popular as it is today had it not been for the inimitable style of the prolific writer whose famous 'Words and Music' in these and other pages have inspired model engineers to produce astounding work with no other instructions than those provided by the one and only 'Curly' Lawrence, otherwise known by the pseudonym 'LBSC'.

It is to celebrate his contribution to the hobby that this competition was originally introduced and it is to his memory that we are delighted to continue with it year by year. It is a one-day event during which steam locomotives to or based on LBSC's designs are steamed up and run in a relaxed and enjoyable atmosphere, and in the very good company of fellow enthusiasts.

The only entry restriction which currently applies, other than that just stated, is that only engines which have not already won an award in a previous LBSC Memorial Bowl Competition are eligible.

So, whether you are a novice builder/driver, or experienced, if you have an LBSC design locomotive which you have built, completed or purchased outright, we would enjoy your company at Rugby. Why not contact Club Chairman David Eadon at 162 Hillmorton Road, Rugby, Warwickshire CV22 5AL (tel: 01788-576956), ask him for an entry form and have a go?

### SEQLEC 2003
We are pleased to announce that arrangements are now well in hand for the 2003 $7^{1}/4$in. gauge Model Locomotive Efficiency Competition which will be held on Sunday 12 October at the Prospect Park track site of Reading Society of Model Engineers on the A4 Bath Road just west of Reading in Berkshire.

Readers wishing to participate in this thoroughly enjoyable event for owners/drivers of $7^{1}/4$in. gauge steam locomotives should make a note of the date, keep the weekend clear and contact Reading SME Chairman Gary Williams for an Entry Application form. Gary is at 96 Highfield Park, Wargrave, Reading, Berkshire RG10 8LE; tel: 0118-940-1405 or 0794-272106. Limited space is available for overnight camping or caravans, strictly by prior arrangement.

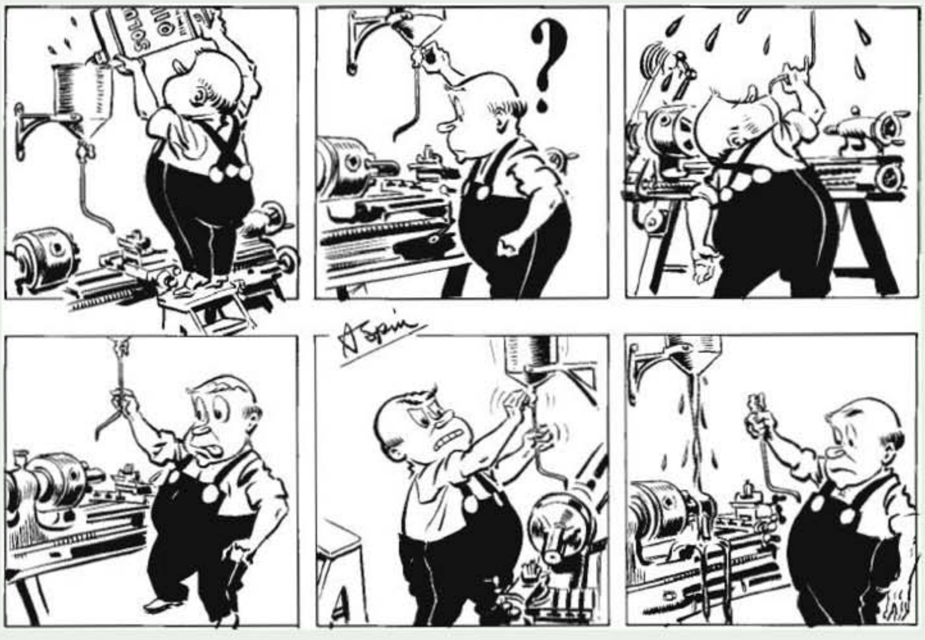
### Knowl Hill
Knowl Hill Steam Rally is a well-known high spot in the enthusiasts' calendar of summertime events. To be held this year on 9/10 August in its usual location just off the A4 west of Maidenhead, we learn that plans are well advanced for a bumper exhibition of model engineering at this year's event. We are informed that over 100 exhibitors have entered at this sought-after venue.

A star attraction and a very special feature for this year will be the pairing of Ron Dawe's Duke of Edinburgh Award winning 2in. scale Burrell Special Scenic Road Locomotive with Alan Walker's superb Burrell Scenic Road Locomotive recently featured on the cover of this magazine (*M.E.* 4199, 11 July 2003). Other exhibits which have been accepted for display include the exquisite carving on Ernie Summerhayes wonderful Savage gallopers — 45 years and still in the making — plus the late Bill Free's 1:10 scale Irvins gallopers. Members of Reading SME, the home club of our new Club News Editor Malcolm Stride, will be operating their 5in. and $7^{1}/4$in. gauge miniature railways as well as their *Thomas the Tank Engine* small gauge layout for younger enthusiasts.

*"This is no usual rally model tent"* said organiser John Billard, who added *"...the emphasis is on model engineering, boats and aeroplanes, and I am delighted to say that the standard of the exhibits seems to get higher every year."*

Contact John Billard (tel: 01189-340381; e-mail **billard@billardj.freeserve.co.uk** for further information.

### CHUCK the MUDDLE ENGINEER — by B. TERRY ASPIN



# POST BAG

## Fabrication or casting?

SIRS, - As a fabrication enthusiast, I was interested to read Trevor Faulkner's letter under the heading *Fabrication or Casting?* in *M.E.* 4196, 30 May 2003. In my opinion, there is much to be said in favour of fabricating many of the parts we make, as opposed to employing castings. There are also many situations where machining items from solid stock material is preferable to using a casting. In many cases fabrication enables far cleaner and more finely detailed components to be produced than can be achieved with sand castings.

This is particularly true in the case of very small parts where quite small moulding defects or inaccuracies can have a serious effect on appearance. The draft necessary on a pattern to facilitate withdrawal from the sand often produces 'out of scale' form errors which must be corrected by machining, leaving little benefit to be had from using a casting. The outside profile of eccentric straps is a typical example. In the case of 'one-off' models for which commercial castings are not available, fabrication avoids the manufacture of patterns which may only ever be used once.

In the case of more complex parts, the fabrication process calls for careful planning, which adds further interest and challenge to the task. In many cases it is necessary to incorporate additional features to facilitate assembly of the parts in preparation for silver-soldering and/or subsequent machining, these features being removed during the final stages of manufacture. Progressive soldering is also a useful technique, parts being incorporated into the fabrication in stages using solders of successively lower melting points.

If a component is to be purely functional, its fabrication may be fairly simple, but in most cases the simulation of a casting will be the intention. The use of soft-solder is often adequate for the application of cosmetic details, assuming the anticipated working temperature will be appropriate. The use of plumber's metal and to a lesser extent, tinman's solder, facilitates the incorporation of fillets at the root of webs, etc. Although I have not done so myself, I know of cases where final details and fillets have been incorporated using epoxy resins.

The other great advantage of fabrication is the cost saving. Much of the material required can be found in the 'odds and ends' box. As an example, I built a *Vulcan* Beam engine to the design by Edgar Westbury and which was featured on the cover of *M.E.* 4190, 7 March 2003, without purchasing a single item of material other than nuts and bolts. Castings are available for this model, but at a cost in excess of £100. Similarly, my Heinrici hot air engine, also to an Edgar Westbury design, (see *Post Bag, M.E.* 4183, 29 November 2003) was built without the use of castings, the only cost being the sheet steel for the furnace enclosure. Here again castings are available at a cost of around £100.

There are, of course, many cases where castings are the obvious and preferred choice even if fabrication is possible. This is particularly true of large heavy components or components which would involve very large numbers of individual parts to be fabricated, For example, I would not personally attempt to fabricate or machine from the solid the wheels for a locomotive although there are enthusiasts who have done so. Similarly it would be rather laborious to cut large gas engine flywheels with curved spokes from the solid. The economics become suspect when large quantities of material have to be removed by machining, bearing in mind the wear and tear on cutters, etc.

Mr. Faulkner suggests that a review of the advantages and disadvantages of fabrication might make for interesting correspondence. I offer the above observations in the hope that others will also be prompted to contribute their views and experience.

**Norman R. Barber, Essex.**

## Low cost lathe conversion

SIRS, - M. L. Appleyard (*M.E.* 4196, 30 May 2003) approaches the question of lathe batch production of parts from one point of view, and quite economically.

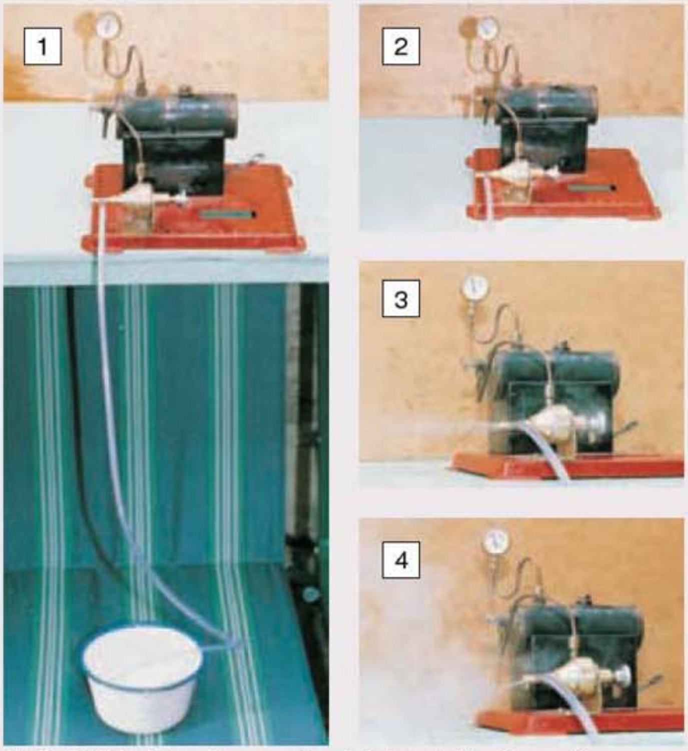
He raises the point that *"with older lathes it is nearly impossible to get consistent readings"* for cross-slide travel. One of my own Myford Super 7s is possibly as old if not older than the strangely painted version shown in the article. I tried his tests.

Using a dti with 0.001in. divisions, I scored 10/10. Using a Verdict gauge with 0.0001in. divisions, I scored 8/10. Upon closer examination of a 'failure' I realised that I had failed to set the division lines spot on. On the second run, I scored 10/10.

Of course I have 'cheated', the feed screw runs in a replacement Oilite bearing and is complemented by dual needle roller thrust races, i.e. no discernable backlash here. The feed nut has an *additional* modified feed nut to prevent backlash at this point. The point I make is that with a little care some older lathes can be very accurate indeed.

On the earlier point of speed and accuracy in use, I am adopting the use of a commercial industrial DRO system, which is a matter of personal choice and cost.

**K. A. Willson, Hampshire.**




***Mr. David Kirk's jet condenser and model steam turbine in operation. Photo 1 is of the boiler, pressure gauge reading 60psi, turbine, bowl and 24in. long siphon tube. Photo 2 shows the set-up ready to run. Photo 3 is of the steam turbine and jet condenser working together at speed. Photo 4 shows the steam turbine working well with the jet condenser operating.***

## Working jet condenser for a model steam turbine

SIRS, - Further to your *Queries and Replies* feature published on p1084 of *Model Engineer* magazine dated 5 November 1971, I enclose a copy of the original query and reply together with photographs showing the jet condenser in action with a small steam turbine.

The turbine wheel is a 1in. diameter stumpf wheel fully enclosed to a running fit within the casing to maintain laminar flow. The boiler joints are fully silver-soldered and the pressure gauge registers c180psi on the dial. The condenser is a convergent/divergent cone with syphon tube. At 15psi and above the engine runs very fast. For the sake of several experiments executed, a head of cold water is raised 22in. above the cold water basin and engine speed increases, due to the partial vacuum induced.

Its purpose may be of interest to your readers and the model fraternity. If this application has been successfully produced before, it would be most interesting to know. Your reply would be gratefully received.

**David Kirk, Kent.**

*(For those without access to the magazine quoted and published 32 years ago, the original enquiry sought design details for a steam turbine to power a ship model of unspecified size together with details of a gearbox, boiler, paraffin burner and float control gear. In the brief reply, which suggested that the enquirer should do his own research, is printed a comment which Mr. Kirk has highlighted stating "So far as we know, no experimenter has achieved a model steam turbine working on a condenser vacuum." — Eds.)*

## Small drills

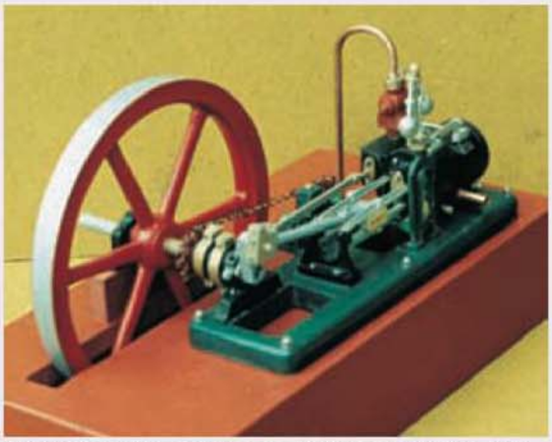
SIRS, - I have found that the best way to sharpen small drills is to build the simple little tool described by Derek Brown in *M.E.* 4119, 5 May 2000.

The sweet sound of the drill gliding across the diamond, knowing it is all at the right angles, is only surpassed by the self-centring and cutting action of the four facets. The now available credit card diamond stones are ideal for this purpose.

Thank you Mr. Brown.

**C. Barnwell, West Sussex.**

*The roller which Mr. Sinclair is using to illustrate his enquiry concerning scaling from photographs.*



*Dr. Tulloch's splendid Ransomes & May engine built mainly in wood, based on the Woking Precision Models drawings.*

## Photographic evidence

SIRS, - Does anyone know of a way of determining dimensions from a photograph taken at an angle? Perhaps by using trigonometry, vanishing points and the like.

I enclose a photograph of a roller at Victoria Beach, Manitoba to emphasise my question.

I expect the genius types among readers have already explored this and an article on their methods would certainly be appreciated.

**J. B. Sinclair,**
**Manitoba, Canada.**

*(If Mr. Sinclair cares to furnish us with full details of his address we will be able to forward replies to this enquiry — Eds.)*

## H. P. Jackson

SIRS, - Over the years a number of model engineering businesses have changed hands, disappeared or become amalgamated with other enterprises. One such business was that of the late Mr. H. P. Jackson, who lived in Acomb, York.

H. P. Jackson was a well-known and respected model engineer, who was active certainly from the 1920s through to the 50s. Indeed, I purchased a set of drawings and castings from him to build one of his $3^1/2$in. gauge Stirling Singles. The drawings were dated 1945 and were excellent examples of draughtsmanship of that period. While building the locomotive I encountered no dimensional errors and only had to resort to measuring the actual blue print on one occasion.

Following Mr. H. P. Jackson's death I understand that his son continued to supply drawings and castings for a period of about eighteen months before the business passed into the hands of Clarkson's of York. However Harry Clarkson only listed the $3^1/2$in. gauge Jackson designs including the Schools, a Princess, a Duchess, a King and an A3. The Schools design is a three-cylinder slide valve model dated 1932 and anticipated LBSC's piston valve *English Mechanics* series describing *Roedean* by several years. Again the Jackson drawings were of an excellent standard.

In the 1930s there are frequent references to H. P. Jackson's work and designs in the pages of the *Model Engineer*. Before I and the generation that may hold the answers pass on, can readers throw any light on what happened to the H. P. Jackson drawings for his $2^1/2$in. gauge designs? These included such as the GWR *Achilles* 4-2-2 and an LMS streamlined pacific, to mention but two that featured in the pages of this magazine.

**Des. Adeley, East Sussex.**

## Wrong side of the tracks

SIRS, - I was much amused to read in *Club Chat* about the problems experienced by the Saffron Walden club in making dual gauge points. I have made a number of sets for my garden railway and have never managed to get them right first time! Thank goodness for the welder's best friend, the angle grinder! My last efforts though, beat the lot.

My track consists of an inner oval with a much larger outer circuit which returns to a common side with the inner oval, joined with electrically operated points from the signal box. This gives two places where a reversing triangle is possible. I decided to make one.

The points went as well as ever, the angle grinder being well employed, but when I came to do the simple (?!) track work to join them up the problem emerged. The $3^1/2$in. gauge rail on the outside of the inner and outer circuits came round from the outer track and absolutely refused to end anything other than on the inside of the inner circuit!

I sat down with pencil and paper to draw out a set of staggered points, but then realised that there seemed to be no way a train hauled by a $3^1/2$in. gauge engine could ever run through the system as the 5in. passenger vehicle would arrive at the crazy points long before the engine was off them at the other end. My solution was crude and simple. $3^1/2$in. engines would have to stop, uncouple and be pushed carefully over the dreadful trackwork at the changeover. This consists of two open forks with check rail opposite to drag the engine over to the other side.

I wonder if any of the track experts have solved this one and how? I am sure *Chuck, the Muddle Engineer* will have the answer!

**Derek Lattey, Redhill.**

## Non-metallic

SIRS, - You may recall my photo of a cardboard Allchin traction engine which you published in *Post Bag* (*M.E.* 4189, 21 February 2003)

I enclose a photograph of a wood (mainly) Ransomes & May engine circa 1850 from plans by Woking Precision Models and guidance from Stan Bray, January '01.

At 84+ it keeps me out of mischief!

**A. K. Tulloch, Dundee.**

## Wheel crossings

SIRS, - The following tip may be useful to those readers who make clocks and have to carry out the 'crossing out' of gears, usually a rather exacting task.

Essential to the professional appearance of any clock described in *Model Engineer* is the correct and accurate shaping of the gears. Most of us have to do this by hand, needing some pretty meticulous filing to scribed lines on the wheels. In particular the inside edge, next to the pitch circle, is the most difficult to get right; in my experience anyway.

Here is the way I now do it. Take two pieces of wood about 3in. square and the common timber thickness of about $3/4$ inch. Sandwich them together and secure with wood screws at diagonally opposite corners. Drill the corners on the other diagonal for mild steel dowel pins of $1/4$in. diameter. Insert the pins and trim the edges. A table saw is useful here if you have one. Now mount the assembly in the 4-jaw chuck with the screw heads outwards, mark both pieces at the No. 1 jaw and bore right through to a diameter equal to the required filing outline of the inside edge of the gear 'rim'.

Remove the screws and pins and remove the top block from the sandwich which will not be gripped by the chuck jaws. Using the same boring tool, bore a recess in the face of the part left in the chuck. This should be of a diameter equal to the outer diameter of the gear, over the teeth, and to a depth just less than the gear thickness. The gear should now fit snugly into this recess and the top part of the sandwich can be replaced using the dowel pins and the wood screws, thus gripping the gear.

The whole assembly may now be removed from the chuck and placed in the bench vice for filing. The wooden support will provide an adequate limit for filing to the required circular profile as wear of wood of this thickness by the types of file used in clockmaking will be minimal for just one or two gears. Filing can be carried out quite safely into the very corners of the cutouts.

If gears of several sizes are being made then you should start with the smallest so that the wooden jig can be returned to the lathe for re-boring and recessing to the next larger size. If the shape of the cutout requires a central boss and straight spokes, these edges may be profiled by the usual method of filing to a pair of hardened buttons for the boss and by clamping the wheel between straight wooden blocks for the spokes.

It also helps to have a few small emery sticks handy. I make them from lolly sticks, available in quantity from the supermarket, by gluing strips of wet and dry emery paper on three-quarters of their length and marking the unclad end with the grade of abrasive.

This tip may be 'old hat' to some of our fraternity, but it is certainly new to me. I can recommend it.

**Bill Brading,**
**Auckland, New Zealand.**


*The neat mill/drill built by the author for use on his Myford Super 7 lathe.*


*A view of the electronic speed control circuit and the motor used to drive the tool.*


*Another view of the assembly showing the toothed belt drive and the speed control knob.*

# A CROSS-SLIDE MILL/DRILL

**Frank Taylor**
describes an ingenious and useful lathe accessory.

Many years ago I made the headstock dividing device described in *Model Engineer* by Mr. C. W. Rose (*M.E.* 3740, 2 November 1984, *et seq.*). The device caters for most commonly used divisions and has a zero setting up time. I have not been able to get the full benefits of this because I lacked a cross-slide drilling spindle. I decided that it was time to rectify the matter.

At first I envisaged a simple spindle, running in small ball races and driven from an overhead drive. This method, favoured by many model engineers, offers a quick solution to the problem. I was in favour of the quick part, but it was not to be, because above my lathe is a long cupboard containing such uninteresting materials as emulsion paint, wallpaper paste, etc. A look in my box of ball races showed there were no small races but there were two large ones in almost new condition. I looked at them; they were nice, just asking to be used, and I could not put them back in the box, especially after they gave me the idea of having a No. 2 Morse taper in the shaft. I could see that all my other kit could be fitted into the spindle and from there on the quick solution was dead.

I was very pleased with the idea that the ball races gave me and, believe it or not, I was to receive even more. In the next box was a beautifully made 12 volt motor which, it is thought, came from a 1932 Morris Minor car and was used to drive the windscreen wiper (singular). In those days, continuous rating meant that a motor would deliver full load and run at about 30deg. Celsius. I was sure the motor could be persuaded to give more than its rating without protest and so the spindle could be self-powered. There were no more ideas to come out of the useful junk box, so I had to begin thinking.

I have considerable difficulty in visualising something from a drawing so I usually make up my ideas in wood, which is amenable to cutting a bit off, or sticking a bit on, until I have something that I am happy with. This wooden thing, which has been designed by trial and error (lots of the latter), would now double as a pattern for a casting. Having got a pattern for the main body there was then a lot of fiddling about with it in

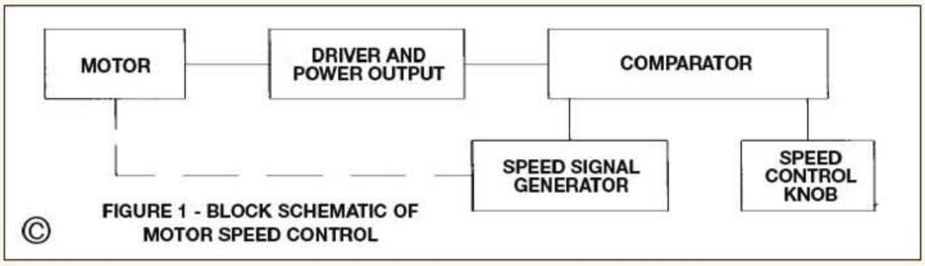



FIGURE 1 - BLOCK SCHEMATIC OF MOTOR SPEED CONTROL

conjunction with my Myford standard accessories. Some changes were made to the wood pattern and it could be seen that the thing was evolving into a multipurpose tool. I made a few rough sketches, got very enthusiastic and the mill/drill was on its way.

## Motor speed reduction

The first part of the reduction was to be by toothed belt and pulleys giving a step down of 3.6:1. An experimental electronic speed control of my own design was tried out and found to provide almost full power over most of the speed range. The speed range varies between 60 to 2200rpm. Torque increases as the speed is lowered and, within limits, the circuit acts like an automatic continuously variable gearbox. Torque at the lower speeds was found to be adequate and I was encouraged to move on.

For this article I propose to explain the circuit in simple block schematic form. A full electronic circuit drawing is also included for those who need one.

The first requirement is the speed signal generator (see **fig 1**) — preferably at no cost if possible. At present, tape recorder/players are going out of fashion and are being thrown away. Within these resides a mine of goodies: rubber belts, pulleys, gears and small permanent magnet DC motors. These, if driven, will generate a DC voltage which is directly proportional to the driving speed provided that no significant current is drawn. Coupling this motor/generator to the main shaft with a rubber belt and pulley provides the required signal.

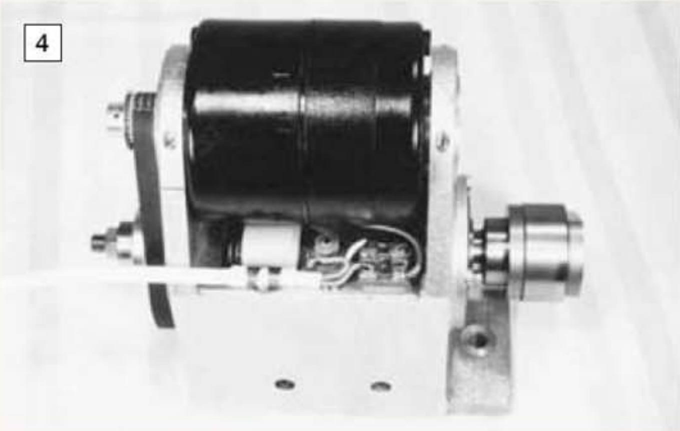
The voltage from the generator is fed into a comparator as can be seen in fig 1. The comparator is a microchip, which costs about 45 pence. Into the second input of the comparator is fed another DC voltage which can be varied by turning a knob that becomes the speed controller. When the controller is turned to minimum (off) it is arranged that the voltage from the controller is very slightly less than that from the generator. The comparator compares the input voltages and. gives out a negative (off) signal to the driver and power output stage. The motor is switched off. The circuit operates as follows:

1: The speed controller is turned to the desired speed.
2: The voltage from the controller exceeds that from the generator.
3: The comparator gives a positive 'on' signal to the driver.
4: The power stage feeds power; the motor begins to run up to speed.
5: The motor drives the main shaft and generator and when the generator exceeds the controller volts, the comparator outputs 'off' and power to motor is shut 'off'.
6: The motor slows down a minute amount, the generator voltage falls a minute amount and the comparator sends out an 'on' signal. This pulsing on and off continues, maintaining a constant motor speed at the desired setting.

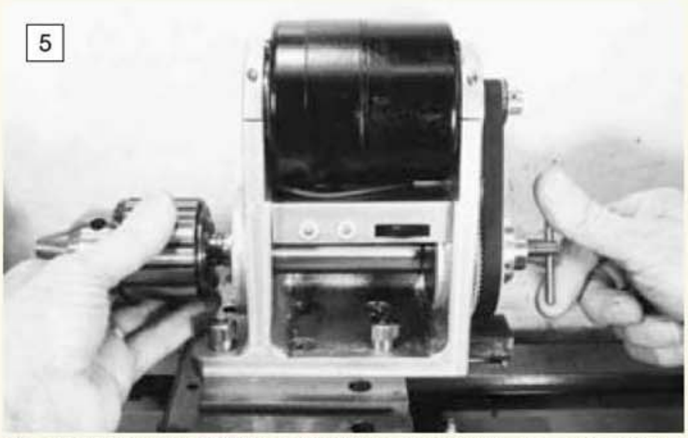
## Variable load

Under a light load the motor will run up to speed quickly when power is applied, resulting in a short 'on' pulse. At the end of the short 'on' pulse the motor will slow down slowly which will prolong the 'off' period. Total power to the motor is thus low but enough to produce just sufficient torque to meet the load and for the motor to hold the selected speed.

Under a heavy load the motor is slow to build up speed when power is applied and the 'on' pulse is prolonged. The 'off' pulse is shortened by the fact that the heavy load slows the motor quickly. Total power and torque are high and the demands for torque and speed are met.

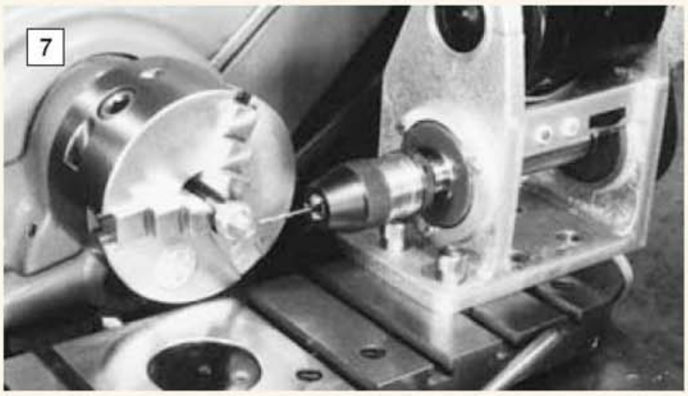



*A rear view of the mill/drill assembly. The main casting is designed with alternative mounting faces to give maximum versatility.*




*The spindle in the mill/drill has a No. 2 Morse taper and can accept a wide range of tooling. Here the drill chuck is being released from the taper.*

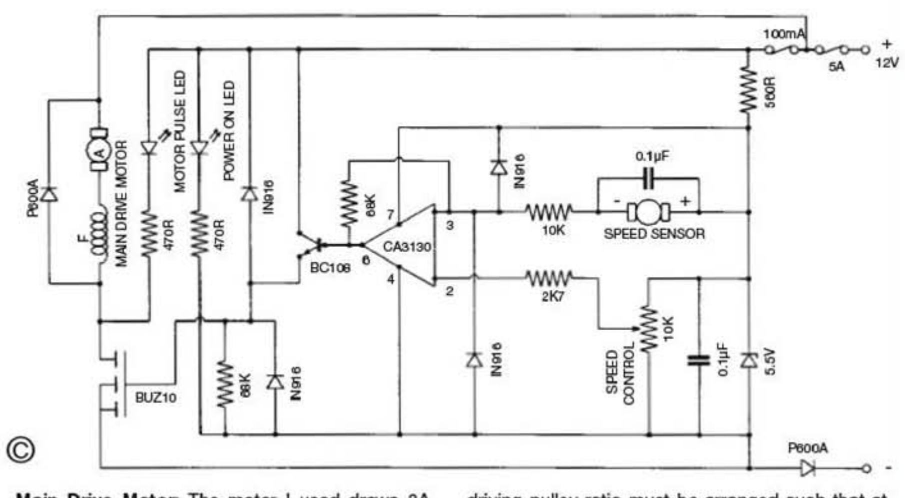

*Drilling and countersinking six equi-spaced holes on a given pitch circle is easy using the mill/drill with the indexing device designed by C.W. Rose.*




*Accuracy of working is assured by boring the mill/drill spindle housing on the boring table of the lathe. It is thus on the centre line of lathe mandrel.*

Under overload conditions the motor is unable to reach the torque and speed demanded, the circuit applies full power and does not pulse. In this condition, if set to maximum high speed, the motor behaves exactly as it would if connected directly to the power supply and its load characteristics would be the same. This feature is useful for small grinding wheels. If the overload is due to a demand for too much torque, it once more behaves as it would if connected directly to the supply. If this condition is prolonged, the result will be a burnt out motor.

**CROSS-SLIDE MILL/DRILL CIRCUIT DIAGRAM AND NOTES**




**Main Drive Motor:** The motor I used draws 3A. When driving a 1/4in. slot drill. This is its maximum loading. If the motor is stalled, which it will if too much feed is applied, it draws a little over 4A. This current is limited mostly by the resistance of the field windings.

It is my opinion that the circuit would work okay, and maybe even better, with a permanent magnet field motor which should give more power to the shaft. However, if you are going to risk your money then please remember that this is only an opinion and has not been tried.

**Speed Sensor:** Almost any small magnet motor would do for this job. The exact voltage for which it was designed does not matter. However, the driving pulley ratio must be arranged such that at the highest spindle speed (i.e. no load) the output voltage is between 3 and 4 volts. Ensure that the polarity of its output is as shown on the diagram. If an error is made, the protection diodes on input 3 of the chip will protect the chip but the circuit will not work.

**Protection Diode:** The diode connected to the -ve input terminal is to prevent damage by an accidental reversal of the +ve and -ve inputs. If non-reversible plugs and sockets are used, this diode can be omitted with a saving of 0.6V.

**LEDs:** The values of the 470R resistors may need to be changed depending on the LEDs you use.

## Putting things together

The motor and speed controller are shown in **photo 2**. Looking at the circuit board the speed signal generator (ex-tape recorder motor) appears in the bottom corner. In the left-hand corner, secured with a nut and bolt, is the power output stage. To the right and up a little is the comparator with eight connecting pins, only four of which are visible.

In the right corner is the speed control knob in the form of a wheel which protrudes through the front panel. In the top corner the two white objects are holders for two light emitting diodes to indicate power on and the pulses going to the motor. Fixed to the ends of the motor casing are two round extensions which are turned eccentric so that rotation of the motor case provides belt adjustment. The two other items shown are the clamps which hold the motor in place.

**Photograph 3** shows preceding items assembled in the home-made casting, together with the toothed belt reduction drive. I did not make the toothed pulleys but purchased them from Davall Stock Gears (tel: 01707-283131) after sending for their catalogue. Digressing for a moment, in addition to the catalogue I was sent (at no extra charge) a *Handbook of Metric Drive Components*. The handbook is one and half inches thick and contains 232 pages devoted to gear technology, which I have found most useful. I have no connection with this company other than as a satisfied customer.

To continue, the light emitting diodes and the speed control can be seen on the front panel, and

*Drilling compound angles using the mill/drill mounted on the swivelling vertical slide.*

*When undertaking milling operations it is wise to lock the lathe spindle. The clamp locking the chuck to the lathe bed can be seen in this photo.*

*A $^1/_4$in. wide slot milled in the end of a work piece using a slot drill. Larger cutters tend to overload the drive motor of the mill/drill.*

the clamps which hold the motor securely in place. Drilled holes in the base and the back are spaced for Myford T-slots along or across the slide. This photograph shows the device fitted with my milling chuck held in a No. 2 Morse taper socket and secured with a draw bar.

A rear view of the unit is shown in **photo 4**. It can be seen that it is constructed on a basis of one and a half angle plates. All faces and edges have been machined truly square, which makes mounting and setting up easier. The back of the circuit board is visible and, from right to left are the 12V power input terminals; the diode for protection against reversed polarity of the input (which looks like nut and bolt); and the speed sensor with the belt from its pulley going down and around the 1in. diameter mild steel main shaft.

A set of tools was made for the machine (not photographed). One of the tools is shown in **photo 5** in use to push my lathe tailstock chuck out of the taper.

## The machine in action

As the months go by, I am finding new things for this device to do and, if all goes well, these may be shown in future articles. The remaining photos show it at work just after it was completed.

**Photograph 6** shows the bull wheel-dividing device with its clever coloured dots, by C. W. Rose. With his device and the mill/drill, I now have the facility to drill a set of holes at an exact pitch circle radius as set on the cross-slide index. Previously it was a case of putting a punch mark at the position and drilling separately, wasting time and introducing inaccuracy. In the photograph, the drill is running slow and easy for the countersinking bit.

**Photograph 7** shows a cross-drilling operation on a round shaft. The bearing housings for the drill were bored out on this very boring table. What more could you ask for drilling a hole exactly through the centre of a round bar?

The set up in **photo 8** removes the eyeing up or guesswork from drilling compound angles. Provided you get the trigonometry right(!) the drill arrives at the other end exactly where you want it. Here a Myford milling slide and raising block are in use to set both requirements: angles and position of the drill. I do have to admit that much of the versatility of this machine is made possible by the lovely long cross-slide on my lathe.

Being able to mill a piece of work which is being turned in the chuck has the advantages of speedy convenience and better accuracy. However it has to be remembered that the mandrel is not clamped 'solid' as it would be in, say a dividing head on a milling machine. Some form of clamping to prevent rotational movement must be provided to do the work, but the bearings of the lathe still have their normal working clearances and could suffer if heavy cuts were taken. Using a mill with limited power takes care of these worries.

**Photograph 9** shows my clamp, which fixes to the lathe bed and grips one of the chuck jaws. The mill is fitted with a $^1/_4$in. slot drill set to cut a depth of $^3/_{16}$in.; it is quite happy provided hogging cuts are not taken. The swarf reveals that the cutter is not nibbling, which is bad for any cutter. The completed nice clean slot is shown in **photo 10**. Slot drills bigger than $^1/_4$in. dia. start to overload the motor.

About 20 years ago I purchased a group of small milling cutters at the Model Engineer Exhibition. I only wanted one of the cutters but they were sold very cheaply as a lot. Two of these were a mystery to me but I later discovered that one was a ratchet tooth cutter and the other was for thread milling. After years hanging on a peg I realised I could now use them.

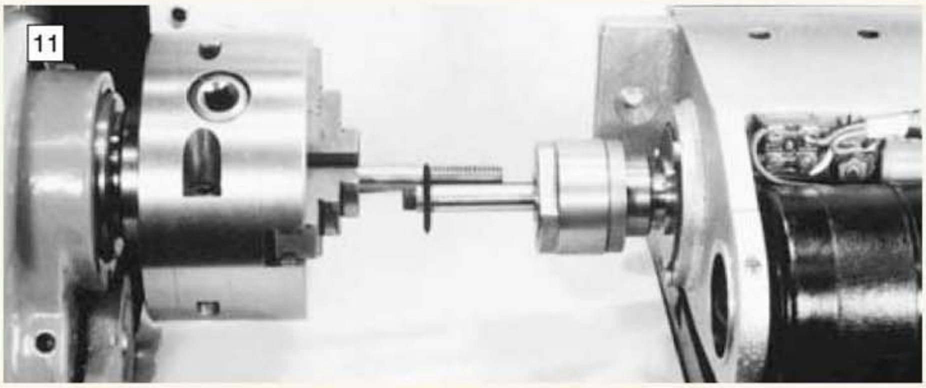
My set up for thread milling is shown in **photo 11**. This was to be a completely new experience for me and problems were expected. With the mill slide set over, to the thread (helix) angle, and fixed in the back T-slot of the cross-slide, it was only necessary to set full depth of cut on the slide index and cutting could begin. Pulling the lathe over by hand without a mandrel handle meant it was a bit jerky but in next to no time an inch of thread was there. The nut screwed on nicely but the finish was not as good as a normal lathe cut thread. On my second attempt I made two cuts taking just 0.005in. on the second. This, with greater care being taken to turn the lathe evenly, produced a really nice thread. It was so quick and easy I could hardly believe it. I then realised it also allowed cutting a full depth thread right up to a shoulder without any fear of accident.

I run the mill from a general workshop power unit. It will also run on a car battery for which the motor was originally designed. However, I was astounded to find that it ran quite well on the raw unsmoothed output from a cheap battery charger.

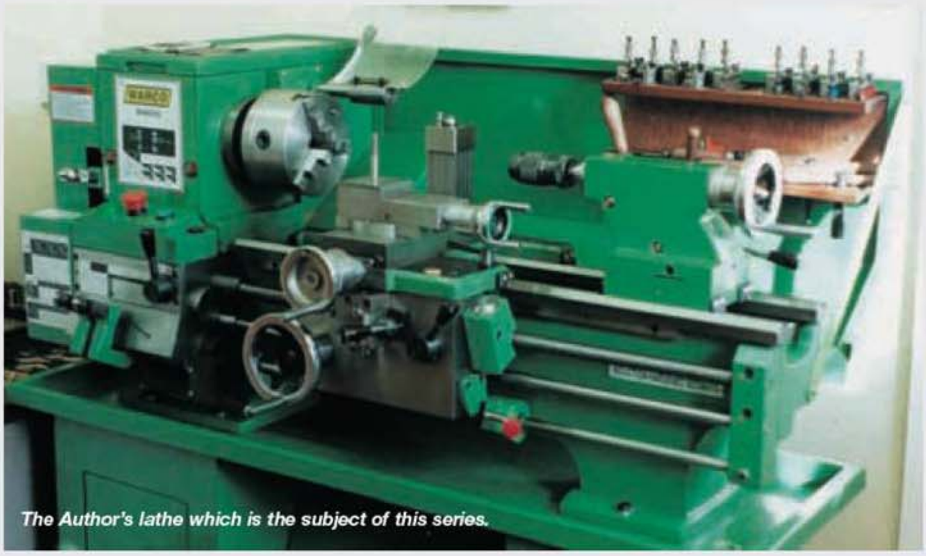
It just goes to show how far the modern microchip has come.

## Conclusion

This little friend, as it has become, lives in a lowly cardboard box and has been denied any beautifying paintwork. I almost feel guilty about this, but my friend does not seem to mind!



*Thread milling using the mill/drill attached to the swivelling vertical slide in order to obtain the required helix angle and height settings.*


The Author's lathe which is the subject of this series.

# FINE TUNING A WARCO BH600G LATHE

**Anthony Mount** discusses improvements to the headstock and steadies before introducing us to a handy clutch designed and built for his lathe.

●*Part VI continued from page 23 (M.E. 4199, 11 July 2003)*

A number of things needed attention inside the headstock (**photo 28**). First to be tackled was the spring-loaded plunger that moves the back gear into engagement. On first trying it was very stiff to move and my fingers slipped off. It freed up somewhat on twisting it, but was still hard to pull. Two spanner flats are provided at the bottom of the plunger, so the whole lot was taken out and examined.

It was soon apparent that the plunger was tight in the handle. All that was required to remove the odd thousandth of an inch from the plunger were a few strokes with a file while running the plunger slowly in the lathe. All was then well.

If you reverse the spindle and re-chuck, on rotating the lathe mandrel you will notice that the coned point is offset. *Do not* true it up, it is offset so that when it is turned a quarter of a turn it locks the plunger. The same applies to the tumbler reverse lever.

The plunger was now easy to pull, but the back and forth movement to engage the back gear was also a little stiff. A pivot block will be found inside the change gear cover. This supports the eccentric spindle for the back gear and has two bolts fixing it to the headstock. On easing these bolts movement of the shaft became easy. The block was removed and a skim taken off the end that abuts the lever casting. On re-assembly everything was much freer.

It will be noticed that the block has two slots instead of holes for the fixing bolts. These allow adjustment of the eccentric shaft for smooth engagement of the gears which should not be tight but should have just a slight movement between the gears. I also exchanged the washers under the bolts for ones of larger outside diameter and a little thicker to spread the load on the casting.

*A view inside the headstock of the Author's lathe before the addition of the clutch.*

One final thought regarding the pivot block: the flange is clamped against the side of the headstock casting, which does not seem to have been spot faced. It is therefore possible to throw the block out of true. You might find that all is well with one bolt tightened, but the second bolt will tighten things up again. A shim under one side of the flange will straighten things up.

The second problem concerned the lever behind the chuck that operates the belt tensioner which was very stiff to operate. The spindle of this lever fits into a pear shaped casting inside the headstock. The casting is locked to the spindle by means of an Allen screw fitting into a dimple in the spindle shaft. Loosening the screw freed the lever a bit. Inspection revealed that the dimple was too close to the headstock side and on tightening the screw the casting was forced against the side of the headstock.

The unit was dismantled, the spindle chucked in the lathe, and 0.40mm removed from the back shoulder. On re-assembly the whole spindle moved easily, but that was not the end of the story. The casting had been faced off completely one side and on the larger boss on the other, but not on the small boss. Thus, when the link screw was inserted it could not seat down squarely on the rough casting. This also caused the linkage to tighten up in use. The casting was mounted in the milling machine and an end mill used to spot face the area around the screw hole to allow the shoulder of the screw to seat down square.

On checking the thread for squareness, it was found to be a bit out, so a tap was put through to straighten up the thread. The unit was re-assembled, and the opportunity taken to adjust the belt tension. The link lever is in two parts joined by a screw; by screwing in the two parts of the link the length is decreased and the belt tension relaxed. I reduced the length by half a turn and got the tension I wanted. I do not like to work with too tight a belt. If one does happen to have a dig in or foul up, I would prefer the belt to slip as a fail-safe. Especially as there is now 2hp from the motor and not the 1/3hp I had on the ML7R.

I often wonder about the size of electric motors supplied with machine tools aimed at the model engineer. Looking back to earlier examples of my lathe, in the 1980s it was supplied with a 1hp motor. This was then increased to 1 1/2hp, and now stands at 2hp. If memory serves me right, Myfords had a 1/3hp motor on the ML7, which later went up to 1/2hp. The Super 7 has a 3/4hp motor as does the Myford 254, a somewhat larger machine. For our use I think that 1hp is quite adequate for a 150mm (6in.) centre height machine. What do readers think? Do you use more power, or less?

On re-assembly everything worked easily and with the slacker belt, a little quieter as well.

Having further thoughts about the dimple in the shaft for the locking screw, I felt that this is not a good type of fixing in this situation. I removed the lever and pivot again, unscrewed the lever, clamped the pivot in the machine vice on the mill, centred the dimple, drilled down about 8mm and pressed in a plug to full depth. Back on the mill, a flat was milled on the pivot shaft to coincide with the dimple. The end of the Allen screw was skimmed flat and the unit re-assembled. The shaft was now firmly clamped, and there would have been no need to face off the back shoulder of the pivot.

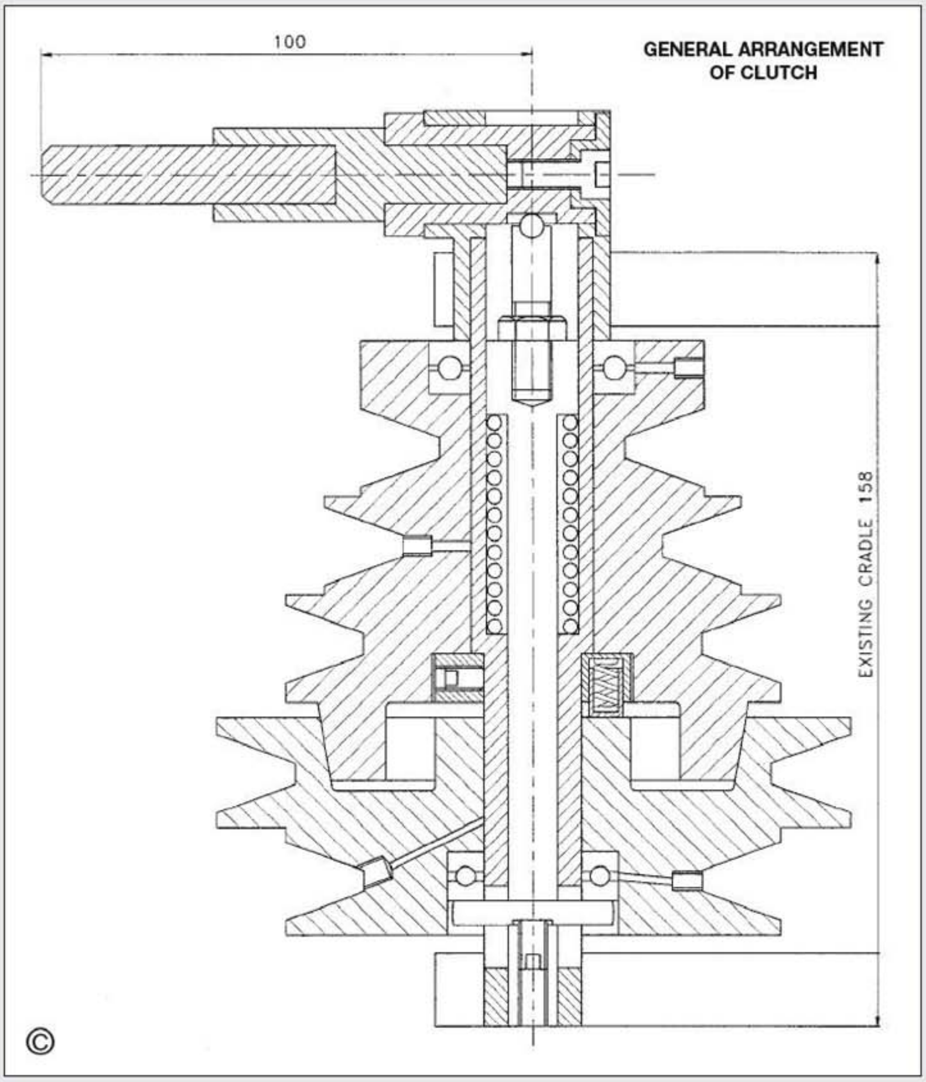
While working inside the headstock, a short length of rubber tube can be pushed over the pin that stops the countershaft from falling too far forward. As with the levers on the tailstock, it all helps make for quieter operation.

After the lathe had been in use for a little while, the oil in the front bearing window looked decidedly murky. To drain the oil, this window is prised out with a knife. When doing this, be careful not to chip the paintwork, and do not damage the O-ring which forms the seal behind the window.

Lay an absorbent paper towel below the window to catch the oil as it runs out. Mine came out looking like liquid mud. After it had stopped running, the area was wiped clean and pipe cleaners were used to twiddle down the outlet holes to remove any 'gunge' left inside. Just keep pushing the pipe cleaner inside, pull it out, wipe it clean and push it back in again. Keep doing this ▶

until no more 'gunge' comes out. The back bearing got the same treatment, but it was a lot cleaner. Both windows were cleaned and replaced and the bearings refilled with clean oil.

I changed the oil five times in a one-week period but still it did not stay clean, so I tried a different tack. The oil was replaced with paraffin and the lathe run for a short period. The paraffin was drained out but, to help it on its way, I pushed a piece of plastic tube down the oil filler hole and connected it to my little air brush compressor. Though only a few pounds of pressure it did push out some more liquid. I refilled with clean oil and it now keeps a lot cleaner.




## General lubrication

I must admit to having very little knowledge concerning lubrication. On the Myford I religiously followed the instructions in the handbook, using Esso Nuto H32 in the headstock and elsewhere, and an SAE 30 oil (ISO VG68) for the slides and quick-change gearbox. I had no problems or any wear on the spindle bearings. Apart from adjusting the bearings once after changing the V-belt the headstock bearings never needed touching in 20 years use.

The new lathe has tapered roller bearings in the headstock and the recommended oil is Shell turbo T-68 for this and the quick-change gearbox. A 20W machine oil is used elsewhere.

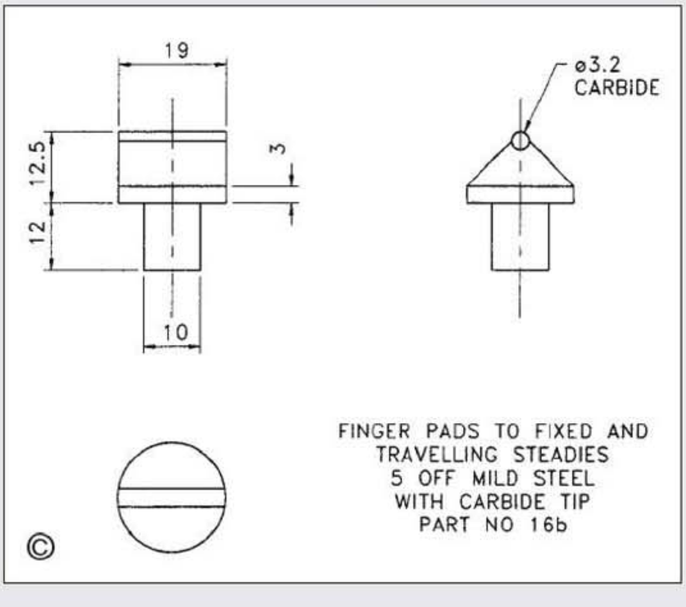
I went along for a chat with an oil supplier near to where I live and he supplied me with some leaflets on lubricating oils. To cut a long story short he had available an ISO 68 oil specially formulated for machine tools that took care of the headstock, medium load gear drives, slideways, leadscrews and spindles. It also eliminated the tendency to stick-slip when used for the slideways. So, I needed only one oil for the whole machine. It is called Excelslip Tachus Machine Tool Lubricant and is available in 5 litre cans.

## Steadies

The lathe is supplied with fixed and travelling steadies as standard and these can be used just as they are. However, I have modified most of my steadies in the past. All have been supplied with gunmetal fingers which wear very quickly.

I have previously fitted hardened inserts, and did so with the BH600G. How far to go will depend on your enthusiasm. It would be a lot of work, but the ideal would be to replace the fingers and screws completely. The existing screws have right hand threads, if replaced with left hand screws, the fingers would go in when the knobs are turned clockwise, and not back to front as at present.

The simplest solution is to remove the fingers, knock out the bronze heads and replace them with new hardened heads. These could be in silver-steel.




FINGER PADS TO FIXED AND TRAVELLING STEADIES
5 OFF MILD STEEL
WITH CARBIDE TIP
PART NO 16b

## Finger pads
(Part No. 16b)

Instead of turning the ends of the fingers to a cone as the originals, I left them square and cross-drilled close to the end. I used mild steel for the new pads, cutting off enough material for five pads. After cross-drilling, the ends were bevelled either side of the cross-hole, breaking into the hole so that just over half the diameter was left. Lengths of $^{1}/_{8}$in. dia. carbide (broken drill shanks) were then silver-soldered into the cross holes. Before silver-soldering, I ground them off 1mm oversize of the heads which left about 0.5mm to be ground off either side after silver-soldering. The other end of each finger pad was turned to a push fit into the fingers; they are held in place by a set-screw, cross-drilled in the end of the fingers.

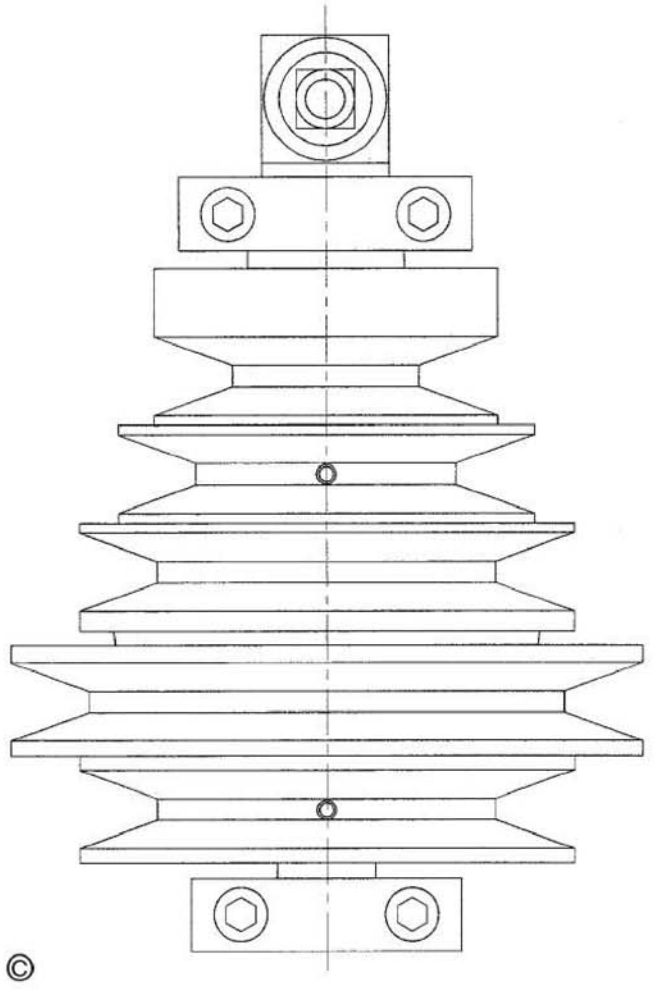
Use of the whole width of the finger provides greater support to the work, support is brought further forward towards the face of the steady, within easy reach of the tool and the carbide rubbing surfaces minimise wear. This is particularly noticeable when running over a rough surface, such as when screwcutting an Acme thread.

All the material so far measured to round figures on the lathe has been metric, but the fingers are 0.746in., just 0.004in. under $^{3}/_{4}$ inch. The metric equivalent of $^{3}/_{4}$in. is 19.05mm but I do not think 19mm is a stock metric section.

Now that the fingers are provided with straight ends, they need to stay in the correct plane. To stop them turning, 5mm wide grooves are machined along the sides of the fingers to locate set screws. However, the ends of the set-screws on my steadies had been reduced to 4mm diameter allowing considerable movement of the fingers. I made up new screws with 5mm diameter pins.

I was not impressed with the pivot arrangement on the fixed steady. The hole had been drilled 6.9mm diameter and the supposedly 6mm screw measured 5.6mm diameter. The hole was drilled and reamed to 8mm in the lower part of the

**PLAN VIEW OF CLUTCH**



steady, and a fitted bolt made up. The top part of the steady was tapped M8 and on assembly the screw was fitted with a lock nut.

The knurled knob for clamping the steady shut abutted direct onto the casting, so a washer was placed underneath the knob. Though only cosmetic I also knocked out the C-Lok pin, releasing the screw, and removed the paint on the screw.

## Lathe bed

There is little to say about the bed except that it is a massive casting with hardened bedways. I removed the gap piece to try it out and found that care was needed to get it to go back in exactly the same place with the vee and flat ways truly aligned. I made up a plywood clip-over board to protect the bed when changing chucks, etc.

## Nameplates

A number of plates are attached to the machine, giving warnings and threading information. There is nothing wrong with these, but two had been fitted slightly out of plumb, which irritated me.

Fortunately, the fixing is by means of aluminium alloy rivets which were easily prised out without damaging the plates. The holes proved to be the right size for tapping 6BA. It was a simple matter to use roundhead brass screws to re-fix the plates into position after the holes in the plates had been eased to bring the plates to a true perpendicular position.

When I switched on the machine I noticed a humming sound from the electrical box, which I took to be electrical in origin and ignored. But during my 'study' of the machine I happened to touch the box and the hum stopped. There must have been some natural resonance between the electrical equipment and box. The catch was 'tweaked' to make it a little tighter and the problem has not re-occurred.

## Clutch

One of the pleasures of using a Myford Super Seven lathe is that it is fitted with a headstock clutch. Push a handle and the spindle stops. The motor keeps running so wear and tear on it is minimised. I must have operated mine a million times. Stop to check a size, stop and change a drill, stop and change a tool. You might ask why worry about a clutch when switching off the motor achieves the same end. Sometimes when doing a repetitious job such as making studs, or steam glands I have clocked up 400 or more stops and starts in a day. That number of starts cannot be good for an electric motor. Besides, it feels right to have a clutch fitted. I had to have a clutch on the new lathe.

It took some time to evolve a design. The existing setup has a fixed countershaft spindle with the pulley on ball races. I wanted my new clutch to be a direct replacement for the existing set-up, just drop it in and use it. As can be seen from the drawing, this has been accomplished. A new shaft was made with an end block that carries the cam spindle. This is drilled right through for a push rod. New pulleys were made and the two larger steps that take the drive from the motor pulley were reversed to give a bigger diameter for the cone.

This means that the motor pulley also needs to be reversed which would seem to be a simple enough job. However, although I have removed a number of pulleys from shafts, apart from one all were tight on the shaft, and this one was no exception. With the motor tucked away behind the lathe I found it easier to remove the motor from the lathe to gain easy access. Do not be tempted to start hammering the shaft or knocking in wedges behind the pulley. The only safe way to remove the pulley is to use a proper pulley puller. Then all the forces are retained within the puller and no strain is put on the motor.

It was like drawing teeth, but bit by bit the pulley rose up the shaft. Once off, all that was needed were a few strokes with a file to remove the burrs from the keyway. A few more strokes with the file, literally with the key in one hand and the file in the other, and the key smoothly fitted the keyways in both the shaft and the pulley. Finally, a piece of abrasive paper, wrapped around a 20mm dia. rod was rolled around the bore of the pulley a few times and the pulley just slid on with a satisfying glide.

Cast iron was used for the pulleys since it is a good material for a cone clutch and is also a good bearing material. However, if you prefer, you could use Oilite bearings. Two ball thrust races are also used, they are 20mm bore, No. 51104, and 25mm bore No. 51105.

When you get the thrust bearings you will find that one race has a bore of the nominal diameter, the other is a little larger. In the case of the 25mm diameter bearing, the smaller bore goes on first, tight on the shaft, and abuts the seating. For the 20mm bearing, the smaller bore goes on last, but as it needs to move laterally, it should not be tight on the shaft.

The spring in the drawing is shown with a normal round wire section but mine, which I got from Terry Holt of Kerjeng (tel: 01509-672025) is made of rectangular section wire. Nice and stiff it does the job and is $1\frac{3}{4}$ long x $\frac{3}{4}$in. outer diameter. When engaged, the spring pushes the push rod to the right. This pulls the cross-pin against the left-hand thrust bearing, which in turn pushes the two pulleys together engaging the drive. The forces are finally stopped by the right hand thrust race which abuts a flange on the countershaft spindle.

When you come to assemble the clutch, should the forces have worked out differently from mine, you can increase the main spring pressure by putting a washer between the spring and the push rod flange. To release the clutch, the handle is pushed. This moves the cam spindle and pushes the push rod to the left, compressing the spring. Pressure is removed from the cone and inertia from the lathe spindle unlocks the cone allowing the lathe spindle to stop.

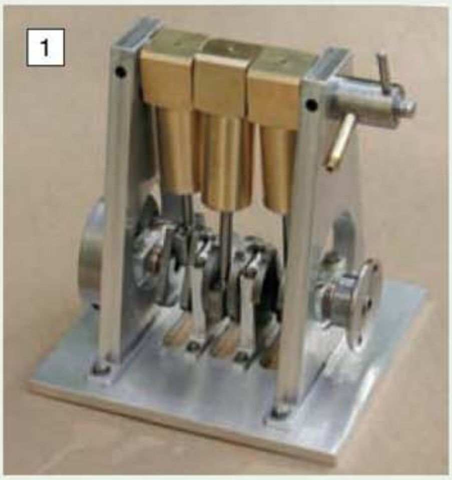
You will notice that between the two pulleys there is a 40mm dia. collar. This serves a dual purpose. One is to stop the three-step pulley from being dragged to the left and resisting disengagement. The other is to house three spring-loaded plungers. These push the two step pulley to the left, hastening disengagement.

Though I have not tried it, an alternative to the three spring-loaded plungers would be to use a disc spring or 'Belleville' washer. These are flat springs dished like a saucer. Most Belleville washers are very strong and only a light pressure is needed.

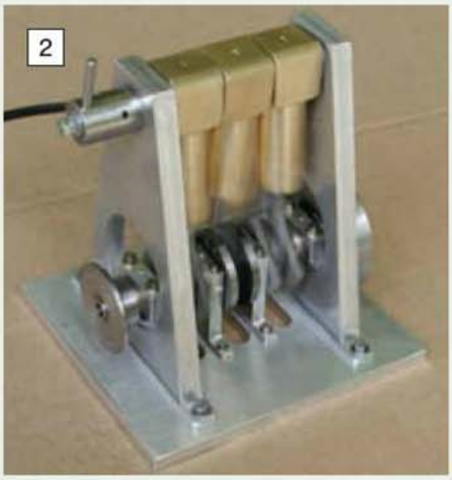
The operating handle comes up through the cover and a lever on top engages and disengages the clutch. As the cover needs to be raised for speed changes, etc, the handle pulls straight out of the cam spindle via a square socket. It might be worth investigating to determine if the rear portion of the cover could be a separate part and screwed permanently to the headstock. The front portion of the cover could then be hinged to the rear portion.

Before you do any machining on the clutch, check that the holes in your countershaft bracket are the same as mine. If not, adjust the design to suit your hole sizes. Also check that your pulley sizes are the same. More details of the clutch will appear next time.

●*To be continued.*



The in-line engine with three oscillating cylinders and a long crankshaft.



Moving parts a blur, the new engine is given a test run. Vibration is negligible.

The holes having been drilled and tapped, the first pillow block is separated from the bar.

# AN IN-LINE 3-CYLINDER OSCILLATING ENGINE

**Colin Pape**

introduces a new project for oscillating engine enthusiasts.

●*Part VIII continued from page 35 (M.E. 4199, 11 July 2003)*

The engine to be described in this series is a derivative of the single-cylinder engine called PIP described in a previous article on different variations of oscillating cylinder engines.

PIP stands for 'port in the pivot' and it has this name because the ports are in the pivot and not on a backplate. A PIP type of engine is possible because the cylinder pivot is at the end instead of the centre. A pivot at the end of the cylinder can be of almost any size. If a big enough pivot is chosen, the passageways for the inlet and exhaust can be formed inside it and there is no need for a backplate and no need for a separate port face.

PIP is a single cylinder engine but it is evident that there is no design limit on the number of cylinders that can be added on the pivot so that engines with multiple in-line cylinders could be built, but for me there was a snag. It was not possible to use the straight-line crankshaft and I was not sure how to make a traditional crankshaft for a three-cylinder engine. So the design of the engine went on hold while I thought about the crankshaft.

Then, one day came inspiration and I decided to design and build a three-cylinder engine. The result is shown in **photo 1.** This is the first oscillating cylinder engine that I know of that has multiple in-line cylinders and as with all multiple cylinder engines of this configuration, the crankshaft becomes quite long and needs several bearings. These crankshafts become increasingly difficult to make as the number of cylinders increases. In addition, with this type of crankshaft, the big ends and their bearings, and all the intermediate journal supports and their bearings are also more complex because they have to be split. I have made quite a lot of these parts in the past but I have never been happy with the fabrication methods I have seen described and have followed. I decided that the time had come to find a better way of making these parts.

The engine works very well and the new methods with which I experimented to make the complex parts all worked out well. This series describes the new engine and the solutions I developed to tackle some old problems related to long multi-cylinder crankshafts.

**Photograph 2** shows the engine running at high speed. There is very little vibration and it does not need to be held down at all.

## Engine description

The engine has three oscillating cylinders arranged in a line. The design is a loose interpretation of a classical three-cylinder marine engine. These engines were often triple expansion engines. I do not know a way to make triple expansion engines using oscillating cylinders so these cylinders all work at high pressure.

The engine is fully self-starting and runs in either direction with an excellent speed range and negligible vibration.

The cylinders are suspended from a long pivot bar which is supported above the crankshaft by two end frames. These are like A-frames with large windows in them. I made these windows large enough for the assembled crankshaft to be passed through them. The windows incorporate the supports for the main journals. The end frames, their sole plates and the bearing supports are designed to remain together and if painted I hope that they will resemble castings.

I use air to run these engines but steam would be possible with suitable piston material. The steam or air enters the pivot at one end and is directed by the reversing valve to one of the two passageways inside the pivot. The second passageway is used for the exhaust path. The passageways communicate with ports machined in the outer face of the pivot bar at each cylinder station.

Each cylinder has two ports machined on the inside of the pivot hole. These ports communicate with the inlet and exhaust ports in the pivot bar as the cylinder oscillates.

Because the pivots are quite far from the crankshaft in an end-pivot design engine, the angular motion of the cylinder is small. There is insufficient motion for the cylinder and pivot ports to fully overlap, so slots are used to increase the communicating cross-section.

The reversing valve is mounted directly on the end of the pivot bar and also serves as a throttle. Apart from the air (steam) feed, no external plumbing is visible.

The main characteristics of the engine are as follows:

- Three in-line cylinders:
  13 x 20mm bore x stroke
- Four bearing crankshaft
- Angular displacement of cylinder:
  15.3 degrees
- No-load speed range: 90-900 rpm

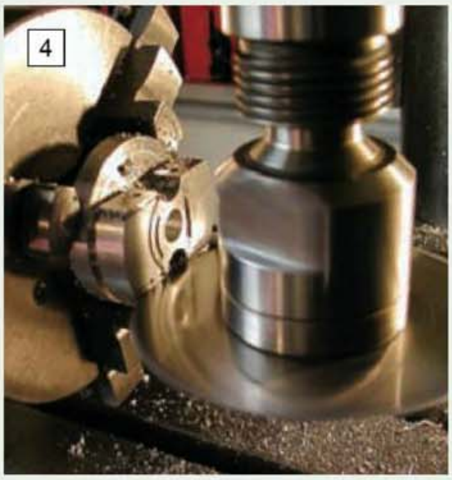
The stroke of all the other oscillating cylinder engines I have made is 14mm. I wanted this one to have more torque and to have more visible motion so I lengthened the stroke.

## Making the engine

First of all, some comment about the plans, the dimensions, the materials and the sequence of the building operations.

**Plans:** all the necessary drawings for this engine are shown in figures 1-6. The plans were all produced with a CAD system. They are the actual plans that I used. CAD is a great help in designing because it saves a lot of time and helps to avoid a lot of waste. I use CAD to create sub-assembly drawings that I use to check the fit of various parts and, for example, to establish the port openings and overlaps. Thanks to CAD I know that there is a 0.35mm space between the adjacent edges of the cylinder and pivot shaft ports at TDC and that there is an overlap of 0.58mm in the fully open position.

**Dimensions:** I work mostly in the metric system and the dimensions of this engine are almost entirely in millimetres. I try to design engines with dimensions in whole numbers of millimetres. I think that the CAD I use works




***Here the work has been indexed through 180deg. and the second pillow block is being separated.***

internally to about 40 places of decimals and can print up to 8 places of decimals, but to me it is meaningless to quote too many on the drawings.

The dimensions quoted are nominal. For example I give a bearing bore diameter of 6mm and specify a shaft of 6mm diameter to pass through it. Readers will already know that some tolerance is required but I do not normally venture into that subject. I only quote one place of decimals. I think this is adequate bearing in mind that 0.1mm is about 0.004 inch. If I went to 0.01mm I would be giving the impression that I work to 0.0004in., which is certainly not the case. The index scales on my machine only go to 0.05mm.

I do sometimes quote a good old-fashioned dimension like 1/16in., which is a very convenient size for some items. I can easily buy a 1/16in. dia. FC3 type milling cutter but I do not know where to get a 1.6mm one! Since 1/16in. is almost 1.6mm it is very easy to remember.

**Materials:** all the material is commonplace; nothing is exotic. No castings are required. I run my engines on compressed air and this allows quite a wide choice. For shafts and cranks I used silver-steel, for cylinders I used hard brass, for bearings I used bronze. For frame parts I used aluminium alloy. For fasteners I used 3mm and 4mm screws where the parts were hidden, and BA sizes where appearance was important. Millimetre size screw heads and nuts are far too big.

For use on steam I think the only change would be to use stainless steel or bronze for the pistons. In this case the single piece construction of the piston/big end assembly would not be possible.

**Tools required:** A small lathe is necessary. I used a Myford S7. I mounted the end frames on the faceplate to bore the windows and to do this the lathe must accept a part that has a maximum radius of 76mm. However, on a smaller lathe, this part could have been held static and machined with a boring bar. A small vertical mill is a great help.

Some means is required to accurately mark out the angles for the pivot slots or to index the parts to the correct positions.

**Sequence of operations:** in all projects some parts have to be produced before others and some operations have to be, or are better, performed before others. The frame and bearings should be ready before the crankshaft and I like to make cylinders first and then their pistons afterwards. In some cases I have indicated that prior to commencing a part, some other part should already be available. Everything worked out for me but I am not claiming the best sequence!

## Components

Lots of parts are quite straightforward and require no special description. Some parts are important and special attention is needed, and some techniques are new; it is these on which I have concentrated.

**Pillow blocks:** the end frames are required very quickly in this construction but curiously enough, a couple of minor parts should be made before the end frames. These are the pillow blocks for the outer journal bearings. The reason is that they have to be a perfect fit in the window openings. These parts are shown in **fig 1**. I wanted the finished end frames to resemble castings if I ever decided to paint them. I wanted the end frames to serve as bearing supports. I could not produce the desired window shape without starting with a full circle so the pillow blocks had to be separate components. The windows, with the pillow blocks in place, are big enough to allow the assembled crankshaft to be passed through.

It is easier to make the window openings to fit the pillow blocks rather than the other way around because the pillow blocks are a lot smaller and can be brought to the lathe to check the progress of the boring. Better still, it is possible to make a gauge with the pillow blocks.

The pillow blocks were made as a pair on the end of round aluminium alloy bar. The bar was first turned to 40mm over a length of about 15mm and then the two 10mm holes were drilled about 10mm deep and 180deg. apart on an 11mm radius in the end. The blocks were then partially cut off with a parting tool. The depth of cut was just through the 10mm holes. At this stage the bar, still in the chuck, was transferred to the milling machine where it was set so that the two 10mm holes were vertically one above the other. I did this by inserting short lengths of 10mm rod in the holes and checking these with an engineer's square placed on the milling machine table.

The next operation was to drill and tap the three holes in each block. I found it convenient to mill a small flat where the two outer holes are to be drilled so that there would be no tendency for the centre drill to wander off down the slope.

When the holes were finished the blocks were cut off with a slitting saw. The saw was set to allow exactly half the 10mm hole to be left in the cut off part. **Photograph 3** shows the first block being separated.

The work was then turned through 180deg. for the second block to be cut off. **Photograph 4** shows this operation.

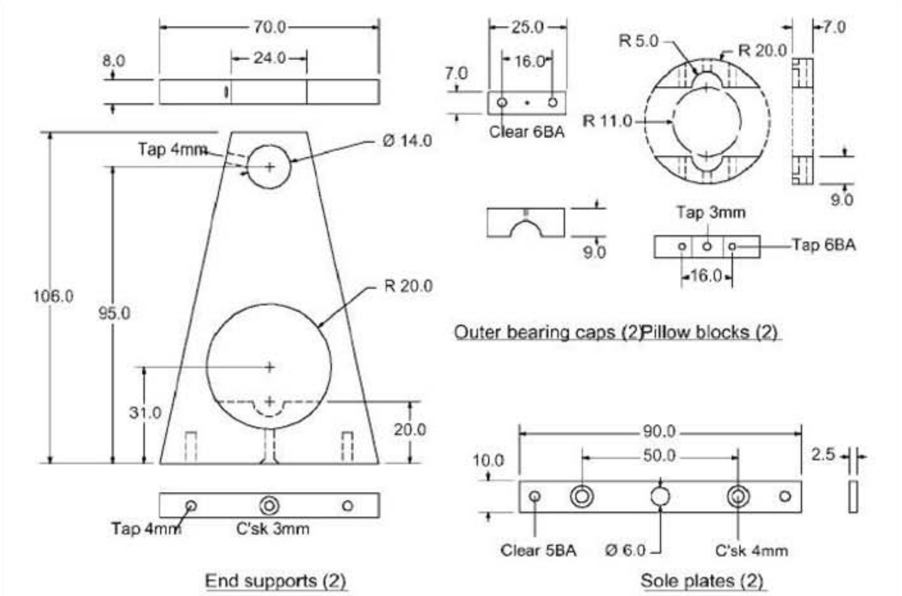
At this stage the pillow blocks were cleaned up, sharp edges removed and the stub, which was now going to be used as a gauge, was removed from the chuck.

**End frames:** Now that I had the gauge for the windows, the frames could be produced. Trapezoidal in shape, the end frames are shown in fig 1. I started by marking out the outlines on the less good face of a piece of 8mm alloy plate, making them slightly oversize to be on the safe side. I then cut out the two shapes.

From this point I made the two frames as a pair so that they would be identical. I clamped them together with the good sides inward and then machined the base edge flat. Using this edge as a datum I set out the positions of the centres of the pivot and window holes. I drilled the pivot holes to the final 14mm size and the window holes to 8mm only.

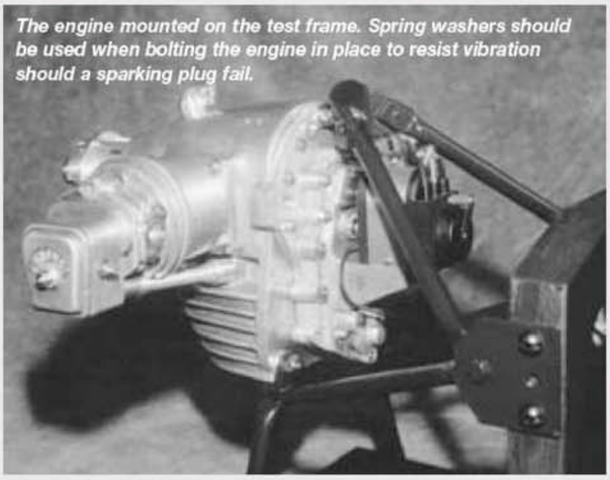
With the two plates placed side by side, I placed a short length of 14mm rod through the pivot holes and a short length of 8mm rod through the window centre holes. With these two rods in place the pair was held in the vice and with appropriate packing under one rod, the angled side edges were machined in the mill. The two rods became the reference points so equal angles were easily achieved by simply turning over the pair in the vice.

●*To be continued*




© **Figure 1: The End Frames and Bearing Supports**

# AERONCA E113 AERO ENGINE in 1:4 scale


The engine mounted on the test frame. Spring washers should be used when bolting the engine in place to resist vibration should a sparking plug fail.

**Les Chenery**

**brings his description of building this power plant to a conclusion.**

●*Part VIII continued from page 27 (M.E. 4199, 11 July 2003)*

The contact breaker/distributor body is machined from a piece of insulating material such as Delrin, Tufnol, PVC or similar. The centre of the block can be cut out with a long series end mill of about 3/8in. diameter. Do not forget to machine the relief on either side of the base for the cover to slide into.

When the milling operation is finished, round off the top corners with a file and radius the edges of the front face and of the top rear face. Mark out all the hole positions except the two bottom holes in the side recesses that can be followed through from the aluminium alloy cover and then drilled and tapped 8BA. Drill and countersink the two top holes for the spacer rod.

Make the spacer rod and fit it across the top of the body to act as a steady to stop any inward movement of the body. Drill and ream the 3/8in. and 3/16in. holes for the phosphor bronze shaft bushes. Turn a 0.375in. dia. mandrel on the lathe with a 0.187in. dia. pin on the end protruding 0.125 inch. Push the body onto the mandrel and turn out the rear recesses with a small boring tool. Remove from the mandrel and drill the three holes down from the horizontal rear face. Try not to break through with the centre hole and open them out to 0.125in. dia. to a depth of 0.125 inch.

Mark out, then drill and tap the three 12BA holes for the brass contacts, breaking through into the vertical holes. When screwing the brass contacts in place make sure the 12BA screws make contact with the high tension wires in the vertical holes when screwed tight. If the brass contacts are made from a turned ring from which the segments are then cut, the inside diameter of the ring can be made slightly smaller than the measurement shown on the drawings (say 0.550in. instead of 0.562in.). They can then be fitted in place in the recess.

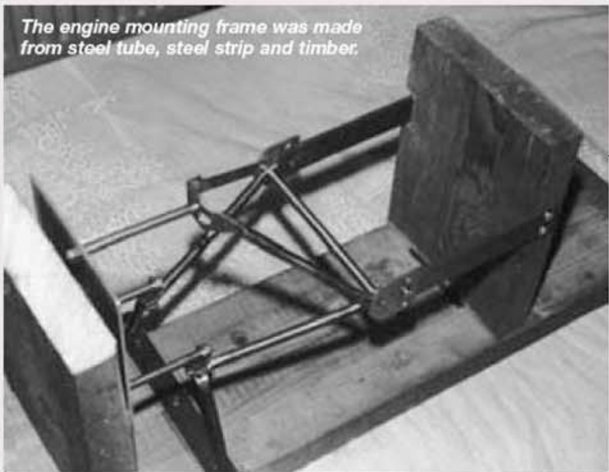
Press the two phosphor bronze shaft bushes in place in the body and turn the mandrel down to 0.312in. dia. with a 0.125in. dia. pin on the end protruding 0.125 inch. Push the body onto the mandrel again and turn the brass contacts inside diameter to 0.562in. with a sharp boring tool and very light cuts. A touch of Superglue on the rear face of the contacts when screwing them in place will help to prevent them from moving while being skimmed to size.

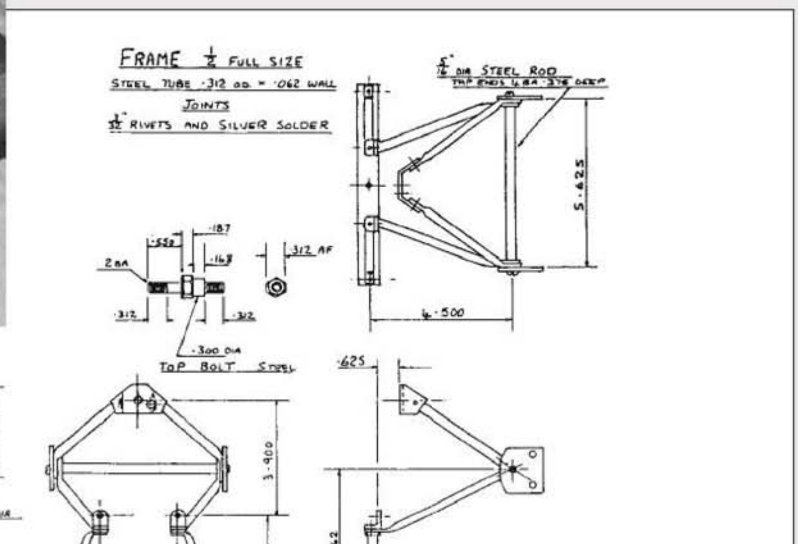
Make the centre spindle and cut the 0.093in. slot across the end by holding in a small block of brass reamed 0.187in. dia. and split with a small saw to form a collet clamp in a vice. Carefully machine the slot across the centre with an end mill. Make the sleeve slightly oversize on the outside diameter as stated on the drawings, maybe around 0.020 inch. This can then be turned true to 0.312in. after being secured on the spindle using Loctite. Clean any oil or grease from the spindle and sleeve and Loctite together. When set, clean any Loctite out of the slotted end and machine the outside diameter down to 0.312in. holding the 0.187in. dia. in a true running collet.

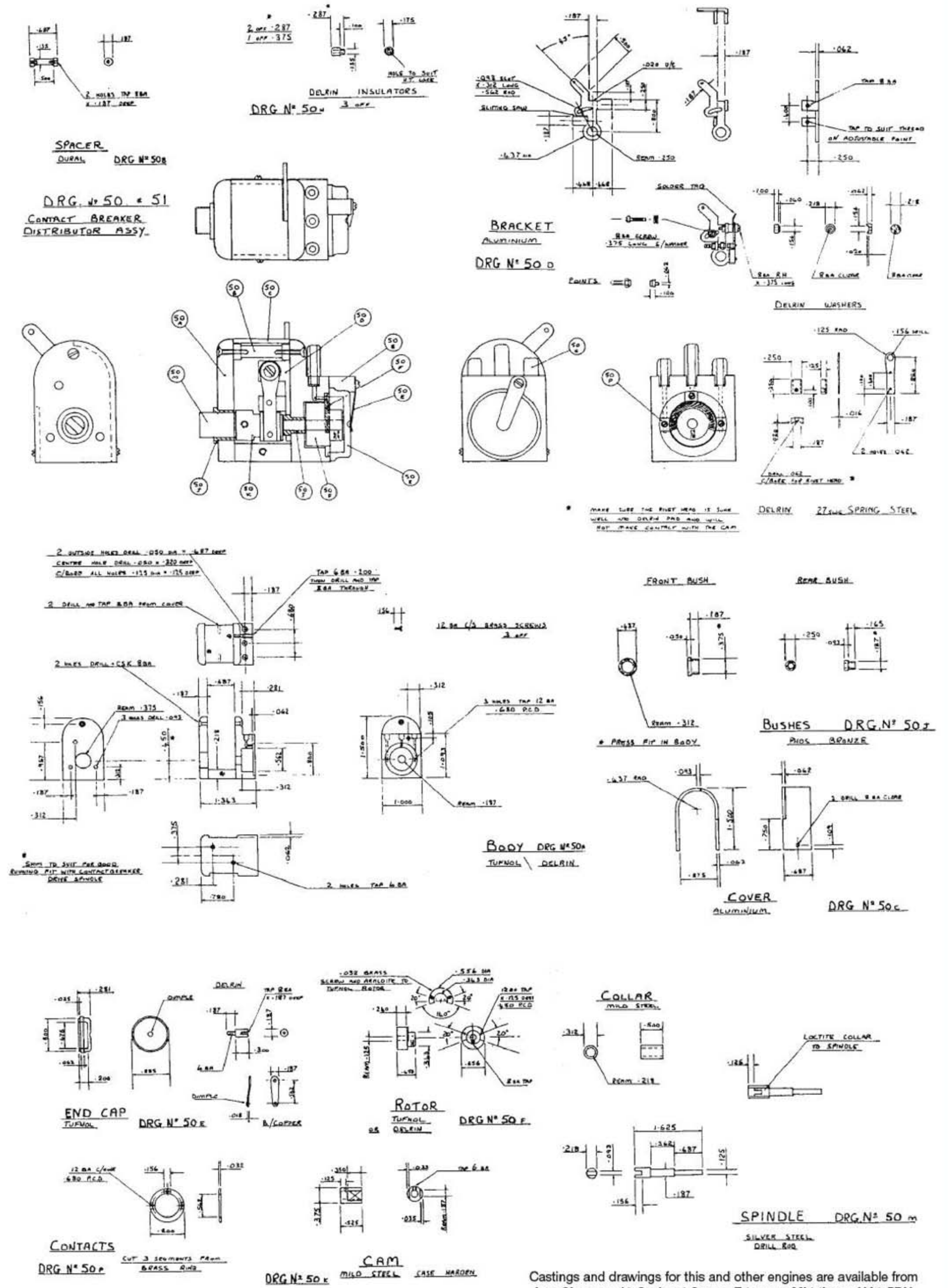
The cam is made from mild steel. Lightly radius the corners of the flat and drill and tap the 8BA holes. Polish the outside diameter and flat with fine emery paper and then case harden.

The contact breaker bracket can be made from a piece of aluminium alloy sheet and shaped with the two lugs bent upwards. The elongated curved 0.093in. slot should match up with the 8BA hole already drilled through from the rear face. An 8BA screw with a spring washer will hold the bracket in place and allow it to pivot around the flange on the rear bearing bush for advance and retard of the spark.

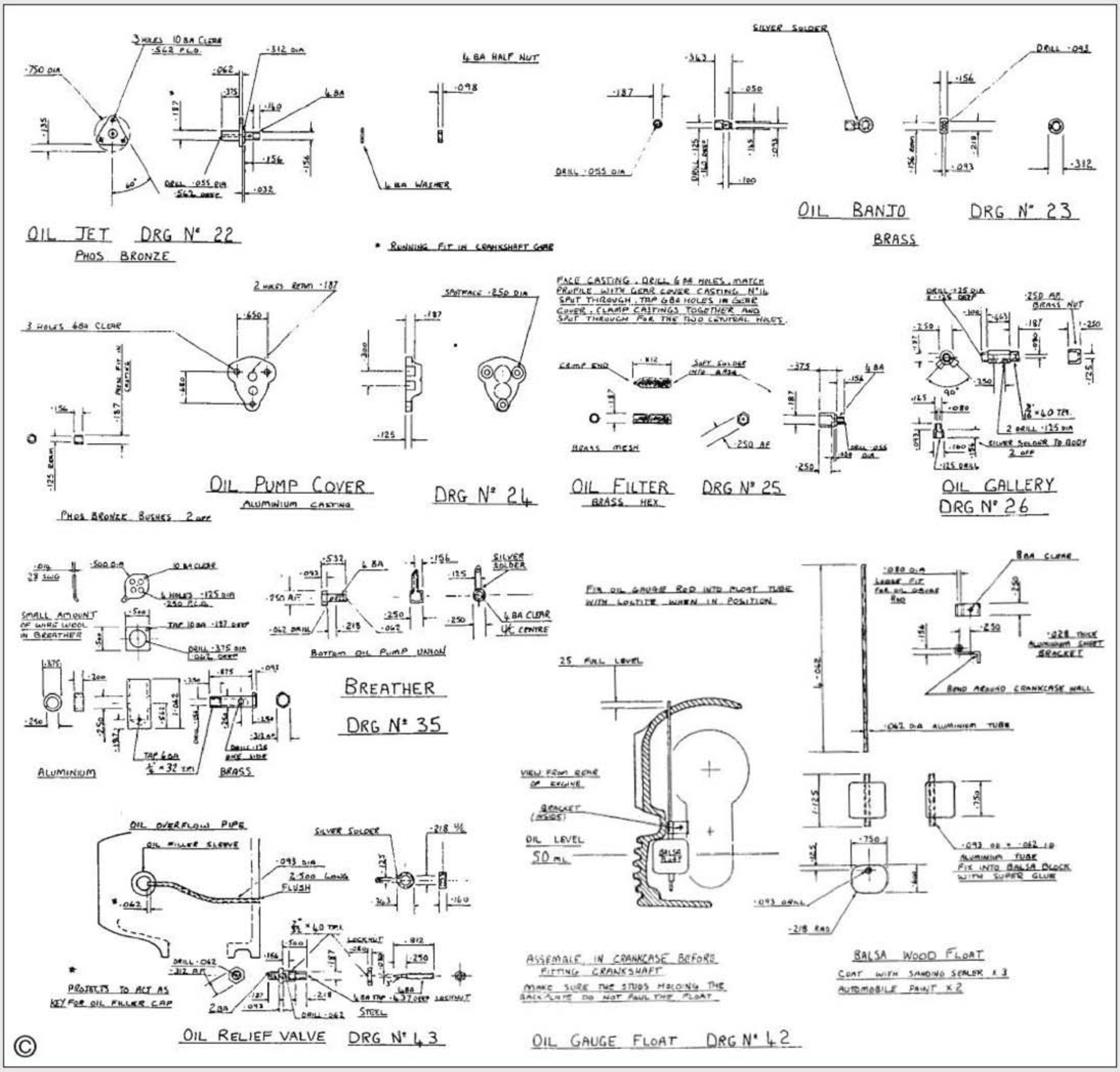
A small punch can be made up for the holes in the leaf spring otherwise much sharpening of the drill may be needed. Rivet the contact point onto the spring and the Delrin pad on the end of


The engine mounting frame was made from steel tube, steel strip and timber.






Castings and drawings for this and other engines are available from
**Les Chenery, 18 Orchard Grove, Edgware Middlesex HA8 5BH**
Please enclose SAE with any enquiries.




the spring. Be sure to sink the rivet head well into the Delrin pad so that it will not make contact with the cam.

The plastic collars are straightforward turning and when assembled make sure the clamping screw is not in contact with the leaf spring. A solder tag clamped with the leaf between the plastic collars can be used to connect the negative wire. Adjust the screwed contact point so that the gap is 0.005in. when lifted up by the cam. The cam and rotor can be adjusted with the final timing of the engine. The rotor can be made from Tufnol and the brass contact screwed on to it with a touch of Araldite to keep it in place while turning the outside edge down to a diameter 0.003in. less than the inside diameter of the three brass contacts. Use a sharp boring tool once again and take very light cuts.

The end cap and spring post are straightforward. Put a set in the beryllium copper spring to hold the cap firmly on the body. The negative wire to the contact breaker bracket can be taken through the two lower holes in the front of the body; the top hole allows a screwdriver to adjust the tension of the clamping screw on the contact breaker bracket. Six volt or three volt ignition systems can be used.

## Breather

The breather is a straightforward machining operation holding the main body in a 4-jaw chuck. The small tapped hole in the bottom can be used as a drain hole for excess oil and the 3/8in. dia. hole in the body filled with lightly packed wire wool.

## Lubrication

The sump should be filled with approximately 50ml of engine oil. With a small sump like this I have found the oil quickly thins with the seepage of fuel into the crankcase and should be changed frequently. It might be that a small tap may be preferred instead of a drain plug in the sump. Signs of oil dilution are a rise of the oil gauge rod showing on the top of the crankcase and a drop of the pressure gauge needle.

When filling with oil use a syringe with a plastic tube attached which can be inserted a small way into the oil-filling hole. When the engine has been run in and the piston rings are bedded down the oil should not dilute so quickly.

If you use a small steam engine pressure gauge for the oil pressure on the engine, close the adjustment screw at the beginning of starting trials and open in small stages of around a quarter of a turn because when the oil is new the pressure will rise to over 100lb./in.$^2$ and possibly strain the gauge. I have had this happen several times, but if you are careful the gauge can be dismantled and the Bourdon tube tweaked back a small amount.

## Engine-mounting frame

This was made from steel tube 0.312in. dia. x 0.062in. wall and 14swg brackets. The joints were loosely riveted together at the front end and screwed at the rear. The front end was then held in a jig with the three bolting holes on the same dimensions as the holes in the crankcase and all the joints silver-soldered together.

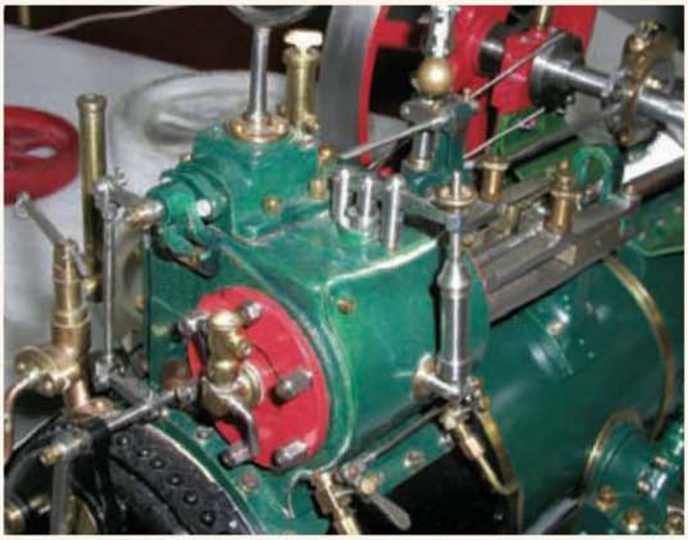
When the engine is bolted to the frame, use spring washers or self-locking nuts because if one sparking plug fails there will be vibration.

# LETTERS TO A GRANDSON

**M. J. H. Ellis** discusses the problems and some solutions concerning drilling holes the right size and in their proper place.

●*Part LIII*

*continued from page 28 (M.E. 4199, 11 July 2003)*



*Many model engineering projects require holes which align correctly with one another and others where the positional accuracy is less critical.*

Dear Adrian, to carry on from where I left off in my last letter, there is a fundamental difference between, for example, drilling a hole as part of a straight row for the sake of neatness, and drilling one accurately positioned because it has to match another, as in the case of the cylinder and the cylinder cover. It is essential for the holes in the cylinder and the cover to coincide, whereas neat spacing of the holes round the cover is only a cosmetic matter. In fact, there have been times when, to avoid drilling into the port, I have been obliged to space the holes irregularly, something which the designer had overlooked. Likewise with the studs holding down the steam-chest; I can't say that it matters very much. If you didn't know that the spacing was uneven, you wouldn't notice it.

There are occasions when you cannot conveniently use one component as a jig to drill into another. I have in mind my 'parallel-twin' mechanical lubricator which had two parallel pump barrels in a single oscillating block. In order to locate the tiny ports accurately, I made a little shovel-shaped jig. I used it first to drill the passages into the pump bores, and then, from the other side, to drill the inlet and delivery ports into the corresponding face of the main pump body.

It is seldom indeed that a way cannot be found to get round a difficulty. I quote as an example the time when, most likely through lack of foresight, I had to fit the sole-plate to match pre-existing tapped holes in the tender of a model traction engine. I could not get at these holes from beneath to drill through them, so I made a dummy sole-plate from some scrap material, cutting out gaps and oversize holes roughly where the proper holes in the real sole-plate would be. I then made small plates and washers drilled to the correct clearance size, and used these to fasten the dummy sole-plate in place. I now soldered them in position and was then able to use the dummy plate as a template to make the real one, drilling the holes through, all in their correct positions.

There was another occasion when I had to drill a single hole in some kind of cover (I don't remember the exact circumstances), all the other holes being in the right places, and the hole I was going to drill had to match a tapped hole which already existed. It sounds like a made-up story, but it's true. What I did this time was to make a little stud from silver-steel which would screw into the tapped hole and which had a point accurately turned on its end. I don't remember doing so, but I think I must have had enough sense to file a couple of flats on opposite sides of the point, or I might not have been able to get it out again. I hardened it, screwed it in place with the point projecting and fixed the cover in position by screws in the other holes. Now it just needed a tap, and the point made a small indentation to mark where the final hole should be. It was just a matter of enlarging it with a centre-punch, and drilling the hole.

Sometimes holes have to be drilled where there is not much metal to spare; a good example is the holes for the holding-down studs round a steam chest. In such a case, I would not attempt to drill the holes starting with centre-pops. I prefer to mount the steam-chest on its side, on an angle-plate bolted to the vertical slide. You have to make sure that the angle-plate is truly horizontal, testing it with a square set against the vertical edge of the vertical slide, and, using a 'point indicator' held in the 3-jaw, make sure that the line of holes will be along the centre of the wall of the steam-chest. But once that has been done, and the vertical slide locked to prevent it moving, all is plane sailing.

If you start each hole with a small centre-drill it is hard to go wrong. Later on, the steam chest will be used as a jig to drill holes in the steam chest cover and also the port-face; the former, clearance size, and the latter, tapping size. It is therefore a matter for debate whether the holes in the steam-chest itself should be of the larger or smaller size. I think I have usually drilled them clearance size, and when it came to the port-face holes, used the clearance-size drill to make a crater no deeper than the Vee point of the drill. This was all that was needed to give a start to the tapping-size drill, and this has never caused me any trouble.

I can see, however, that there is also something to be said for drilling the steam-chest holes to tapping size, thereby eliminating any possibility of error; but one would then have to take care that when the holes were opened up to clearance size, the drill did not wander off because of misalignment. Having thus been stimulated into thinking about the matter in a way which I have never done before, I now make the suggestion: when you are drilling the steam-chest, why not go all the way through with the tapping-size drill first, then change to the clearance-size drill, and open up the hole for all but the last 3/16in. or so? You would have to make sure that you were operating from what was going to be the upper side of the steam-chest. There have been times, by the way, when I was most anxious for nothing to go wrong, when I have made a little steel sleeve with an inside diameter to suit the tapping drill and an outside diameter to fit the clearance hole, and slipped it over the end of the tapping drill to be quite sure.

That reminds me of the story about an American senator who was extremely circumspect regarding the accuracy of whatever he said. He was once travelling with a friend by train, when the other gentleman looked out. of the window and remarked: *"I see that the farmer here has sheared his sheep already."* The cautious one hesitated before replying *"Well, on this side, at least."*

I have seen it maintained, that it is unwise to make an unnecessarily deep centre-pop when a hole is to be drilled in a work-hardening metal, on the grounds that the drill will fight shy of the hard place and wander. In view of the tendency of a drill to wander in copper plate, which I have observed and already mentioned in one of my earlier letters, I can see that there may well be some point in this warning. It seems to me, that to be on the safe side, it would be sensible to start drilling with a really small drill even as small as 1/16in.; small enough, that is, for the point of the drill to enter fully into the centre-pop. You have to remember that if the centre-punch has work-hardened the centre-pop, the tip of a drill, which can do no cutting, but merely displaces metal sideways to where the cutting edges can get at it, will only harden it further. Obviously, the smaller the drill, the less chance will this have of taking place.

One after-thought before I leave the subject of drilling: a drill can be made to cut over-size by grinding it so that the point is off-centre. Not that I look with favour on this sort of practice, but it can be useful in case of emergency, for example, if one does not have a suitable tapping drill and the job cannot wait.

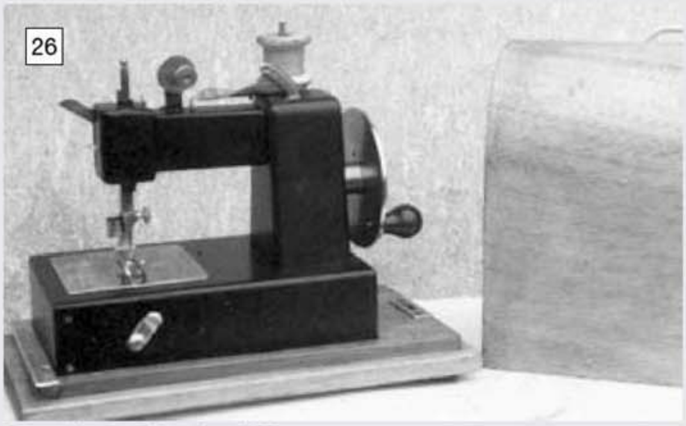
Perhaps we can now turn to the subject of marking-out, and as this mostly comes into the picture when you are working with flat stock, it is in this respect that metal work is most akin to joinery or cabinet-making. I expect that you have found out for yourself that in one way you are worse off than the woodworker, in that bright mild steel flat stock is under very considerable internal stress as a result of the finishing process, as will be seen as soon as you saw down it lengthwise, when the tension in the skin of the metal causes the saw-cut visibly to widen.

Now, once again, I shall have to leave you eagerly awaiting the next instalment from

Your affectionate Grandpa.

●*To be continued.*


Selection of childrens' toys circa 1955.


Toy sewing machine circa 1955.

# WHAT MAKES A MODEL ENGINEER?

**Don Unwin,**
self-styled 'maker of things', brings his reminiscences to a conclusion — for the time being!
●*Part III continued from page 663 (M.E. 4197, 13 June 2003)*

As the children were growing up more toys were needed (**photo 25**) and a more mechanical sewing machine (**photo 26**). The whole family enjoyed caravanning but unfortunately my first van had two double berths. With a girl and a boy, we decided we needed a second van with two singles and a double berth incorporating in the design the experience of eight years of use. Once again I built everything except the light alloy windows which were purchased since we had been paid a good price for the old van. The new van was shorter, lighter and fitted with the double and two single berths which we now needed. It also featured my own design quick-acting corner jacks and the chassis inside the van to minimise the overall height. In all it was of quite advanced design, the publishers of *Caravan* magazine awarding it a specially struck Silver medal for 'A Meritorious Contribution to Caravan Design' (**photo 27**). It was used for 16 years and was towed over 15,000 miles.


Long case musical clock built in 1966.

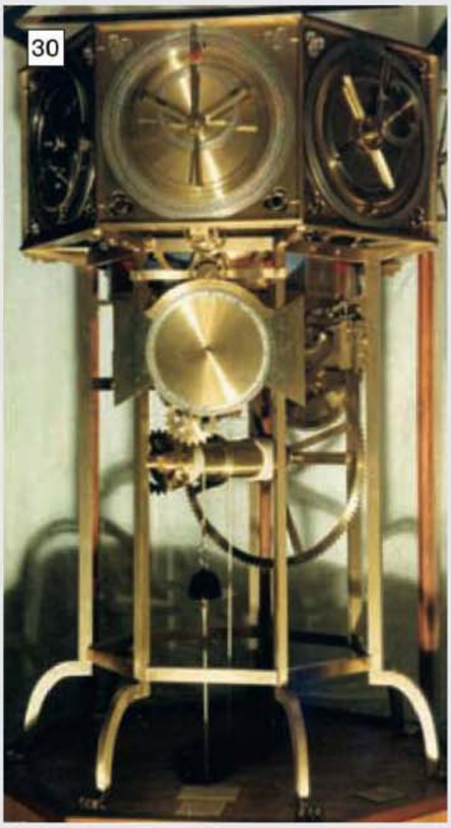

Caravan No. 2 photographed in 1956.

Following a spell of making more tools for the workshop including bench shears, a hacksawing machine and the like, the description of the Reeves long case musical clock appeared in *Model Engineer*. My parents had a nice long case clock of 1836 which I had always admired, so this seemed an ideal next project. I dislike buying anything that I can make, so the first job was to make the necessary gear cutters. A method of producing multi-tooth form cutters was devised to make them and has been described several times (*M.E.* 3426, 1 October 1971, *M.E.* 3427, 15 October 1971 and *M.E.* 3399, 21 August 1970).

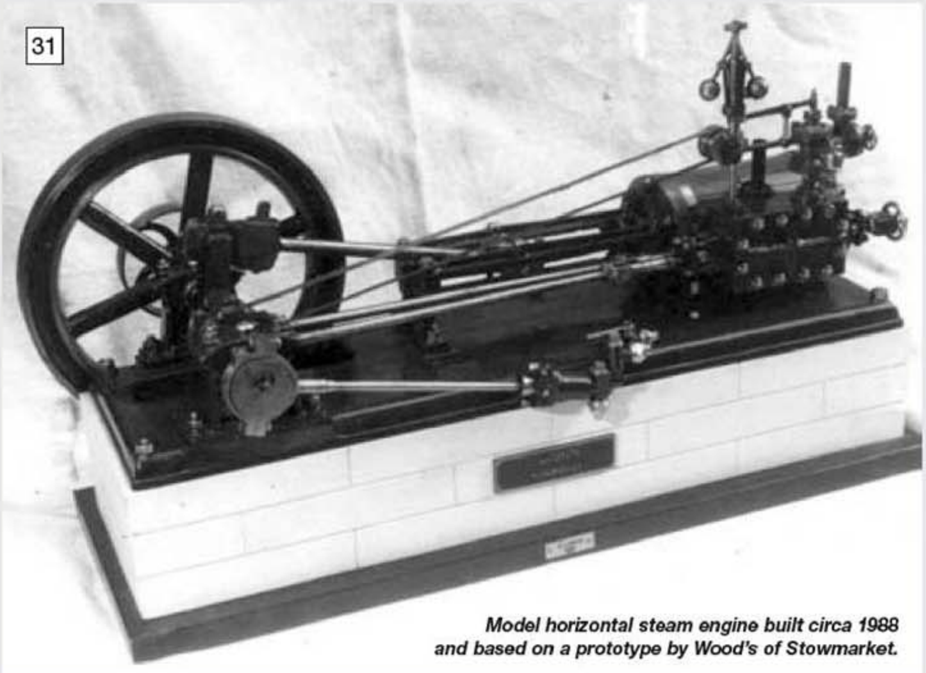
Since I really don't like working to instructions, Reeves description was not followed closely, however and a number of variations of my own were introduced. As I have a good collection of woodworking tools, I made the case, which was a pleasant change from metalwork (**photo 28**). Devising a method for making and tuning the bells together with creating the spandrels was an interesting exercise which I have described elsewhere (see *Engineering in Miniature,* September 1994).

Quite frequently I found myself giving talks and showing my ciné films to groups and felt that


Tape deck built in 1968.



*Replica planetarium of Giovanni de Dondi.*



*Model horizontal steam engine built circa 1988 and based on a prototype by Wood's of Stowmarket.*

a tape recorder would be a useful thing to have. I designed and made a two track reel-to-reel tape deck incorporating a tape amplifier to the Mullard design (**photo 29**). As both my ciné projector and the tape recorder were fitted with synchronous motors, it was possible to start the projector and the tape deck simultaneously for a sound film show!

A number of accessories were made for the milling machine at various times, including an engraving attachment (*M.E.* 3626, 1 February, *M.E.* 3628, 7 March, *M.E.* 3630 and 4 April 1980), a slotting attachment for cutting keyways, a rotary table, a device for dividing scales, a boring and facing head (*Model Engineers' Workshop* August/September 1991) and, most important of all, a vertical head together with many other workshop tips that have nearly all been described at some time in *M.E.* or its companion journal *M.E.W.*

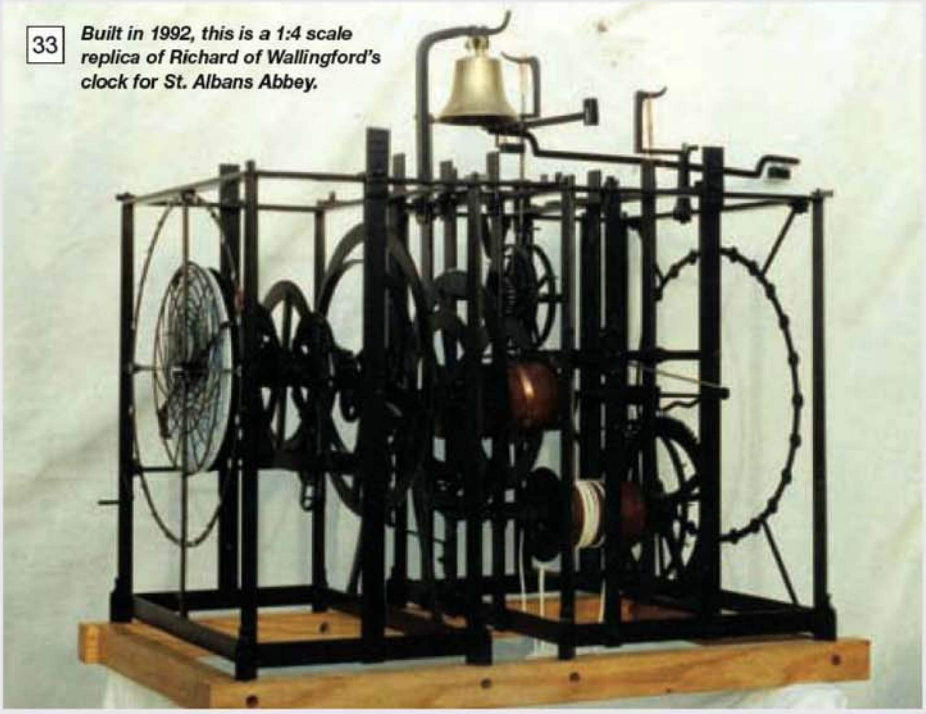
In the 1970s I was looking for a 'meaty' project and came across a translation of a manuscript describing a mediaeval planetarium made by Giovanni de Dondi in 1347 that was just what I was looking for.

However, before I could start I was 'head hunted' to a new job in Hertfordshire and had to move house. This involved another hiccup whilst we got ourselves organised again. As it was our intention to return to Cambridge on retirement I built a de-mountable 16 x 8ft. timber workshop of 8ft. modules. Four years passed before a start could be made on a full size replica of the planetarium. It took six years to make, involved over 11,000 engraved characters and 6,000 divided lines (**photo 30**) and is now on loan to the Bury St. Edmunds Manor House Museum. It was described in *Clocks* magazine (Vol 9, No. 10 April 1987) which was called *Antique Clocks* for a few issues, and in *M.E.* 3794, 6 February, *M.E.* 3796, 6 March and *M.E.* 3798, 3 April 1987.

Many years ago somebody gave me a box of part-worked steam engine castings which I came across when having a clear up. I decided to try to make something out of the bits, and so returned to model making! A search through Ronald Clarke's book *Steam Engine Builders of Suffolk* revealed a horizontal engine made by Woods of Stowmarket which appeared to be a possible prototype (**photo 31**); this model was described in *E.I.M.* June 1993, and in *M.E.* 3890, 1 February and *M.E.* 3892, 1 March 1991.

While on a visit to the Royal Greenwich Observatory I was interested in the small portable sundials in display so the horological theme was followed by my own version of a portable sundial (**photo 32**). Described in *M.E.* 3935, 18 December 1992 and *M.E.* 3937, 15 January 1993, it involved some interesting 'dialling' or setting out of the summer and winter dial faces.

*Portable sundial.*



*Built in 1992, this is a 1:4 scale replica of Richard of Wallingford's clock for St. Albans Abbey.*


*Equinoctial sundial (1992).*

My next big project was a replica of an astronomical clock contemporary with the Dondi made by Richard of Wallingford for St. Albans Abbey in 1337. However, in this case the original was about 6ft. wide, far too large both for my workshop or the Bury St. Edmunds Museum where it was going on loan so the replica was made quarter full size (**photo 33**) and described in *Clocks* Vol. 16 No. 2, 3 and 4, July, September and October 1993*)*.

Another different type of sundial followed this, an equinoctial or armillary sundial which was mounted in the garden but given to a cousin when I returned to Cambridge where it could be clearly seen in my garden with the consequent possibility of it being stolen (**photo 34**). It was described in *Antique Clocks*, December 1989.

The Curator of Horology at Bury Museum suggested that it would be nice to have something which would run when a coin donation was placed in a box. This gave me the opportunity to make a Grand Orrery, something that had interested me for many years (**photo 35**). I decided to model it on an instrument in the style of the 18th century, normally operated by a crank handle. Searching for information about orreries was a problem; fear of competition between 18th century instrument makers has meant that little is written concerning their design. However, much information was gleaned by studying examples in museums, and a week in the Rare Books room at the Cambridge University Library.

Since the mechanism involves many gear trains with peculiar ratios and other constraints, the design required a great deal of calculation. To prevent unauthorised use, the crank handle was taken out and an electric motor fitted underneath. When any value of donated coin is inserted in the coin-in-the slot unit which I made the motor is switched on to cause the planets to rotate around the Sun in their orbits for about half a minute. It has proved to be a very good money spinner! It was described in *Clocks* Vol. 22, Nos. 9 and 10, September and October 1999 and in *M.E.* 4127, 4129, 4131, 4133, 4135 and 4137, 25 August, 22 September, 20 October, 17 November, 15 December 2000 and 12 January 2001.

Once again the Bury Museum provided the


*Replica 18th century Grand Orrery (1996).*

idea for the next job. This was to be a replica of the sea clock H3 made by John Longitude Harrison in 1749 in attempt to gain the £20,000 prize for a solution to the problem of determining longitude at sea. The Curator wanted H3 because no replica had been made while, together with other innovations, it included Harrison's great inventions, the bimetallic strip for temperature control and the caged roller bearing.

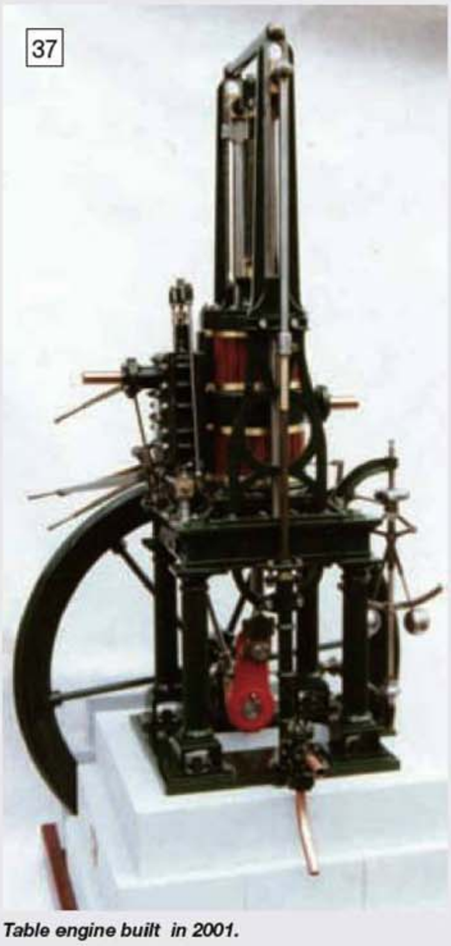
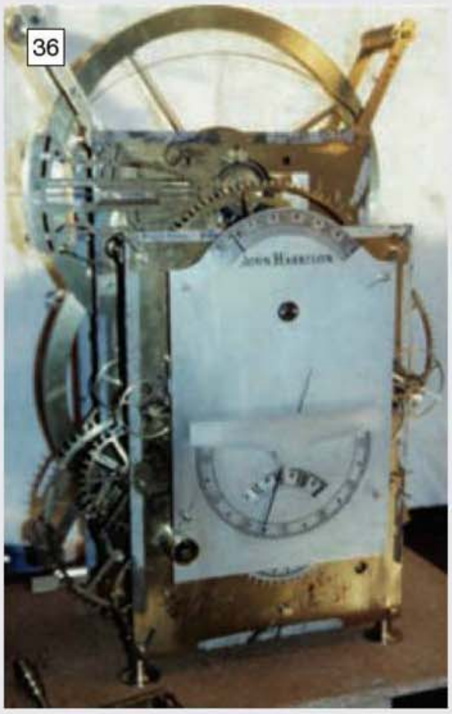



*Table engine built in 2001.*




*Replica Harrison H3 sea clock (2000).*

So, off we go again to the University Library on an information search that together with other searches took eight months. The interesting construction took 13 months (**photo 36**), however, after running satisfactorily for eight months it became unreliable and for a very long while I was unable to find the cause.

During the intervals while I was waiting for H3 to stop, another fill-in job was essential as I can't bear being without something to make. I had found another cylinder casting in the old box of castings from which the Wood's engine bits had been salvaged. What could it be used for? Many years ago a fellow model engineer lent me an old book of engineering drawings published in 1845. From this and with every intention of making the locomotive shown, I used my father's Kodak $3\frac{1}{4} \times 2\frac{1}{4}$in. camera to photograph an early 0-4-2 locomotive of the North British Railway and an elegant table engine. Unfortunately by the time I was able to pick it up I had moved away from building locomotives and so it never came to pass.

These old prints came to light while was looking through some old photographs. The cylinder casting was just the right size for a 1:10 scale model of the elegant table engine although considerable modification would be necessary. It was just right as an interim job as it could be dropped at any time when attending to the H3; so it was back to model making again! Apart from the cylinder casting which needed an additional exhaust passage, all the rest was fabricated from odd bits of steel and brass which I had lying about. When completed it made an attractive model which runs sweetly on air (**photo 37**). It hasn't been described in these pages yet — perhaps our Editor would be interested.

Many other jobs, too many to list here, have been dealt with in my spare(!) time, including repairing and/or restoring over forty clocks, of all types for friends and relations. However, I have great difficulty in convincing people that I am *not* a clockmaker, just a 'maker of things'!

What am I making now? I've had enough horology for a while so I am still modelmaking. Watch this space!

# A SOUTHERN RAILWAY MERCHANT NAVY CLASS LOCOMOTIVE IN GAUGE 1

**Roger Thornber**
**builds the trailing truck**
●*Part V continued from page 31 (M.E. 4199, 11 July 2003)*

The drawings and sketches of the trailing truck may look rather complicated, but it should be noted that there are really only two or three dimensions which need to be accurate! Provided that the wheel centre is correct with respect to the pivot point everything should be fine. Having said that, the outline is very characteristic so it is worth the effort.

Start with the side frames. Make them slightly oversize from 1/16in. brass. The bearing block has been shown as bushed but there is no reason why this should not be made of a single piece of gunmetal which should be silver-soldered in place. The remainder of the structure is bent up from 1/32in. brass. I suggest that these are also silver-soldered except for the small triangular pieces which can be soft-soldered. Don't forget that the side frames are handed. I almost ended up with two of the same hand! The whole piece is trimmed to shape.

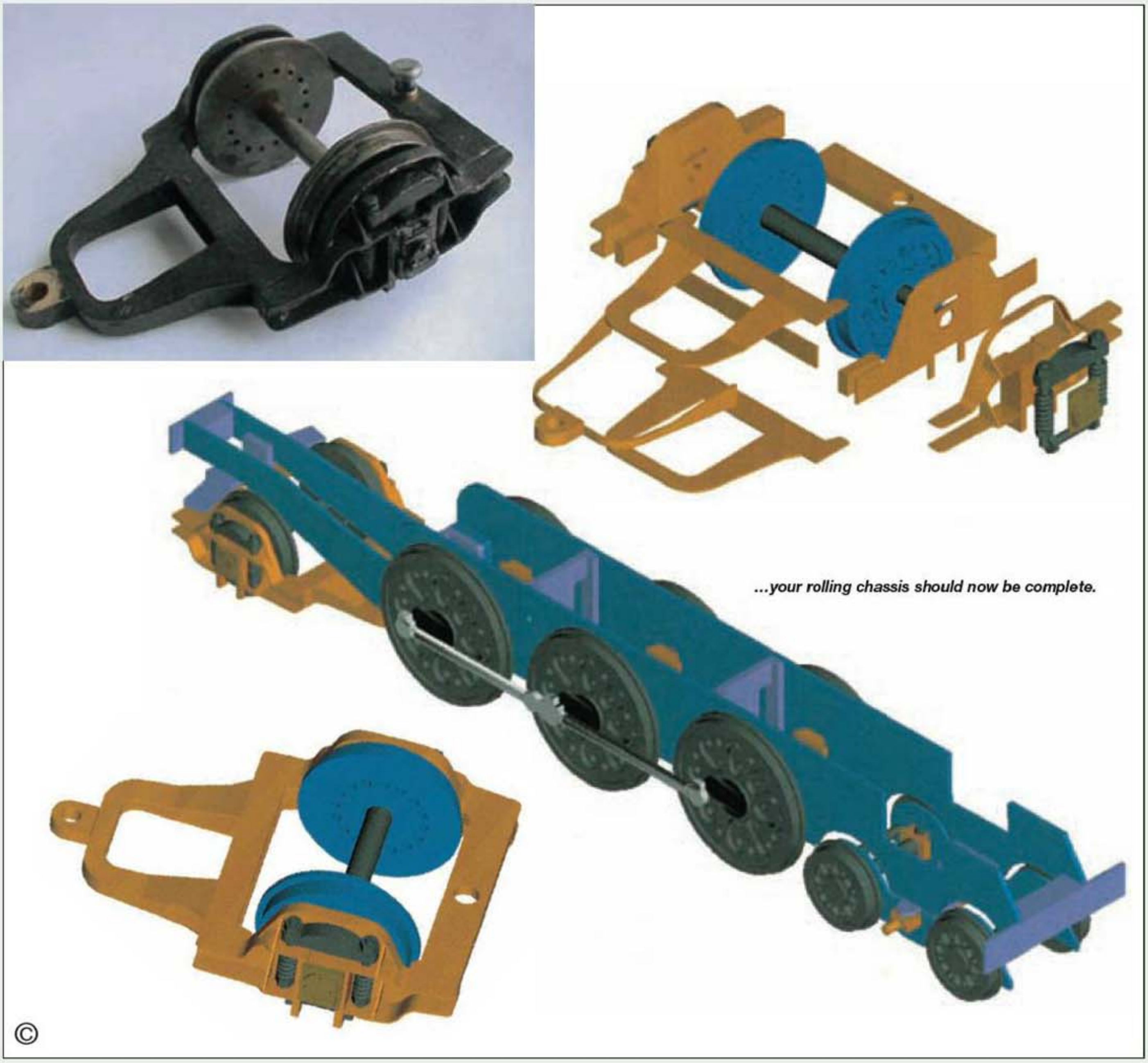
Various bits and pieces are added for the (dummy) springing. The outside axlebox covers came from some existing white metal tender axlebox castings.

The front frame starts of with the bottom in 1/32in. brass, again slightly oversize, onto which the sides and back of 1/16in. brass are fixed. The bolting faces are made of 1/8in. material. The top can now be added. Trim to shape. The front bearing block is added last.

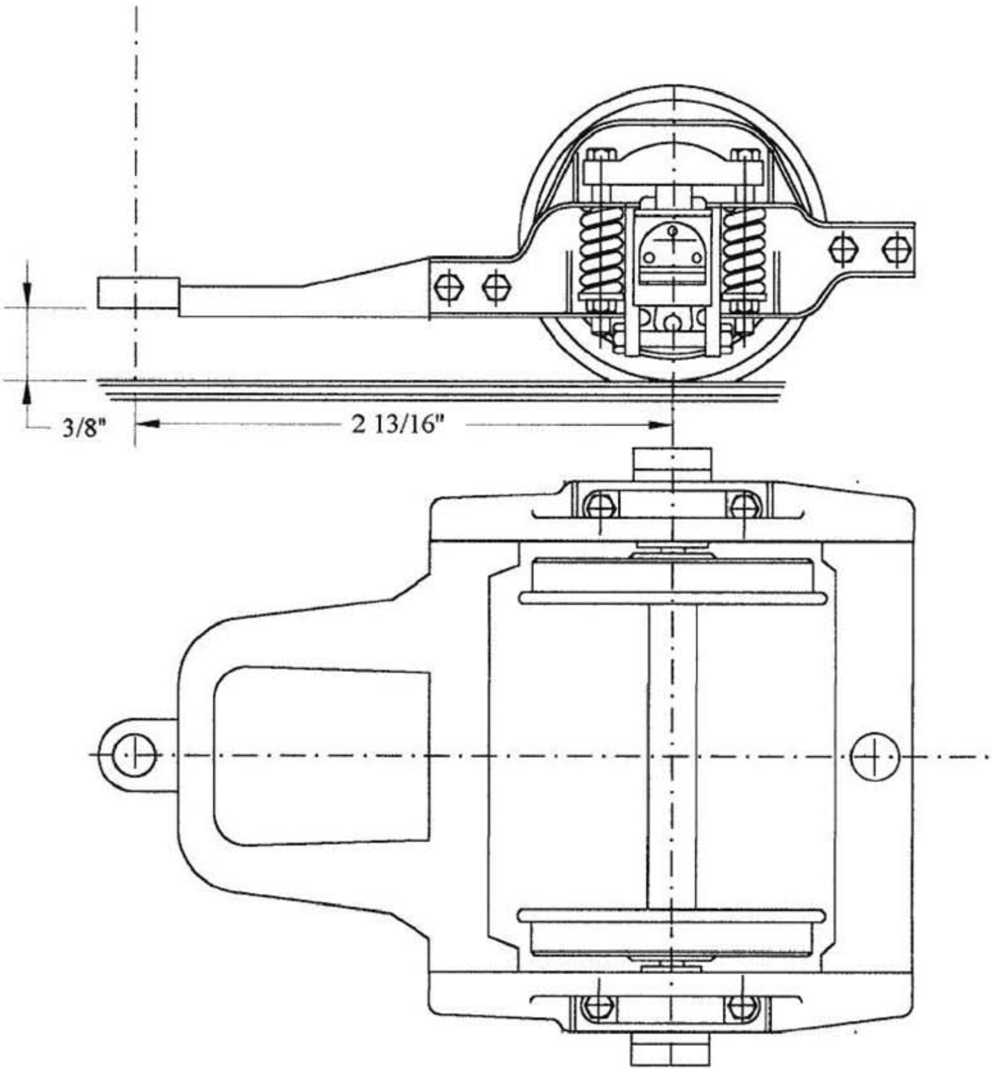
The actual springing is provided by a sprung pad screwed into the rear frame. This should bear on the trailing frame bearer (see Part III of this series, *M.E.* 4197, 13 June 2003).

Your rolling chassis should now be complete.

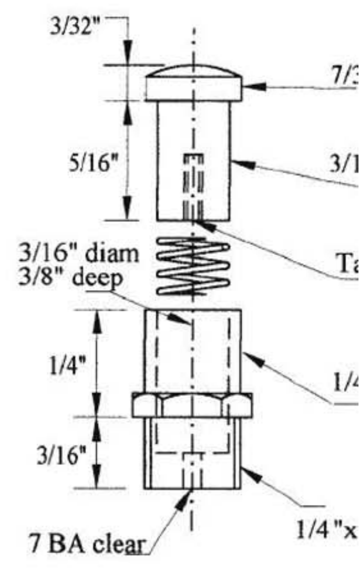
●*To be continued.*




*...your rolling chassis should now be complete.*

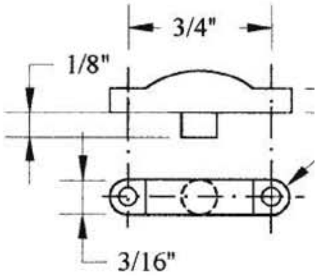



**General Arrangement**

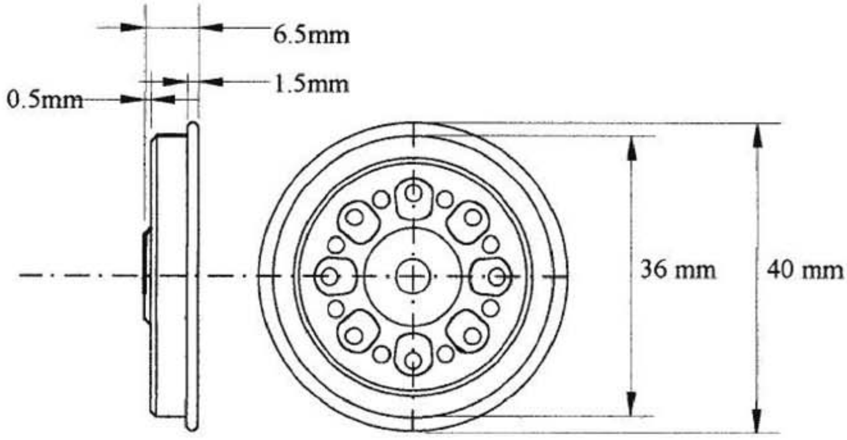



**Trailing Truck Spr**

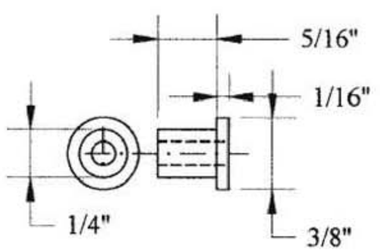
(Twice full size)



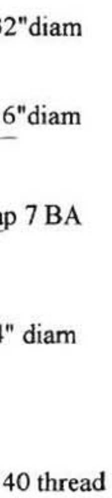

**Spring Pressure Pla**



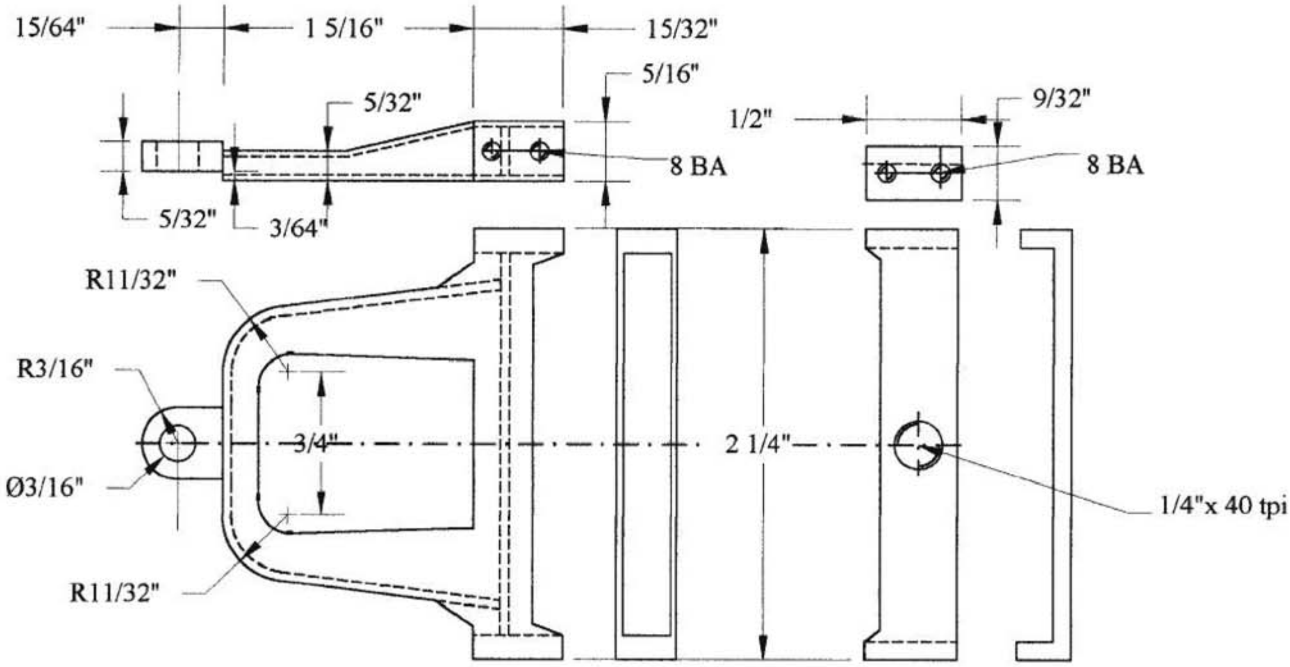

**Wheels**




**Bearing Bush**

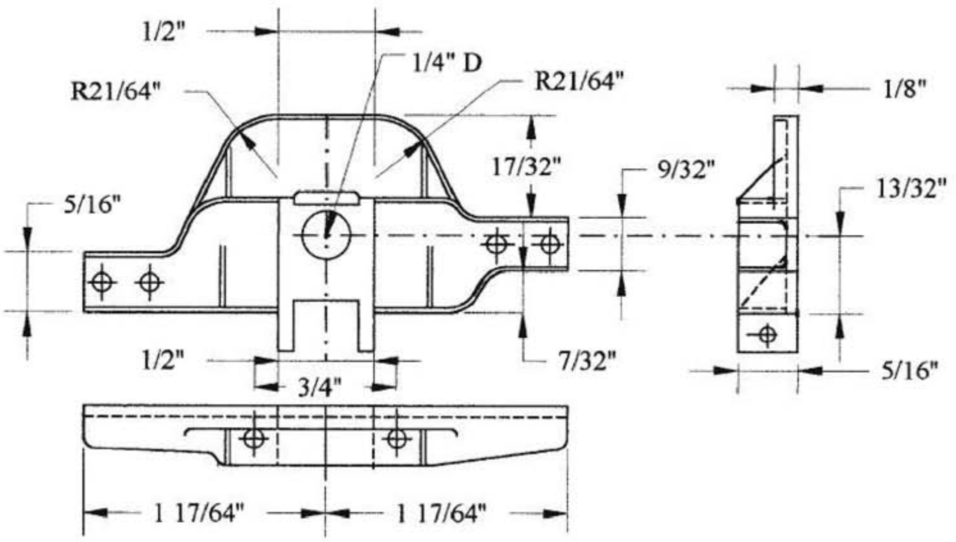



**ing Pad**

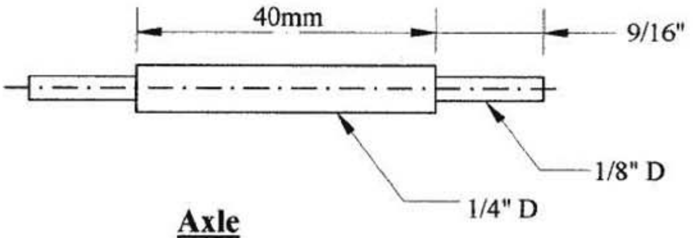



**Front and Rear Frames**


**te**



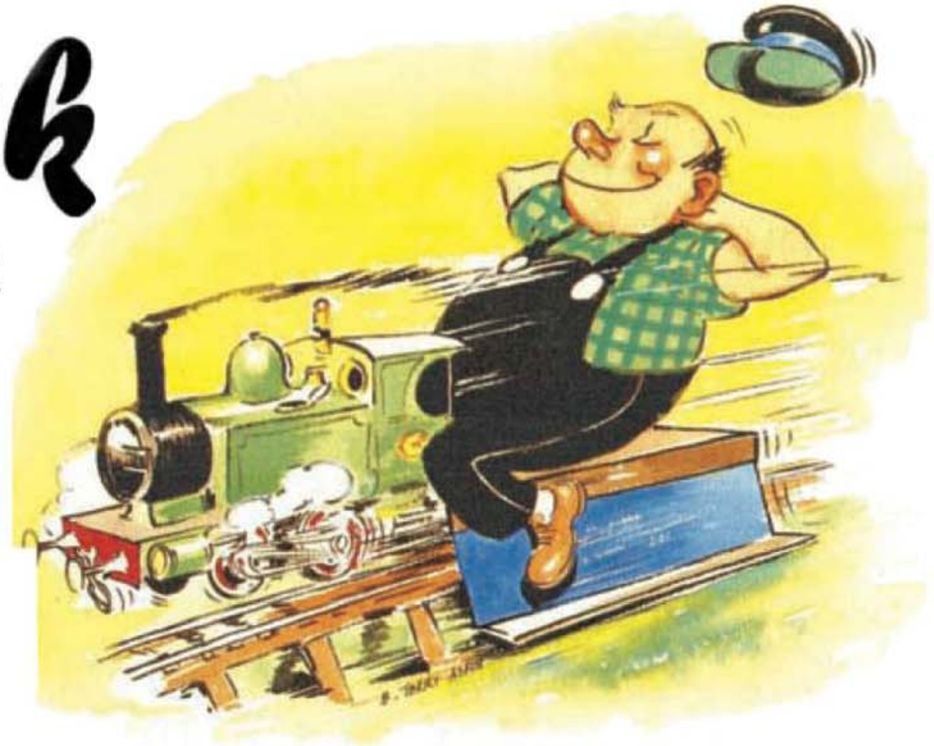

**Side Frame (left hand shown)**




**Axle**

**A SOUTHERN RAILWAY MERCHANT NAVY CLASS LOCOMOTIVE FOR GAUGE 1 BY ROGER THORNBER**

# Chuck goes philosophical



**B. Terry Aspin**
wonders "What drives us?"

This is a theory Chuck has been considering for many years. It is based on his belief that any human being who produces an artefact is motivated automatically by an inherent requirement to make that object, however insignificant it may be, pleasing to the eye. In this respect it should be made clear that this theory does not apply to *added* decoration. In this latter respect he refers, as an example, to a recent series of Royal Institution lectures. In the final lecture the speaker exhibited two objects made by early man. The first was the head of a harpoon with its beautifully fashioned barbs. A practical implement, which, in itself, had what today we might call eye appeal. The second object was a spear thrower, most beautifully sculpted along its length with representations of animals, which patently had nothing to do with its function of aiding the projection of a spear That would be what Chuck would refer to as added decoration. The spear thrower was nonetheless artistic and a credit to the ancient man who carved it but the carving dearly affected the hunter's prowess not one jot!

Before going further with the discussion it may be reasonable to refer to the dictionary description of the words 'Art' and 'Artisan'. The Concise Oxford defines the words as follows which may well seem to indicate that, linguistically at least, there is a recognised connection:

- **art** n Skill, *esp.* especially human skill as opposed to nature; (ability in) skilful execution of an object in itself, cunning; imitative or imaginative skill applied to design, as in paintings, architecture etc. (Middle English from Old French, from Latin *ors adis*.)
- **artisan** *n* Mechanic, skilled worker (esp. *manual*) [a French word from Romanic *adiculanus* from Latin *aditus*, past participle of *adire* to instruct in arts]

Perhaps we ourselves would define an artist in simple terms as one skilled in producing beautiful patterns, paintings, drawings, sculptures and so on. Sometimes representative, sometimes not, but without the slightest claim to utility. Likewise to us an artisan is one whose skills are directed towards the production of articles of use such as weapons, tools, clothing, footwear and vessels in metal and pottery. The list is endless. If there is art here it is in the *form* of such an artefact, which is combined with *function* in a way in which one cannot logically be separated from the other.

A good example of this may well be the *sabot*; (French = hoof) the wooden shoe, whose outline consists of a series of graceful curves from

*Breton sabot made on a remarkable machine.*

whatever direction it is observed. It is made to fit the foot, which it does and it is given a heel and an instep to support the wearer. At the same time the front is curved upwards to a point; as the sole is inflexible; to allow the foot to roll in the normal stride. The protection it affords to the wearer is undeniable.

The design is indeed so functional that the wooden shoe from other areas, such as Holland, differs from the Breton *sabot* very little and there is little doubt that a similar configuration will be found in other parts of the continent. Although the modern *sabot* is probably the product of ingenious machinery consisting mainly of flailing knives (which would never get past the Health and Safety rules in the UK today) there is no doubt that the wooden shoes were originally carved by hand, one at a time, by a craftsman. Remarkably the modern machinery seems to reproduce the crafted appearance of the hand carved clog almost cut for cut.

It may be to navigation that one has to turn to find the truly superb examples of functional art. The coracle may be a practical vessel without scoring too highly in the beauty stakes, but the traditional clinker-built dinghy, even in its rather basic form, is endowed with the most seductive

*Dutch 'clogs' made by hand.*

*Model coracle offered to tourists.*

lines. Ships, boats, barges of every conceivable kind and every form of construction from reed boats to Viking ships have been, and continue to be, an irresistible inspiration to artists and painters, not to mention modellers, members of our own fraternity. Pictorial and model records of such craft remain from pre-history and, although a great deal of added decoration has been applied to marine craft, particularly in the middle ages, the greatest emphasis has always been on function which was, and still is, a matter of life and death. Even the advent of mechanical propulsion in the form of the steam vessel failed to diminish the charm.

Weaponry by its very nature, has always perforce been practical and a spearhead or an arrowhead from the stone age is as aesthetically

*The bucket on the front of* **Golly Gosh.**

***The pliers and the adjustable are steel forgings.***

recognisable today as it was when it was made and the apparently flamboyant shapes of knives and swords has always been dictated by their lethal efficiency. The archery bow, before it was made from carbon fibre and fitted with telescopic sights and rear-view mirrors, in the right hands was probably one of the most effective weapons of all time. In the form of the longbow, completely free from embellishment, it was also at its most handsome as well as most deadly. With firearms too, as their efficiency improved so did their appearance, almost as if, suiting a machine to its duty automatically improves the quality of its design. It would seem that the craftsman is impelled to please his own eye and in so doing pleases the rest of us.

Sometimes the reproduction of an artefact in miniature enhances the beauty of its shape and Chuck believes the apparent phenomenon forms the basis of model making as we know it. It would appear that the model, to be really fetching, must be made to follow as closely as possible, the form and detail of the prototype. Few things can be more banal, for example, than a traditional galvanised bucket. On Chuck's locomotive *Golly Gosh* the miniature bucket on the front attracts more attention than the model itself. The evolved shape of the London pattern anvil, which is probably almost international, receives little in the way of acclamation where it stands in front of the blacksmith's hearth. Nevertheless, visitors to the club were prepared to shell out £5 a time for

***Chuck's pastel interpretation of a cave drawing at Lascaux.***

***Cast iron anvils: £5 a time.***

the miniature version in cast iron purely on the basis of its aesthetic appearance!

From the tin whistle to the grand organ and every variation in between the musical instrument has always been as attractive to the eye as to the ear. It may be to the strings and to the violin family in particular that the union of function and form is most pronounced. The intrinsic and basic shapes are sufficient to satisfy the vision and added decoration, where it is applied, is merely cosmetic and superficial. Different again but equally practical and evocative are the shapes of the brass section, no less the woodwinds, and the percussions, accordions and keyboards all contribute to their special appeal.

Chuck asks himself if the traditional diamond shape of the mason's trowel could be varied to make brick laying more efficient? Surely it is a classic case of utility designing itself. Could anything be more appealing than a set of BA spanners, especially the smaller sizes, to the same pattern as the large inch or AF sizes? Plated, of course, they look even better! In the matter of miniaturisation other than model making Chuck, in his very much younger days, has recollection of a small instrument lathe in the window of a certain tool shop in Liverpool. The sight of those miniature slides, dials and ball handles almost caused him to drool!

Chuck is completely unable to go along with the belief, which seems to be prevalent in most archaeological quarters, that the artistic renditions of early man were somehow bound up in a communal, magical or religious ritual. There is no evidence whatsoever to support such a theory. Evidence is limited to the existence of the paintings themselves and to a virtual certainty that they were executed by a person! The experts extend no credit to the individual who simply possessed the inborn talent and had the urge to express himself. He had to work in the most difficult of circumstances, often without natural light and with a most unsympathetic surface on which to draw. Chuck admits and regrets that he has seen only photographic reproductions of cave paintings but those have been sufficient to convince him that this was the work of talented artists. Their art may well be seen as impressionist but never primitive. This is demonstrated by their knowledge of the anatomy of the animals they portrayed and their understanding of perspective. They were limited only by their canvas and their implements. The same can be said of the early people who made the miniature figurines, animals, ships and so on. They were the first modellers. That which has survived is usually of non-degradable material. What about the ingenious objects, of which there is little record remaining, that they probably made in wood? As for the aboriginal hand stencils, Who among us, at one stage in his or her life, has not had a go at stencilling something?

Authoritative sources would often have us believe that these wonderful examples of art were instigated by the tribe as icons to prepare it for the hunt or some religious activity. We are told that prayers were offered and other rituals performed in the proximity of these paintings in the hope of invoking the pleasure of the gods to ensure their success. Chuck prefers to visualise the scene by the light of the campfire as Mrs. Caveperson occupies herself with the children and other domestic matters while Mr. Caveperson, having seen to the provisions and fuel, at the end of the day returns to his painting. He is an accomplished draughtsman and, being familiar with the animals he sees every day, he needs no model. His memory provides all the information he requires and the performance as well as the result of his effort gives him pleasure. When you come to think of it, the long winters on the edge of the ice sheet would have afforded him plenty of time for practice. There were no locomotives or other ingénues machines in his neck of the woods at the time or otherwise the sight of these may equally have turned him on and, being no less intelligent than ourselves, he would probably have reproduced every detail. His horizons may have been more limited than ours but, judging by the way he moved large rocks about over great distances, his horizons were not so limited as all that! The archaeological world would tell us that he accomplished these tasks by the crudest of means. The truth is more likely to be that *he* knew exactly how to do it with confidence. We ourselves fail even to *imagine* what method he may have employed.

It is difficult to imagine a rival in magnificence to the great pyramids of Egypt. The greatest engineers of our day with all the mechanical backup now available would be overawed at the prospect of such a prodigious undertaking and the best archaeological brains are unable even to suggest how such enormous feats of engineering were achieved. Very often such suggestions that are made simply border on the ridiculous. But many early skills have been lost and, in fact, continue to be lost. From comparatively recent years old film records of the building of steam locomotives, particularly of the manual work involved, raise the question

*This delightful '00' gauge loco. was made from shim brass.*

*A novelty miniature violin from the far east.*

*The body is just 1in. long and includes a pump.*

*"How on earth did they do it?"* and in only a comparatively short space of time it will be just as difficult for archaeologists of the future to explain that which, only 50 years ago, was the norm. What seems quite difficult to accept is the fact that at the time the great monuments were erected, the people who carried out the work knew exactly how to go about the job. After all, they had been working on similar projects for thousands of years before! In two or three millennia hence, if humanity has not by that time succeeded in destroying itself, there will doubtless be authoritative minds endeavouring to explain how the 'primitives!' managed to put men on the moon with the technology then available. Only 30 years after the event it is not easy to see how the process can be repeated! Perhaps the lesson to be learned is that it is not possible to quantify the human intellectual capabilities of the past by reference to the present.

Humanity comprises those who would create and those who would destroy. It is likely that model engineers are among the former category rather than the latter. If there were more of them Chuck thinks the world may be a better place to live in. In the main he believes that the minds of model makers are far too occupied to become involved in less sociable activities.

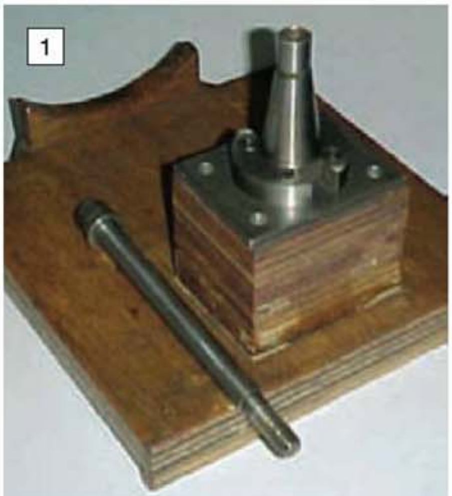
*Clinker built of marquetry veneer.*

# VERTICAL HEAD STAND AND FITTING AID

**Neil Read**
describes a useful aid for the owners of horizontal milling machines.

Many model engineers these days have access to a milling machine of one sort or another. Each individual selects a machine to suit his or her pocket, the envisaged work to be done on it and the space available. Often the machine chosen will be of the light vertical type, and this will be adequate for perhaps 90% of a model engineer's needs. Where funds and space allow a large industrial machine like a Bridgeport is sometimes selected, particularly if larger scale models are to be built.

In my opinion, the small industrial horizontal milling machine (either plain or universal) equipped with a vertical head (preferably of the sliding quill type) is still a good compromise. Such machines take up less workshop space than most turret milling machines but can cope with large side and face cutters, slitting saws, gear and sprocket cutters. They also have the facility for presenting cutters like slot drills to the work from the horizontal spindle, which is often more convenient than the vertical spindle when machining large parts. Such machines usually have a detachable vertical head that must be unbolted from the main machine column before the horizontal spindle can be brought into use and it is to machines of this type that the following notes apply.



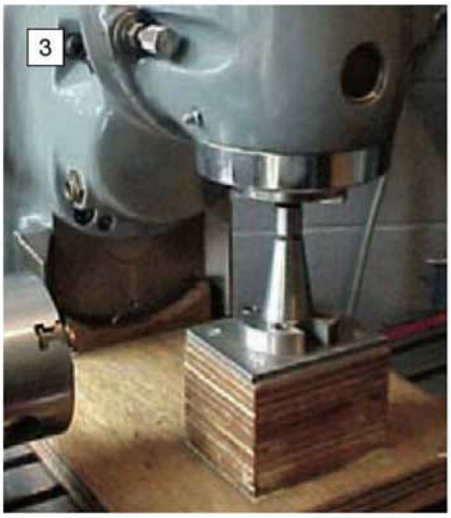

*The stand complete with draw bolt. It is made from plywood glued and dowelled together and has served the purpose for 15 or more years.*

If the best use is to be made of a horizontal milling machine with a detachable vertical head then it must be arranged such that changing over from one mode of operation to another is as simple and painless as possible. How this is accomplished depends very much on the machine. Some larger machines have a built-in hoist that permits the vertical head to be removed and stored on a jib attached to the side of the machine column. Small machines rarely have this facility. Some years ago I owned a Senior M1 milling machine. The change over from horizontal to vertical mode was very simple on this machine, as the vertical head was relatively light. It could almost be picked up with one hand.

This machine became rather too light for the work I then had in hand so I sold it to make way for a Harrison M1 milling machine. This machine has a very substantial vertical head equipped with a stout spindle having, like the main spindle, a 30 International taper. To provide the maximum daylight under this spindle, the drive is via a gearbox that effectively raises the spindle nose to a height roughly in line with the horizontal spindle centre line. This added complexity makes the vertical head relatively heavy; I estimate that it would tip the scales at 80lb. or so. To lift this head into position unaided, line up the spindle drive and do up the fixing screws would need someone who has the build of Charles Atlas (remember him?) combined with the dexterity of a brain surgeon and I do not qualify on either count.

Most people in this position would install a hoist. However, some exploratory tests showed that I could in fact lift the vertical head, particularly if it was at table height. It was just too difficult to line up the spindle and do up the fixing screws while supporting the mass with one hand. Also, there was the problem of what to do with the thing once it was off the machine. Laying it on an old coat on the floor was fine up to a point, but I invariably tripped

***Battens underneath the stand locate it laterally on the milling machine table.***



***The shape of the stand automatically lines it up correctly with the spindle.***

***The knee is then raised, the spindle orientated to locate the dogs and the draw bolt nipped up.***

over it and, in any case, in that position it quickly got covered in swarf, oil and other muck. The lubricating oil also tended to leak.

What I needed was a device that would support the weight of the head during removal and fitting and free the hands to manipulate the spindles and fixing screws. This device should also support the head, the right way up, during its time off the machine and avoid it having to suffer the indignity of rolling about on the floor or bench. It should also be capable of being used in conjunction with a hoist if lifting the head manually ever becomes too much like hard work.

**Photograph 1** shows the outcome of my deliberations. This stand/alignment fixture is hardly a thing of beauty and would probably make my old woodwork master blush with shame. However, it was made in a hurry one weekend and has served me well this past 15 years or so. The main constructional material is plywood, the various parts being glued together and the joints reinforced with dowels. I did not use screws in case they damaged the machine. I did give it a couple of coats of varnish just to seal the wood and prevent oil soaking into it; it helps stop splintering too.

The photo sequence really explains the method of use. The important thing to note is that the actual removal and fitting of the vertical head is now done using the main operational axes of the machine. To remove the head you just wind the knee of the machine down far enough to get the fixture underneath the spindle. Drop the fixture on to the table so that it is approximately under the vertical head spindle. The built in battens (**photo 2**) stop it sliding across the table and, by winding in the cross-slide until the notches in the back edge engage between the vertical column V-guides, the 30 Int. taper spigot is brought directly under the vertical spindle nose (**photo 3**).

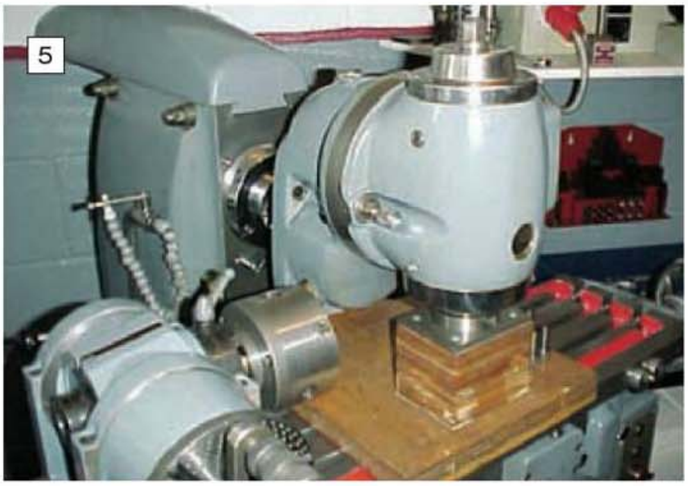
My spigot is a commercially made hardened item screwed to a piece of plate. It could just as easily been turned from mild steel but I happened to have it by me. The knee of the machine is now raised to engage the spigot in the taper and the draw bar fitted and nipped up (**photo 4**). The draw bar for the vertical head drive can now be released, the four cap head screws removed and the vertical head withdrawn from the horizontal spindle and its location dowel by using the cross-slide feed screw. The head is now completely free of the machine but fully supported by the spigot and shaped cradle on the fixture (**photo 5**). It can be brought to any convenient height by raising or lowering the knee of the milling machine.

It is now relatively easy to put your arm through the gap between the vertical head and the fixture and lift the whole lot off and place it anywhere convenient. I usually use the top of a tool trolley/portable bench that stands in the middle of my workshop and serves as a convenient place to lay the small tools and instruments that I need whilst operating any of my machine tools. I am aware that the lifting of a weight of this magnitude would not be allowed in industrial circles without mechanical help but we do not have to tell anyone. In any case, as already stated, there is nothing to stop the use of a hoist to help with the phase of the operation if so desired. The layout of my workshop is such that I literally only have to lift, turn through 180deg. and place the head on the trolley. Simple!

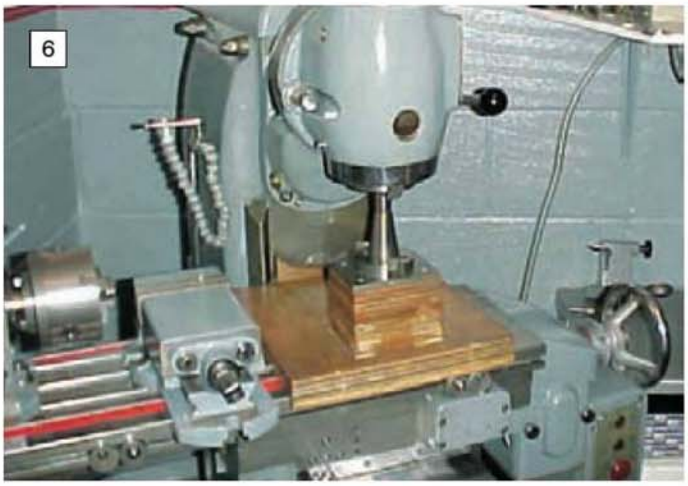
When it is required to refit the vertical head, the procedure is just the reverse of that described. By using the vertical and cross-slide axes of the machine it is child's play to line up the head with the horizontal spindle and fit and tighten the fixing screws and draw bar. The fixture can then be removed and put away until it is needed again.

I have not prepared drawings for this fixture, as I did not think it necessary. It is the sort of thing that you knock up from available materials to suit your machine. If anyone has a Harrison M1 and would like more guidance they can contact me through the usual address. One thing to note when designing your fixture is to endeavour to keep the width as narrow as possible consistent with stability. The reason for this is that you may wish to use the fixture when the machine vice or dividing head is attached to the milling machine table. It would be a bit of a chore to have to unbolt either of these accessories just to change from vertical to horizontal mode. Mine can be used when these accessories are in use by working from one end of the table (**photo 6**).

I hope the forgoing notes help some readers get more use from their milling machines. Even if you have no immediate need for a fixture of this type it may give you an idea for a gadget which you do need.



***The main spindle draw bolt can then be released, the vertical head fixing screws withdrawn and the head brought forward using the cross-slide.***



***When designing your stand ensure that it can be used even if a vice is in the middle of the milling machine table.***

*An underside view of the brake vacuum cylinder showing details of the brake linkage.*

*The Lowmac chassis spine and strengthening plate photographed during construction.*

# SELF STEERING WHEEL SETS and SWING LINK SUSPENSION

**David Hudson** offers some final thoughts based on his experience.

●*Part VII continued from page 39 (M.E. 4199, 11 July 2003)*

There is little doubt that wheel treads wear railheads and worse still, railheads wear wheel treads. This is because continuous cyclic loading, slip, scuffing, etc., occur as wheels rotate. There is a further problem, especially with cast-iron wheels, and that is, continuous cyclic loading causes metal to migrate from high stress to low stress areas giving the impression of wear, although very little metal has actually worn away.

Mixed wheel profiles are another cause of poor adhesion and wear. They spoil the adhesion between wheel treads and railheads by constantly altering the shape of the contact patch and area. This point requires addressing.

Now, elasticity in both wheel treads and railheads is very important. This is so that the resultant hydrostatic distortion will yield an adequate wheel to rail contact area and hence load bearing capability. If the hydrostatic distortion of wheel and rail are matched, then low rolling resistance is attainable.

It would appear that there is sufficient evidence to justify that all wheels, including those of locomotives, should conform to the same single point contact tyre profile. It is so easy to make and use a profiling tool that, over a period of time, all wheels could have the same profile. Then the accrued benefits would do much to improve adhesion and reduce rail and wheel wear. There is no reason why most of the above arguments should not apply to wheels and rails made of steel, as British Rail have already found out.

Over many years, the use of the BR/Heumann wheel tyre profile on 5in. gauge passenger cars using cast iron wheel treads on aluminium alloy rails has dramatically reduced the aluminium alloy rail wear and distortion. However the cast iron wheel treads show considerable metal migration and require re-profiling from time to time. The use of a re-profiling tool enables this to be carried out quickly and without too much metal removal, because the root radius and flange show little or no wear. It may be that cast iron wheel treads are still the best option.

It should be understood that these proposals are not the last word, but only represent the point at which my researches have led me. It is suggested that there are still three areas that require immediate investigation. First, the flange to rail clearance might be reduced, say by increasing the wheel back-to-back distance from the generally accepted distance of $4^5/8$in. and/or increasing the flange thickness. Secondly, the radius of curvature of the curved portion of the tyre profile could be increased (this has not been changed from when my researches started). Thirdly, consideration might be given to using a wheel tyre tread having a different modulus of elasticity and having less propensity to metal migration. Perhaps one of our metallurgist readers could be persuaded to pick up this one and put us on the right track (excuse the pun).

With regard to steel rails, of which there would appear to be many railhead profiles, all wheels appear to suffer adverse wear. This is especially so on raised level tracks where the speeds, and passenger loads, are usually considerably greater and, as a result, considerable metal removal is necessary to restore the proper (sorry, original) profile. The use of a work hardening material for tyre treads having the proposed BR/Heumann profile coupled with swing link suspension is worthy of further consideration.

There are in existence many proposals for wheel tyre profiles being promoted, and most of them could possibly benefit by introducing a curved portion instead of straight conicity.

Perhaps their promoters would care to investigate this. I can see no good reason why this proposal should not also apply to scale wheels. Notwithstanding the preceding discussion and limitations, the use of the BR/Heumann wheel tyre profile when coupled with swing-link suspension has such enormous benefits regarding passenger safety, that its development ought to be an ongoing investigation by people more capable than I am.

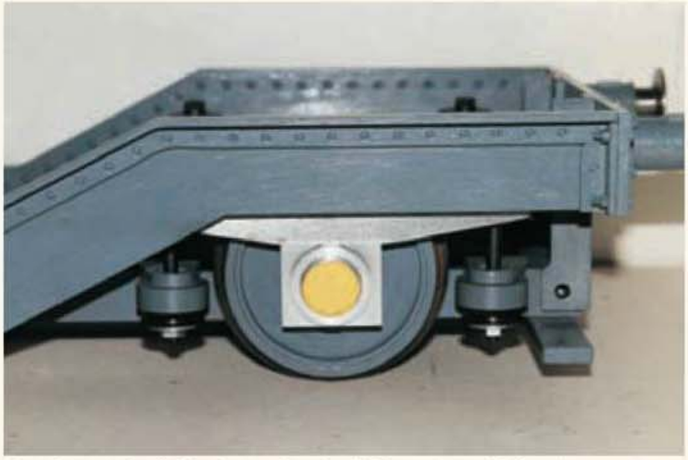
*The chassis outer frame and buffer beams after fabrication.*

*The two parts of the chassis have been united and things are taking shape.*

***The chassis assembly after the spine and outer frame have been united.***

***The chassis with the bogies fitted into place.***

***Buffer beam detail. This shot was taken before the chassis spine had been added to the assembly.***



***Attention to details like rivets give the driving car a realistic appearance as well as providing a comfortable and safe driving platform.***

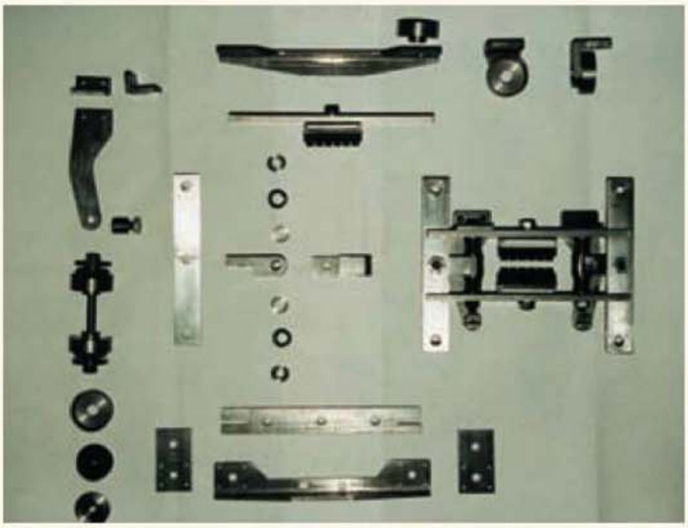
***The towing yoke and clevis coupling.***

## References and acknowledgements


1: Prof. H. Heumann (Professor of Railway Engineering at Aachen and Munich).
2: Dr. J. L. Koffman (British Railways Traction and Rolling Stock Engineer).
3: Articles in *Modern Railways* by Engineers at British Rail Research Division, Derby.
4: Rubber Technologists at Goodyears and at the Malaysian Rubber Producers Association.
5: Dennis Monk C. Eng. (Many articles and conversations).
6: Tom Walshaw (*Tubal Cain*) *Model Engineers' Handbook.*
7: Many articles in *Model Engineer* over the years.
8: Ray Dodds, secretary of Bromsgrove SME, for his kind efforts in proof reading and re-formatting these articles.


***A complete brake assembly in close-up.***

***The brake actuating gear shown in component form prior to assembly.***



***Brake assembly parts shown with an assembled unit on the right hand side.***

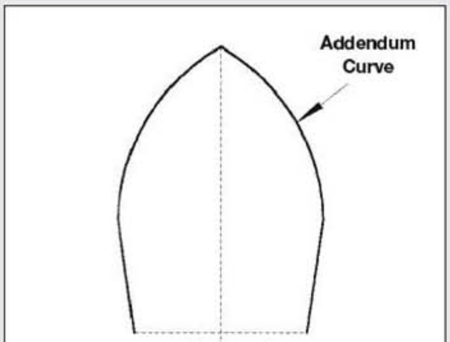
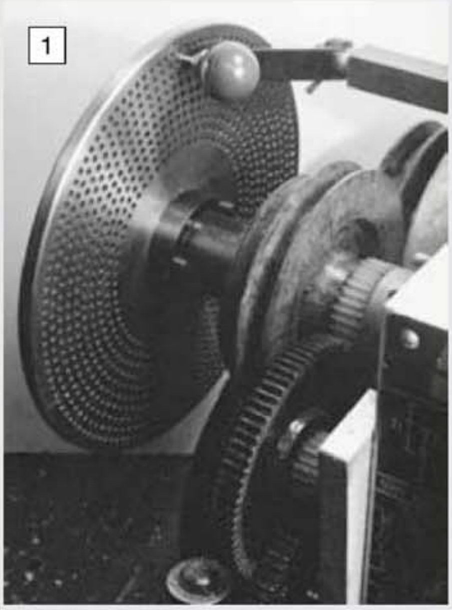



Figure 1
Full Ogive Form Profile




*The pinion teeth are indexed using a dividing plate secured to the lathe spindle and a detent fixed to the lathe headstock.*


*The lathe set up for pinion cutting. Note the top-slide mounted as a vertical slide and the flywheel-like mass of the milling spindle cone pulley.*

# CLOCK PINION CUTTING

**Ian Beilby**
sets out to encourage the amateur clockmaker by dispelling concerns and showing his own approach to pinion cutting in a small lathe.
●*Part I*

As an amateur clockmaker, I have to admit that when I show a non-clockmaker a new clock which I have just made, I am always very flattered when they marvel at the fact that anyone can actually make a mechanical clock in a small home workshop. The most frequently comment is *"Have you made it all yourself?"* and I always own up to the fact that I didn't do the engraving, make the chain or the spandrels, spin the pendulum bob or make whatever component I have happened to buy in.

But what really seems to amaze 'ordinary' folk, is when they learn that you actually cut the wheels and pinions yourself. They seem to imagine this is only possible with fancy equipment! When you then tell them that you actually cut the wheels on a lathe, disbelief and amusement creep in. To compound their surprise, when you explain that cutting the wheels is one of the easier tasks in making a clock, in fact its repetitiveness can be more than a little boring, they think you're having them on!

Most amateur clockmakers would probably agree that cutting brass wheels is not a serious problem, even on the smallest of lathes. This is largely due to many of John Wilding's excellent books and articles in which he describes wheel cutting and the different set-ups that can be adopted when cutting wheels, even in the smallest of lathes. Given the correct set-up and the necessary equipment, most amateurs can confidently cut their own wheels.

Pinions, however, are another matter. Non-clockmakers are often puzzled that you can confidently cut a 96-tooth 3in. diameter wheel with no problem, but a 5/16in. 8 leaf pinion can cause difficulties. Exactly similar principles are involved, the only real difference is that the material used for the pinion is steel. When talking with other amateur clockmakers, I find that pinion cutting, along with making escapements, are the two areas of clockmaking which seem to be the least understood and cause the greatest concern.

The aim of this short series is an attempt to dispel one of these concerns by showing how I cut clock pinions on my lathe. Hopefully, the set-up I use will give a basic idea of what is required, and readers will be able to adapt their lathes in a similar manner. I would not claim that the methods I use are ideal, nor that my pinions are perfectly cut and finished as they would be by a professional, but I hope to be able to show that, given due thought and preparation, perfectly acceptable pinions can be cut on the amateur's lathe.

Very few lathes come equipped with the necessary accessories required to cut clock wheels or pinions. Although some of the essential items can be bought, including division plates, cutters, milling spindles and the like, depending on your own particular lathe, you will find you have to be prepared to make certain fittings for these items to be attached to the lathe.

My own lathe, a Hobbymat 65, is by no means large; it is really quite a small model maker's lathe, however I find it perfectly adequate for making clocks. With a centre height of just over 2.5in. it is possible to cut the great wheel for a Longcase clock, which is about as large a wheel as the amateur is likely to want to cut. The lathe is sufficiently robust to provide the rigidity necessary for most light engineering tasks.

Rigidity is one of the prime factors in all machining operations. In order to achieve an accurate and acceptable finish when cutting, or more accurately milling a steel pinion, rigidity is paramount.

The other critical factor is accuracy. The relatively small number of teeth or leaves being cut and the relatively small pinion diameter mean that the cutter *must* be aligned centrally with the pinion blank to produce accurately cut leaves. The pinion blank must also be accurately held, and machined to the correct diameter.

When cutting brass wheels of relatively large diameters, it may be possible to get away with small errors in cutter alignment or in holding the blank. Perhaps not noticeable, the teeth may lean slightly or may not be perfectly formed, but within limits the wheel is likely to be acceptable. Not so with a pinion! Without doubt, these are the main problems for the amateur using a small lathe to cut pinions. However, once these problems are recognised and overcome pinion cutting is a relatively easy and rewarding task.

The main purpose of these notes is to encourage the amateur who has never cut a pinion before, or who has tried in the past and been unsuccessful. I am therefore deliberately not going to delve into the theory behind pinion design, or other such matters which can be very daunting for the amateur. From a practical point of view, much of this information is not really necessary, and is readily available in reference books and other articles anyway.

## Basic features of a pinion

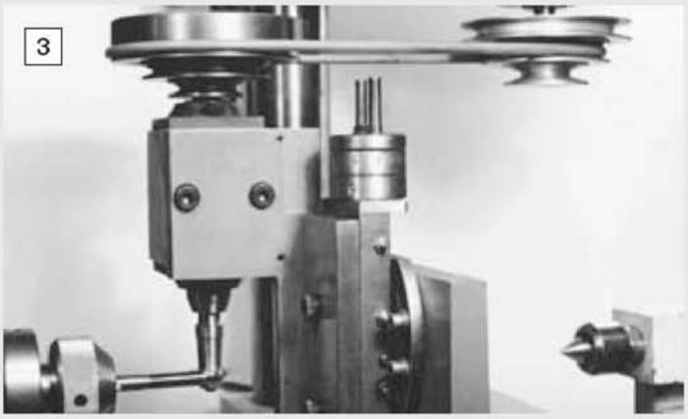
Before describing the methods and set-ups which I adopt when cutting steel pinions, and despite what I have just said, there are two things which we do need to know about pinions:

First, the shape, or more correctly the profile, of the leaves of pinions varies depending on the number of leaves being cut. Fortunately we are making pinions not cutters, so we can leave this little problem to the cutter manufacturer.

Most domestic clocks employ pinions with a count of 6, 7 or 8 leaves, and the leaf profile with this number of leaves is known as the Full Ogive Form. With the cutters from P. P. Thornton the addenda constant for this form is 1.71. This figure is important because we need it to determine the pinion blank diameter. When cutting pinions of 10, 12 and 16 teeth, the form changes slightly and a different addenda constant of 1.61 is used.

**Figure 1** shows the top profile of the Full Ogive leaf form. When actually cutting the pinion, there is a theoretical depth of cut in order to achieve this form. However, in practice it is far better to feed the cutter progressively into the blank until the addendum curves of the leaf just meet. The pinion will then be correctly formed.

Secondly, the diameter of the steel blank from which we are to make the pinion has to be determined from the formula:



Left: the milling spindle is driven by means of a plastic belt.

Right (top): the pinion blank is prepared with a leading chamfer and a small cross-pin.

Right (bottom): the pinion blank is drilled and reamed for the arbor on which it will be mounted.

$$d = (n + 1.71) \times m$$

where n = the number of pinion leaves,
1.71 = the addenda constant for 6, 7 and 8 leaf pinions, and
m = the module of the cutter.

From this it can be found that a 7.28mm dia. blank is required when using a 0.75 cutter to cut an 8 leaf pinion.

## Separate 'heads'

Definitely the easiest method for the amateur to adopt, and the one which I intend to describe, is to make the pinions as separate drilled pinion 'heads' and secure them onto their arbors with Loctite. There are many advantages to this method of forming pinions, and not just in their construction.

Silver-steel, or pivot steel, is readily available in the diameters likely to be used for the arbors. Pinions cut from silver-steel can be hardened and tempered before fixing onto their arbors, thereby avoiding the risks of distortion associated when hardening and tempering a solid arbor and pinion.

If, in years to come the pinion shows signs of wear, it can easily be moved on its arbor by the application of heat, or removed and a new pinion fitted.

If you do not own a conventional depthing tool, the separate wheels and pinions can be depthed accurately in the type of depthing tool described by John Wilding, which is neither expensive nor difficult to make.

Above all, the main advantage is that normally a 1in. length of pinion is all that is required to provide sufficient separate pinions heads for an entire clock.

The only problem with this technique is that the core of the pinion must be of adequate diameter for it to be drilled to accept the arbor.

With this in mind, when cutting a pinion I always use a pinion cutter sized 0.05 less than the corresponding wheel cutter. The pinion blank size is calculated using the same module size as the wheels, but cut with a cutter 0.05 smaller. In the example above, the pinion blank diameter was calculated assuming a 0.75 module cutter was used to cut the wheel. The pinion would however be cut with a 0.7 cutter. This produces a pinion with leaves slightly thicker at the roots, thereby providing a thicker core.

Most amateurs generally tend to use wheel cutters of 0.75 or 0.8 module. An 8 leaf pinion cut with a 0.7 or 0.75 pinion cutter can usually be easily drilled to accept a $^{3}/_{32}$in. arbor that would normally be used with this size of pinion. If a smaller module is used, the diameter of a portion of the arbor would have to be reduced to accommodate the pinion head.

I have only had to do this once when an 8 leaf pinion had to be cut with a 0.55 module pinion cutter and drilled No. 50 (0.070in. or 1.8mm) owing to the small diameter of the core. The design of the clock called for a 0.103in. (2.62mm) arbor; my simple solution was to reduce one end of the arbor to 0.070in. for a sufficient length to accommodate the pinion head. If using pivot steel for the arbor, this may not be the easiest of tasks, but nontheless it can be done.

## Maximum rigidity

As mentioned above, when deciding on the set-up for cutting pinions, similar requirements are necessary as for cutting wheels. The difference is that priority must be given to ensuring maximum rigidity. The pinion blank must be held firmly and accurately, and some means of dividing provided. In this context, the lathe headstock, which is one of the most rigid components of the lathe structure, is ideal.

For accuracy, the pinion blank can be held in a collet chuck or a 4-jaw chuck, and it is usually possible to arrange some means of attaching a dividing plate to the headstock spindle, thereby providing direct division to the blank.

**Photograph 1** shows a dividing plate attached to the headstock spindle of my lathe, and a detent leaf spring firmly fixed to the lathe headstock. To maximise rigidity, the pinion cutter must be mounted on a substantial milling spindle and provided with a flywheel pulley. The flywheel will help to damp out any slight vibration and chatter caused when using multi-tooth cutters. To provide the necessary vertical adjustment when centring the cutter, the spindle should be mounted on the vertical slide of the lathe.

**Photograph 2** shows my milling spindle with its flywheel. The milling spindle is bolted to a substantial angle bracket, which in turn is bolted to the lathe top-slide. In this instance, the top-slide is being used as a vertical slide. The whole assembly is fixed to the lathe cross-slide by way of another angle bracket. Before cutting commences, the assembly should be checked for squareness by the use of an engineer's square placed on the lathe bed. The feed required when cutting the pinion is provided by traversing the lathe saddle.

Some means of driving the milling spindle is of course necessary. On my own lathe I am able to utilise the vertical milling spindle which is attached to the rear of the lathe bed. I appreciate that not all lathes are equipped in this way, but some means of driving the spindle is required. In this respect much depends on the equipment available and the ingenuity of the clockmaker.

Two other important points must be considered when deciding on the set-up for driving the milling spindle. The first is the speed of the cutter, and the other is effecting a positive drive to the milling spindle. Cutters can be run as fast as 4000rpm when cutting brass wheels; however when cutting steel pinions, cutters should be run much more slowly, at about 250rpm, requiring some thought to be given to speed reduction by means of some form of pulley/countershaft arrangement.

My own set up allows me to utilise four motor speeds and combinations of pulley diameters on the milling machine and milling spindle to obtain speeds ranging from 157 to 3200rpm, which is adequate for both wheel and pinion cutting. **Photograph 3** shows the drive set-up, the plastic belt is tensioned to give a positive drive to the milling spindle. That said, I would remind readers that my set up is not ideal.

There are two main disadvantages. First, pinion cutting takes place at the back of the blank where it is difficult to see what is going on. This is particularly awkward when it comes to taking the final cuts and in forming the addendum curve to the pinion.

Secondly, with the milling spindle mounted vertically on the cross-slide it is not possible to provide tailstock support for the pinion blank. This has a detrimental effect on the rigidity of the set-up during cutting. With this in mind I have made a small adjustable jack which is screwed up against the pinion blank and provides lateral support to the blank when cutting.

## Making a start

The first operation in making the pinion is to turn the blank to size. A collet chuck or 4-jaw chuck should be used. The blank, which should be turned from silver-steel, should be faced and then centre drilled. It is also a good idea to provide a chamfer to the front of the blank to help in leading in the cutter when first cutting the pinion. **Photograph 4** shows a blank being turned in the collet chuck with tailstock support. The chamfer at the front of the blank is clearly visible.

It is also evident that I have cross-drilled the blank and inserted a small steel cross pin. This is to prevent the blank working back into the collet during the cutting process. Needless to say this should not really be necessary if the cutting speeds and feed are correct: however I would sooner be safe than sorry!

At the same setting **(photo 5)**, the blank should be drilled and reamed to accept the arbor later. The lathe can then be set up for cutting the pinion. The dividing plate should be fitted to the lathe mandrel, and the milling spindle fitted to the vertical slide.

●*To be continued.*

**David Lloyd-Jones**
suggests that computer simulations are a pale shadow of the real thing and advises active participation!

The advent of the information age now means we can all sample our heritage interactively via the internet without ever leaving the comfort of our own living room. Instant access to thousands of UK heritage websites opens a small window to allow us to take a brief look at our culture and history. But nothing compares with actually going out and sampling the real thing first hand.

*Real steam power and plenty of it on the Welsh Highland Railway!*

# REAL HERITAGE *REAL SOOT IN YOUR EYES!*

While heritage in digital form has to be applauded, as it is now possible to visit numerous heritage sites, all railway activities really need to be experienced face to face and allow you to get real soot in your eyes. One of the most exciting moments in my life came last year when I was lucky enough to ride on the footplate of a steam locomotive and actually got my hand on the throttle and drove it for a while. The experience was so surprising and nothing like I imaged.

After all, I had visited as many websites as I could find about railways on the 'net and even downloaded various train whistles and cab sounds to play back on my computer. I have even driven steam locomotives for many hours on Microsoft's Train Simulator and considered myself to be quite good at driving an interactive locomotive. Yet none of this prepared me for the ride of my life on a real steam locomotive. The moment I climbed onto the footplate I was instantly deafened by the noise as the crew prepared the engine for departure. You might think the whistle is loud standing next to a steam locomotive on the platform, but you cannot begin to comprehend how loud the whistle is while you are standing on the footplate. I can still hear that engine's whistle ringing in my ears even now.

And the smell that fills your nostrils. It is a unique and unforgettable smell; a combination of hot oil, coal dust and smoke from the fire. As well as the noise and smell, the other thing you instantly notice is the searing heat from the firebox, which hits you squarely in the face, taking your breath away. Meanwhile, the floor was so hot I could actually feel the heat through the soles of my sturdy safety boots.

Nothing could have prepared me for the assault on my senses not even numerous hours spent driving trains on my computer.

Although a steam locomotive is an inanimate metal object, basically a kettle on wheels, once the fire is lit the engine begins to come to life. As soon as full boiler pressure has been reached, you can really feel the power, power generated by simply harnessing the steam produced by boiling water. As you take control of the throttle for the first time and open it up, you can really feel the raw power of steam.

The entire awe-inspiring experience on the footplate of a steam locomotive proves that there is no substitute for the real thing. While computer train simulators have come a long way in the past two years, they have a massive gap to bridge before they begin to approach the real thing.

You can, for example, study thousands of close-up pictures of the fastest steam locomotive in the world, arguably the LNER Pacific *Mallard*, sit for hours watching footage of her in action from every conceivable angle and still be completely blown away by seeing her in the flesh. One of my earliest memories is being taken to the Science Museum in London, aged about four, and being totally overwhelmed by the sheer size and might of the GW 4-6-0 *Caerphilly Castle* and the prototype Deltic diesel locomotive. While these exhibits were 'preserved in aspic' and had not run for years, they had a profound effect on me and were probably part of the nucleus for the start of my life long interest in railways.

You can digitally synthesise a prefect copy of the sound of a steam locomotive's whistle, but it will never hit you quite the same way as the ear splitting wall of sound of high pressure steam being forced through a highly polished brass two note chime whistle. It is sheer raw power.

But the big question is, as the internet and train simulators get better and better, will it affect the numbers actually going out and sampling our heritage first hand? After all, it is now expected for every railway to have its own website, and not just a simple one either. Those of you who regularly 'surf the net' have perhaps already noticed there seems to be an unofficial competition going on between railways to outdo each other. As computers get more powerful and internet connections become faster and faster, it will not be long before it is possible to download a video clip of a complete trip along the line. So why go visit the real thing if you can sample it in the warmth and comfort of your home?

While the temptation is there to put everything about a railway on the internet, the time has come to provide only enough information to just tease and tempt people to get out of their comfy chairs and visit the real thing. Railways marketing departments now have to be careful about information overload on their websites, which in the end could have the reverse effect to that intended, by keeping people away from visiting and riding on their systems.

It is not just railways either. Any heritage site, museum or art gallery has to be careful not to provide too much information over the 'net, which eventually will seriously affect numbers. I have to admit, I have seen hundreds of copies of perhaps the world's most famous painting, Leonardo Da Vinci's *Mona Lisa*, and have even visited the Louvre's website to look at it. However, during a visit to Paris last Christmas, I finally got to see this great masterpiece in the flesh and was completely blown away by it. Despite being housed behind a massive glass screen, that tiny painting has to be sampled first hand to really appreciate it.

While too much information on railway websites could eventually have a detrimental effect on passenger numbers, the opposite could be said about train simulators. These 21st century train sets give you a taste of the real thing leaving you wanting more, hence my first ride on the footplate of a real steam locomotive. And after driving up and down for hours and hours on a simulation of the narrow gauge Talyllyn Railway route, I am now planning to go and visit the real thing once again this summer after a decade or so since my last trip on the line.

I feel as if I know this line really well, after driving passenger trains to timetable, stopping at stations and waiting in passing loops for trains coming the opposite direction. But, I still want to ride on the prototype, perhaps to see how it compares to the simulation and pick up some hints and tips on how to drive my interactive version once I return back home again.

Could it be that there is a real danger that the rapidly growing online culture is creating 21st century stay-at-home couch potatoes (or should that be computer chair nerds?) electing only to visit our railway heritage via the internet. If true, it is sad as they are missing out on a truly interactive experience by sampling the real thing first hand, and getting real soot in their eyes.

KEITH'S COLUMN

# LOGGER & SLOGGER
## AMERICAN TYPE 2-8-2 LOCOMOTIVES for 5in. and $7^1/4$in. gauges

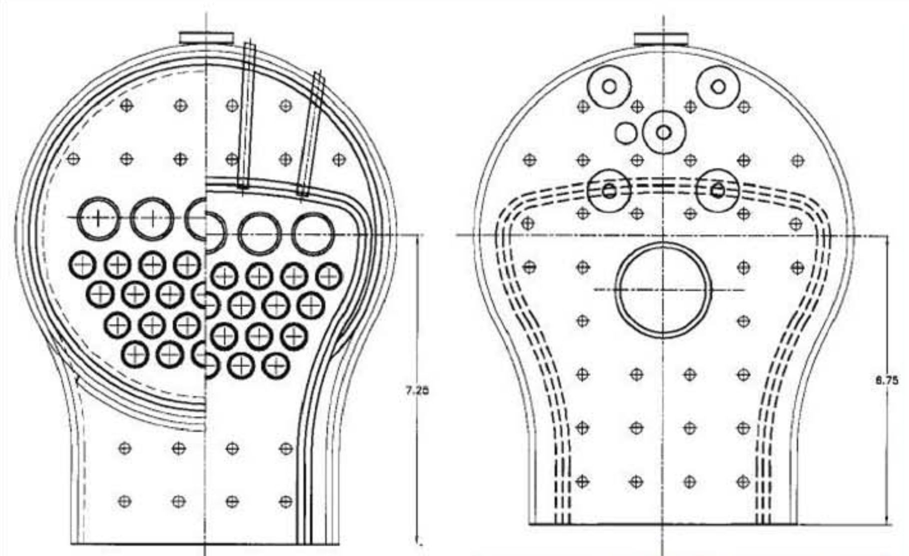
**Wilson's Words of Wisdom:**
*Few things are quite so tightly closed as an 'open' mind.*

**Keith Wilson**
deals with the firebox and other boiler innards before taking time out for some more reminiscences.

●*Part XX continued from page 44 (M.E. 4199, 11 July 2003)*

The endwise shape of a boiler is determined by the former plates used to make it; in our case these are fewer in number than for some locomotives (e.g. those with Belpaire or Wooton fireboxes) and much easier to make. It is possible to purchase ready-bashed copper plates (much the easiest way) but for those who need to make their own, I suggest the use of a good bandsaw to cut steel plates to the profiles shown. Alternatively, you could get them flame-profiled, finishing them with an angle-grinder and rounding off the edges. The thicker this plate the better up to, say 1in. for the big ones and $^3/4$in. for smaller ones. The greater inertia of the thicker plates gives better 'shock resistance' and is a great help when former-bashing. While you're at it, make a plate to the backhead profile but $^{15}/32$in. ($^3/8$in.) larger all round, except at the bottom. This plate will be needed for the outer cladding sheets. As before, dimensions in brackets refer to *Logger*.

Cut the copper blanks about $^1/2$in. larger (except at the bottom) and anneal them by heating the outer inch or so to bright red. For the purpose of annealing, there's no need to cook up the entire plate or to quench it, but dumping a hot copper plate into a bucket of cold water removes most of the copper oxide that forms when it is heated. Clamp the plate to its former, gripping it in your biggest vice and pound the plate towards its final shape. A crafty idea is to have two former plates, the copper can then be sandwiched between them and life made easier. You'll not do it all in one session, but re-annealing three times should do the trick.



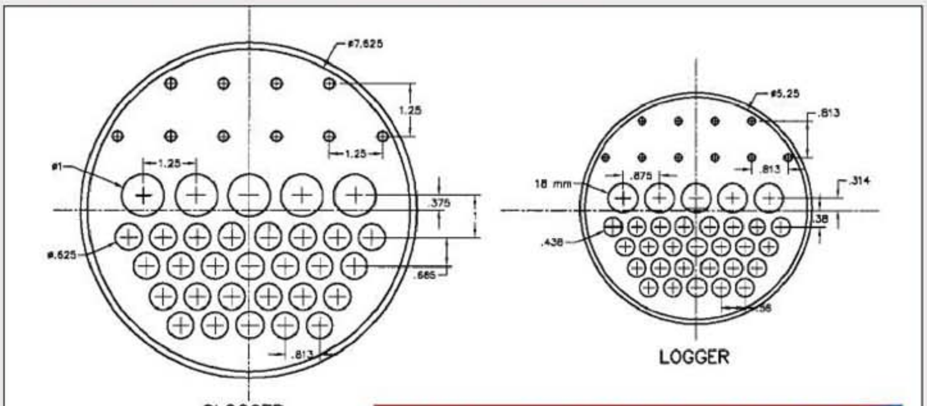
*SLOGGER*
TRANSVERSE SECTIONS OF BOILER

It is a moot point whether to make a full throatplate and cut much of it away, or to just bash up the part at the bottom. The full plate will help to get the outer wrapper to shape, but of course the barrel and the backhead can do just the same job. If you pal up with someone else in making a pair of these big stiffs (and you'll almost certainly need help with handling the boiler anyway) then the pair of backheads will be most useful.

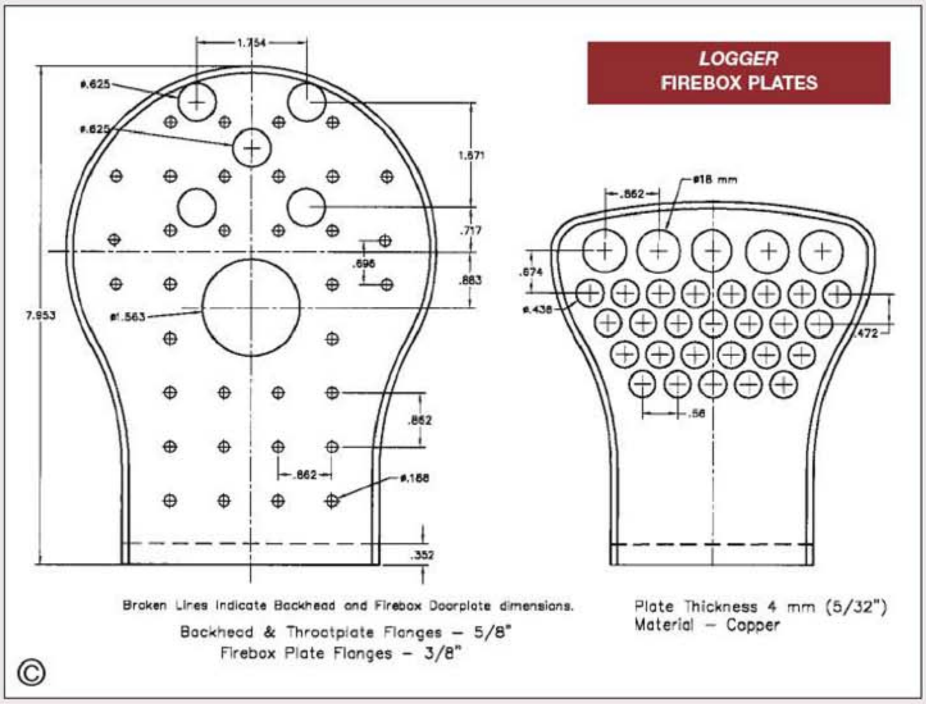
Pre-bashed plates generally come with the holes spotted through, when you make your own you will need some measuring, but nothing too difficult. There's no need to ream holes for the tubes or bushes, you need some clearance for penetration of the silver-braze, so a next larger drill size is recommended. You could always resort to a coarse file.

The tube layout is pretty much the best possible, although whether a vertical layout as in full-size practice instead of a horizontal one is better is open to experiment. In the past, boilermakers were told to cram as many tubes as possible into the plate; well, professional makers (and I) strongly disagree. The practice of cram makes for great difficulty in getting holes in the plates, leaves no room for the scale produced while steaming, and makes re-tubing well-nigh impossible. In trying to make the *Doris* boiler for example exactly to drawing you are very likely to find one huge irregular hole in the plate instead of lots of correct-size ones. You won't get the inner box complete with tubes into the outer shell. Scale (not by measurement, but from hard water) cannot be scaled (!) but probably $^3/32$in. is okay for $2^1/2$in. and $3^1/2$in. gauges, $^1/8$in. for 5in. gauge, and $^3/16$in. for $7^1/4$in. fits the bill.

I have shown solid longitudinal stays through the boiler, but anyone who prefers the hollow stay method of providing steam for the blower can easily make the conversion; $^5/16$ x 16g (0.064in.) will do nicely, or $^1/4$in. x 18g (0.048in.) for *Logger*.



*LOGGER/SLOGGER* FRONT TUBEPLATES




*A finished front tube plate (left) and a firebox tube plate (right) for a Belpaire firebox boiler. The pilot holes location the position of the tubes and will be opened out to an easy fit.*

*An early point in the assembly of the firebox. The annealed wrapper will be shaped to conform snugly to the front tubeplate profile. Toolmaker's clamps are a useful aid at this stage.*

It is worth fitting a bronze bush at each end; the old practice of simply threading the copper tube is open to problems if the thread fails for any reason, as with soft copper it is very likely to do. A few years ago it was suggested that long stays were not much use, for the fact that they rattled around when cold proved that they were slack. However, a few simple calculations showed that a 1/2in. sideways slack only meant a few thou. in longitudinal slackness; this being taken up by stretching of the boiler under pressure plus a bit for temperature.

The foundation ring is of 1/2in. square copper, or 1/2 x 1/4in. if you prefer.

With rod stays as shown, it is fairly safe to cut the firehole in the firebox rear plate at this stage, so it can then be a help in getting the firebox lined up. With girder type crownstays, it is best to leave it 'til later, locating it from the backhead on site, else you are likely to end up with a lop-sided backhead. It is by no means as easy as might be thought to get the alignment perfect. Stay holes are located through the backplate as required, and the best possible short stays are 1/4in. (3/16in.) copper roundhead rivets, heads inside except on the backhead section. Although in due course we will discuss assembly, it is worth using the backhead to locate the firebox, clamping this in place and silver-brazing round the foundation ring but leaving the backhead free. This will be a great help when threading stays through their holes; it will also let you see for yourself that the silver-braze has run through each joint.

The front tubeplate should be a reasonable fit in the front barrel, turned down in lathe if necessary. Leave a bevel on the outside of the flange to make insertion into the barrel much easier; fitting it flange first is strongly recommended.

The holes in the front tubeplate are set higher than the holes in the firebox tubeplate. I do not think that this actually aids steaming, but it gives better clearance for the tubes at the front.

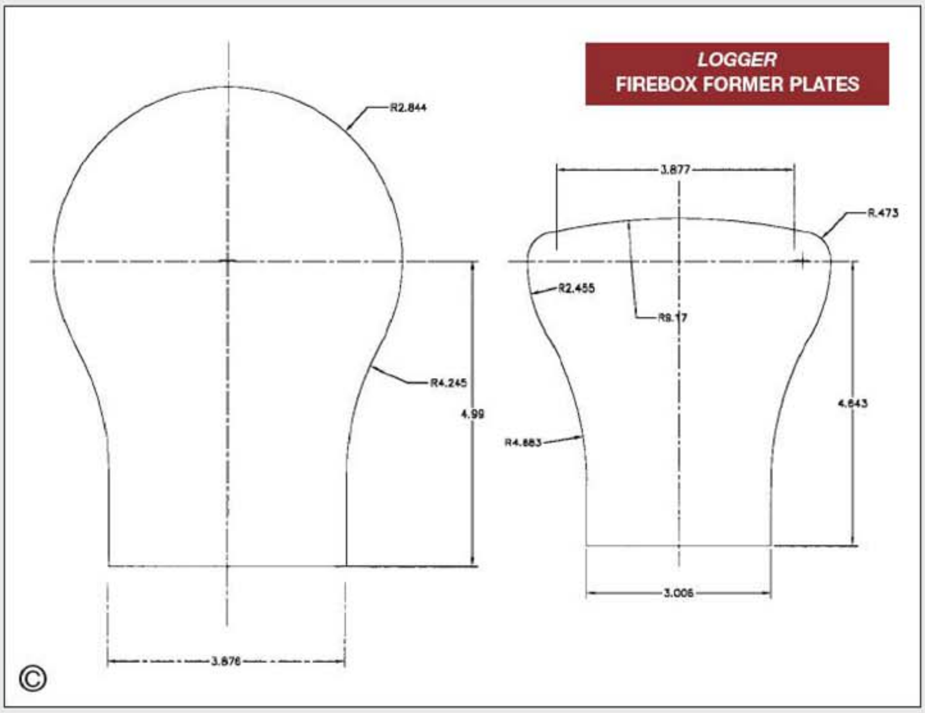
## Service days

The recent article on *Edwardian Elegance* has aroused some interesting memories, triggered in the main by reference to the Slow, Easy and Comfortable. Way back in 1955 I was stationed at Cosford, not too far from Wolverhampton. The GWR ran through the RAF station, or at least the station was in two parts, one each side of the line. The Up Cambrian Coast Express halted there in the mid-afternoon, alas the Down Cambrian did not. A stopping train followed the down Cambrian to distribute passengers therefrom, but even on the GWR no-one had thought of a stopper before it to collect passengers.

Wishing to spend a weekend platelaying on the Tal-y-llyn, I went up onto the platform in comfortable time for the Down Cambrian; to my annoyance it zipped through at over 60 miles per hour. I forget what I said. which is perhaps just as well, but my thoughts were understandably anything but strictly charitable.

The next stopping train was, of course, well behind, so for a change I boarded it and carried on beyond Shrewsbury to Ruabon. Ruabon was the eastern end of what is now the Llangollen railway, alas no longer connected to Ruabon. The train for Barmouth was waiting in the Bay platform and shortly led me to what is possibly the loveliest station on all the railways of Britain, to wit Langollen.

Built to some extent on trestles (or that's how it appeared to me) over some rapids on the River Dee, it would be very hard to beat. It is still there, in use by steam trains, and is well worth the visit. The best bet, however, is to drive on to the far end of the line to Carrog, just short of Corwen, where parking is easier, and travel back to Llangollen by train.



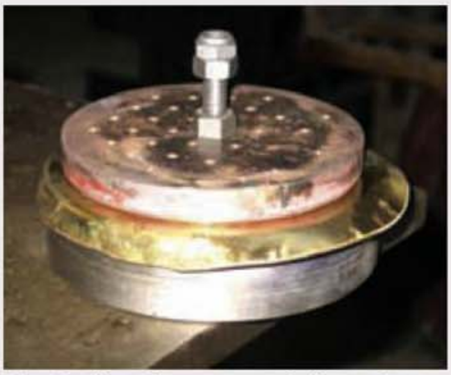
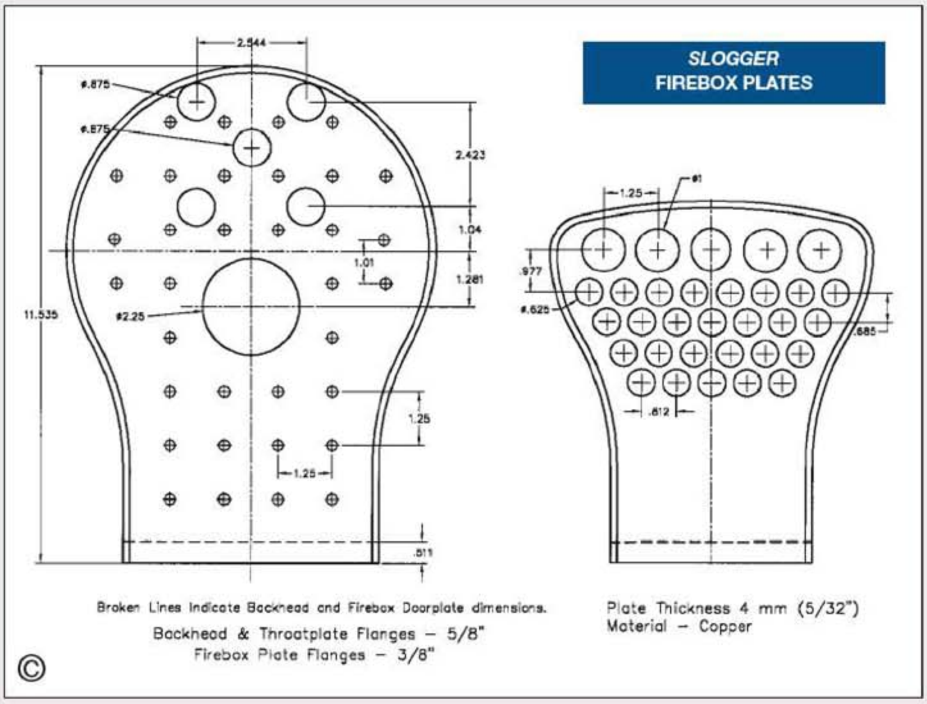


***Plate-bashing thin gauge annealed brass sheet. The 'sandwich' configuration helps prevent the brass from lifting in the middle. Note the pilot holes in the tubeplate former (top).***

***Rear end assembly of a Belpaire firebox locomotive boiler without its backhead during construction showing the firebox, crownstays and part of the foundation ring in place.***



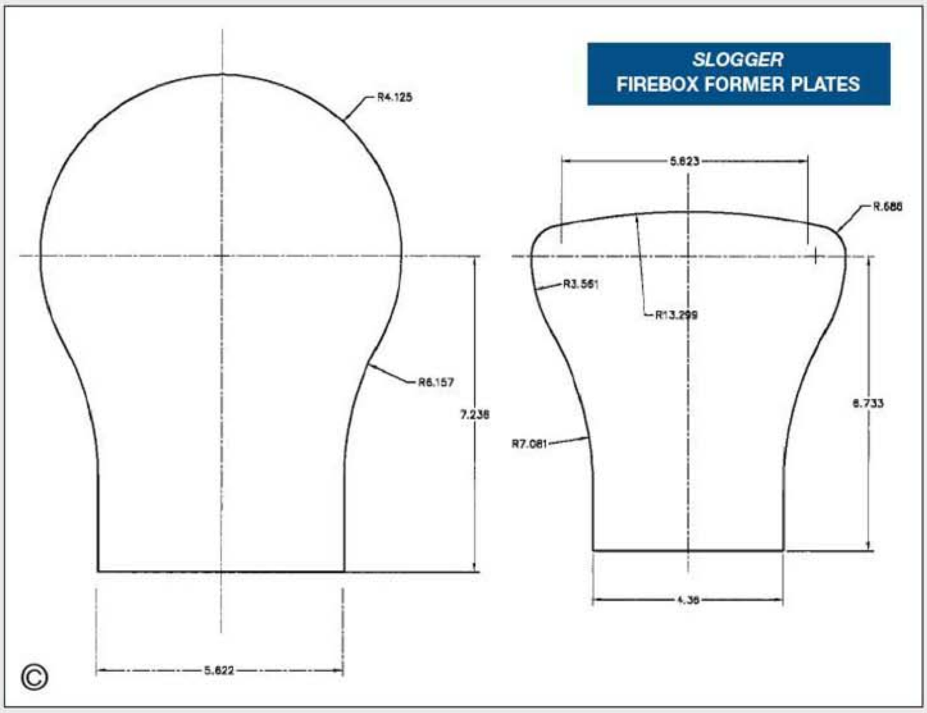

I did my stint on the Tal-y-llyn, and lined up innocently for the Sunday evening train, at that time the one and only up train. At that time nothing opened in Wales on a Sunday, not even parachutes! Transferring onto the Aberystwyth portion at Machynlleth, we duly ran along the old Cambrian line, but only as far as Buttington. The train then went along the original Cambrian main line through Llanymynech, Oswestry, Whitchurch, Nantwich, ending up at Crewe.

It was there that I had to wait, I nearly wrote 'waste', an hour for a southbound train. Wandering around the platform, I was much intrigued by several large piles of mailbags. So what? Well, the piles were of course labelled and displayed such names as South Eastern and Chatham, London, Brighton and South Coast, and London and South Western. It greatly lightened my stay, and I had a quiet chuckle at the fact that these names had not been 'official' since 1923. For all I know the same system is still in use today; it would certainly be hard to beat the system, and I certainly hope so.

To get back to Cosford, I had to travel south to Stafford, wait again for another train to Wolverhampton high-level, walk down to the Great Western station and another hour later get the London train which stopped at Cosford. To do a journey that would take about 3 hours by road, I left Towyn at about 6.15pm and arrived at Cosford at about 5am. It brought home to me the fact that 'cross-country' travel by rail could not compare with roads, for it is not always possible to travel at 'convenient' hours.

I am often asked what I did in the RAFF, as we always pronounced it, despite official bellyaching. I blew into one end of a flute, music usually issued forth from the other end. However, I soon discovered that so-called discipline was largely an excuse for plain bullying. I fought against this aspect, won, and was thrown out. I laughed all the way back to England from Cologne, and have yet to have any regrets. I kept a diary for some time, writing many names in ancient Egyptian hieroglyphics. It worked, for the word got round, and those even remotely familiar with hieroglyphs as used in cartouche form are rather few on the ground.

I would not like it to be thought that the RAF, or indeed any other branch of the services, is necessarily bad. But I will just state that it didn't suit me. Surprised? For fellow *Goon Show* fans, I recommend the 4th Armoured Thunderboxes.




A few years ago my (long suffering) wife and I did the trip to Llangollen in the manner suggested above. My wife went out for a walk through the town, while I explored the station, ending up in the signal box. Brenda came back and looked around for me. Seeing me in the window there came the question *"What are you doing up there?"* I had to tone down my instinctive reply *"what the .... do you think I am doing up here?"* because of numerous members of the public but the 'silly answer to a stupid question' syndrome still runs through my mind.

I would add that while at Cosford, we went to the Isle of Man monthly, a nice 'perk', and there was a reasonable train service 'twixt Wolverhampton and Cosford. It will not come as a tremendous surprise that the 11pm train to Cosford was not always driven by the official driver. The stopping train just after 6pm was usually a Castle working through to Shrewsbury, but of course it was not always dark at that time. It was on the first of these 11pm versions that I realised that the red aircraft warning light on top of the Wrekin TV mast was exactly in the position of a stop signal on a long straight stretch of the line!

●*To be continued.*

# CLUB CHAT

With Malcolm Stride

## UK News

We have been reminded by Tony Finn about his project and web site *The Talk Exchange.* This web site carries details of talks available to model engineerings by speakers willing to travel to other clubs and societies to give their talks. The web site address is **www.finn-aj.freeserve.co.uk/tex.html** and if you have a talk that you are prepared to give then Tony would be pleased to hear from you. Contact him on **tony@finn-aj.freeserve.co.uk**

The **Gas Turbine Builders Association** has announced details of its new web site on **www.gtba.co.uk** which has several new features including a downloadable membership form and substantial revisions to the information on the site. Association member Paul Jackson has announced that he is willing to give talks on model gas turbines or assistance for novices in this field in the Lincolnshire, Nottinghamshire or Leicestershire areas. Contact Paul between 09:00 and 19:00 on his mobile telephone (0797-000-3904) or via e-mail on **paul@microjets.co.uk** Perhaps Paul could make details available to Tony Finn (see prevoius item). Mike Burlington won the Kit Wallace award presented at the association AGM this year. This award is for development and innovation in model gas turbine design and Mike won the award for his work on concentric shaft design in gas turbines. The newsletter also contained details of the progress of many projects including the 7¹/4in. gauge gas turbine locomotive being developed by Pierre Bender.

**Leicester SME** reports that after a cloudy start to the day, their evening steam up was blessed with 'a clear moonlit sky'. Visitors came from the Welsh Highland Railway, the Leicester Railway and the Lutterworth Railway Societies and had an evening's driving and chat accompanied by a light buffet. A good selection of steam and electric locomotives were running with several more on static display.

The newsletter of the **Melton Mowbray & District MES** contains lots of requests for help with the recent Whissendine Rally including a request for 'cakes to feed the five thousand'. We hope all the help was forthcoming and that all those who attended got their cakes! A very sensible debriefing was planned shortly after the event to take stock while everything was still fresh in everyone's mind.

The new secretary of **Norwich DSME** is David Davey who can be reached at 220 Salts Road, Walton Highway, Wisbech, Lincolnshire PE14 7EB or tel: 01945-587527. The society newsletter also includes details of one member's search for a 'Model Wife'. We have no information as to the success or otherwise of this venture but judging from the criteria listed the search may be a long one!

Another society with a new secretary is **North London SME** where David Harris has stepped into the post. David can be reached at 64 Brooksfield, Welwyn Garden City, Hertfordshire AL7 2AN or tel: 01707-326518. The society has also updated its safety rules and members are urged to familiarise themselves with the changes. Members are also looking forward to the club's 60th anniversary next year and are looking for ideas 'to celebrate it in style'. At a recent 'Work in Progress' meeting, member David Jones described the painting and driving of his recently completed gauge 1 *Evening Star* based on Roger Thornber's design. David made extensive use of powder coating in the finishing of his model. Other items presented at the meeting included a gauge 1 0-6-0 by member Roger Woolett and a steam reverser by Les Brimson for his class 'L' locomotive.

*Lionsheart*, the newsletter of the **Old Locomotive Committee** reminds us that their 'Lionsmeet' will be on Sunday 16 August. This meeting includes an 'efficiency' competition for models of *Lion*. The committee would also welcome complete or part built models of *Lion* in any scale, work in progress, or other items related to *Lion* for display at the meeting. Contact John Hawley on 01275-472023 or by e-mail at **ringjph@talk21.com** Member Ian Kemp described his modifications to the safety valves on his 5in. gauge *Lion* to overcome the sometimes temperamental operation of the original Salter pattern. This uses conventional safety valves with a dummy Salter mechanism to retain the original appearance.

The open invitation running day at **Rugely Power Station MES** will be on Sunday 10 August this year. The club has 3¹/2in. and 5in. gauge raised track and intending visitors should contact Derek Moore to gain access to the site. Derek can be reached on 01543-490023.

Members of **Reading SME** are mourning the recent passing of President Jack Shayler. Jack was one of the original founder members of the society before the war and became secretary when the society was reformed after the war. He held that position for 24 years and was made President when he stepped down. As I can personally testify Jack was always willing to help or offer advice to those seeking help and will be greatly missed by all who knew him. When I joined the society a few years ago Jack made a point of introducing me to the other members and also encouraged me to drive his own 3¹/2in. gauge Black Five.

*North London SME member David Jones gained a Silver Medal in MEX 2002 with his gauge 1* Evening Star *'on the table' at a recent meeting.*

Like many model engineers, members of the **Scottish Model Engineering Trust** have an interest in full size engineering as well as the smaller variety. The cover picture of the society news sheet shows 'before' and 'after' restoration photographs of Alex Gray's vintage Carfield motorcycle. The photographs indicate that a lot of work has been completed with a very impressive result. Alex also describes building his Kerr Stewart *Wren* in 7¹/4in. gauge as a result of building a lubricator and wanting something to use it on! Work is progressing on the new site for the society's track. It is hoped to start the actual relocation of the track in July and to be running on it in time for next year's season. We wish them luck and hopefully will be able to report a satisfactory outcome in due course.

The cover photograph on the latest newsletter from the **St Albans DMES** is of member David Batchelor's model Bell Ranger helicopter in the air. Had we not been told, I would defy anyone to tell it apart from a real version. David recently gave a presentation on various aspects of model helicopters to society members and member Alan Harmer described the details of the wood cladding on his tram engine. This was done from a small off cut of swamp kauri wood obtained on holiday in New Zealand. This wood has a very straight fine grain and could be cut into the 0.02 x 0.030in. section required. The wood is obtained from stumps of ancient kauri trees flattened by a cataclysm some 30,000 years ago and covered by swamp. The stumps are dried and can then be used for the manufacture of a wide variety of articles, including it would seem, model locomotive cladding.

A change of officers has occurred at the **Sutton Coldfield MES** with Roger Timings retiring from the position of Company Secretary. The new Secretary is Neal Harrison who can be contacted at 24 Nuthurst, Sutton Coldfield, West Midlands B75 7EZ; tel: 0121-378-3992 or e-mail: **nealharrison@amserve.com**

**Stamford MES**, in common with many others runs a portable track at a few fetes. This year it was the turn of St John's School, Spalding to provide a venue and Richard Stennett was rostered to run his *Polly* locomotive as a change from his day job on the flight deck of a Jumbo Jet. Coming back jetlagged from the far east he visited his brother in the nearby town of Bourne and mentioned the proposed running session at the weekend. His brother pricked up his ears and reminded Richard that their father had been a pupil at the school early in the 20th century. He was able to produce a photograph of father Stennett in the old buildings of the school, which Richard duly took along to the fete. The coincidence did not end there, however, since Richard had named his engine *Old Harry* in remembrance of their father. The photograph above depicts Richard driving *Old Harry* at the *Alma Mater* of father Harry.

We have been asked to mention that the **Stockholes Farm Miniature Railway** open day is to be held on the August Bank Holiday Monday (25th) from 11:00 until 17:00. Contact Ivan Smith on 01427-872723 for further details.

The annual open day of **Wortley Top Forge Model Engineers** is to be held on Sunday 7 September 2003. All visiting locomotives, traction engines and other engineering models will be welcome. Further details from Alec Buttriss on 01226-763693 or by e-mail to **alec@wortleymes.freeserve.co.uk**

*Airline pilot Richard Stennet on the 'flight deck' of* Old Harry, *his locomotive named in memory of his father, one time pupil at St. John's School, Spalding at which Richard represented Stamford MES at the school fete.*

## World News

### Australia

The recent 'Train Operations Day' at the **Hornsby Model Engineers Co-operative** had the objective of running 25 different train operations over a 140 minute period. Unfortunately last minute cancellations caused a hurried re-vamp of the operations sheet on the morning of the event. Further problems occurred when the roster clerk 'lost' two locomotives at the last minute. After a short delay the operations got under way but a 'slight misreading' of the operations sheet caused a stoppage on the main line and a blocked crossover. As they said *"The life of a railwayman isn't easy."* After a few other problems, the operations manager called a halt but much valuable information was collected and the operations schedule will be altered prior to another event taking place in the future.

Also in Australia, **Steam Locomotive Society of Victoria** members are making slower progress than planned on the rebuilding of their ground level truck bogies. A call has gone out for more help for the team led by Fino Faccenda. Another member needing help is Michael Lee who is rebuilding a wall that has started to bulge in the cutting. Other projects include a plan to repaint the steaming bay roof structure. At recent meetings members have shown progress on several projects including a tethered racing car being built by member Harold Bone. The newsletter also carried a recipe for corned beef hash reputed to be from the Gilling club in UK.

### Canada

The new canopy at **British Columbia SME** recently reported in *Club Chat* is now almost complete and in use. Looking at the picture on the front of their latest issue of *The Whistle,* the members concerned have done a splendid job and passengers can now shelter from the sun, or worse, while waiting for the trains. Work is continuing on the raised track project with some 20ft. in place and 34 posts poured and ready for the first phase. It is intended that the raised track will be completed next year. A recent running Sunday suffered a thunderstorm for part of the time, resulting in the train crew getting wet and having to act as 'bankers' up the banks because of the wet slippery rails. It's not just the UK that gets rain then! The club's new electric loco, No. 9000 was running with five fully loaded passenger cars on the holiday Monday, being supplemented by the Mogul No. 73 which has been improved by member Mark Waite. The only time it failed was late in the day when the propane cylinder got low and started to freeze up. Some new interlocks have been fitted to the signalling system to improve safety.

### New Zealand

Member Des Hill was presented with the steam endorsement for his driving ticket at a recent meeting of the **Hutt Valley MES.** Apparently Des is one of a number of members who need to arrange for these formalities to take place so that they can then share in the driving on Sunday running. Reported difficulties with starting the club loco No. 2970 resulted in the realisation that the battery had been in the loco for

## 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.

### AUGUST

8 **North London SME.** *Loco Section Barbecue & Running Evening.* Contact David Harris: 01707-326518.
8-10 **British Columbia SME.** *Annual Train Festival Meet.* Contact Sean Laurence: (604) 931-1547.
9 **North London SME.** *Visit by Erewash Valley, Maidstone & Northolt Clubs.* Contact David Harris: 01707-326518.
9 **Portsmouth MES.** *Efficiency Competition.* Contact John Warren: 023-9259-5354.
9 **Reading SME.** *Club Running.* Contact Graham Bustin: 01189-615450.
9 **Sutton MEC.** *Hosts to Gauge 1 Association.* Contact Mike Dean: 0208-657-5401.
9/10 **Guildford MES.** *OMLEC.* Contact Dave Longhurst: 01428-605424.
9/10 **Leeds SMEE.** *Rally.* Contact Colin Abrey: 01132-649630.
9/10 **Royal Armouries.** *Fort Nelson Model Show.* Information: 01202-692999.
9/10 **Guild of Model Wheelwrights** at Birmingham Nature Centre. Contact Biddy Hepper: 01492-623274.
10 **Canterbury DMES.** *Running.* Contact Granville Askham: 01227-463295.
10 **Cardiff MES.** *Steam-Up & Family Day.* Contact Trevor Jenkins: 029-2075-5568.
10 **Harlington LS.** *Open Day.* Contact Peter Tarrant: 01895-851168.
10 **Hornsby ME.** *Running Day.* Contact Ted Gray: 9484-7583.
10 **Leighton Buzzard NG Rly.** *Family Fun Day.* Enquiries: 01525-373888.
10 **Nottingham SMEE.** *Running.* Contact Gerry Chester: 0115-9259096.
10 **Ottawa Valley Live Steamers.** *Steaming Day.* Contact John Bryant: 761-1109.
10 **Plymouth MSLS.** *Members' Running.* Contact John Brooker: 01752-671722.
10 **Rugeley Power Station MES.** *Open Running Day.* Contact Dereck Moore: 01543-490023.
10 **SM&EE.** *Visit to the Hatherill's Railway.* Contact Ann Hatherill: 020-8654-7288.
10 **Sutton MEC.** *Track Day.* Contact Mike Dean: 0208-657-5401.
11 **Bedford MES.** *Meeting & Barbecue.* Contact Ted Jolliffe: 01234-327791.
11 **Melton Mowbray DMES.** *Summer Evening Steam-Up* Contact Phil Tansley: 0116-2673646.
11 **Saffron Walden DSME.** *Club Night.* Contact Jack Setterfield: 01843-596822.
11-13 **Worthing DSME.** *Kids' Summer Courses.* Contact Bob Phillips: 01903-700642.
12 **Romney Marsh MES.** *Track Meeting.* Contact John Wimble: 01797-362295.
13 **Norwich DSME.** *Barbecue.* Contact Paul Reed: 01603-462925.
13 **Oxford (City of) SME.** *Running.* Contact Chris Kelland: 01235-770836.
14 **Cardiff MES.** *Forum.* Contact Trevor Jenkins: 029-2075-5568.
14 **High Wycombe MEC.** *Meeting.* Contact David Savage: 01494-527402.
14 **Leyland SME.** *The Idiots' Guide to Modelling the Detail.* Contact Mark Entwistle: 01772-422411.
14 **N. W. Leicester SME.** *Visit: Cropston Reservoir.* Contact John Elliott: 01455-847040.
14 **Worthing DSME.** *Bits & Pieces.* Contact Bob Phillips: 01903-700642.
15 **Canvey R&MEC.** *Steam-Up & Fish 'n Chips.* Contact David A. Clark: 01375 846921.
15 **Rochdale SMEE.** *Meeting.* Contact Mike Foster: 01706-360849.
15 **Steam LS of Victoria.** *Gathering.* Contact Graham Plaskett: (03) 9750-5022.
15-17 **Bristol Model Engineering and Hobbies Exhibition** at Thornbury Leisure Centre, South Gloucestershire. Contact Geoff Sheppard: 0117-956-0869.
15-17 **Frimley & Ascot LC.** *Open Weekend.* Contact Bob Dowman: 01252-835042.
15-17 **Guild of Model Wheelwrights** at Bristol. Contact Biddy Hepper: 01492-623274.
16 **Chesterfield MES.** *Efficiency Trials.* Contact Mike Rhodes: 01623-648676.
16 **Erewash Valley MES.** *Lionsmeet.* Contact Jim Matthews: 01332-705259.
16 **Romford MEC.** *Track Afternoon.* Contact Colin Hunt: 01708-709302.
16 **Staines SME.** *2 1/2 & 3 1/2in. Gauge Rally.* Contact Mike Kingham: 01932-788793.
16 **Steam LS of Victoria.** *Club Run.* Contact Graham Plaskett: (03) 9750-5022.
16 **Sutton MEC.** *Visiting Clubs Day.* Contact Mike Dean: 0208-657-5401.
16 **Talyllyn Railway.** *Race the Train.* Enquiries: 01654-710472.
16 **Wigan DMES.** *Visit to Butterly MRS.* Contact John Chamberlain: 01744-882255.
16/17 **Bedford MES.** *Traction Engine Rally.* Contact Ted Jolliffe: 01234-327791.
17 **Andover DMES.** *'Black Five' Day.* Contact R.W. Hanman: 01980-846815.
17 **Canvey R&MEC.** *Gala Day.* Contact David A. Clark: 01375 846921.
17 **Guildford MES.** *Open Afternoon.* Contact Dave Longhurst: 01428-605424.
17 **Hornsby ME.** *Sailing Day.* Contact Ted Gray: 9484-7583.
17 **Leyland SME.** *Junior Members' Afternoon Driving Session.* Contact Mark Entwistle: 01772-422411.
17 **Lincoln DMES.** *Running.* Contact Paul Thompson: 01522-888228.
17 **N. W. Leicester SME.** *Running Sunday.* Contact John Elliott: 01455-847040.
17 **Nottingham SMEE.** *Running.* Contact Gerry Chester: 0115-9259096.
17 **Oxford (City of) SME.** *Running.* Contact Chris Kelland: 01235-770836.
17 **Plymouth MSLS.** *Running.* Contact John Brooker: 01752-671722.
17 **Rugby MES.** *Running.* Contact David Eadon: 01788-576956.
17 **Saffron Walden DSME.** *Running Day.* Contact Jack Setterfield: 01843-596822.
17 **Surrey SME.** *Members' Steam-Up.* Contact John Cook: 020-8397-3932.
17 **Taunton ME.** *Running.* Contact Don Martin: 01460-63162.
17 **Guild of Model Wheelwrights** at Mid-Somerset Show, Shepton Mallet. Contact Biddy Hepper: 01492-623274.

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# LBSC MEMORIAL BOWL COMPETITION 2003

***HOSTED BY***

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## SUNDAY 14 SEPTEMBER

*Any steam locomotive to or based on an LBSC design in $2^1/_2$, $3^1/_2$ or 5in. gauge is eligible provided it has not won an award in a previous LBSC Memorial Bowl Competition*

**Please contact David Eadon, 162 Hillmorton Road, Rugby Warwickshire CV22 5AL; (01788-576956) for an Official Entry Form**

***ALL VISITORS WILL BE VERY WELCOME***

***MODEL ENGINEERS AND THEIR FAMILIES PARTICULARLY SO.***

about 8 years. The loco is soon to be fitted with a reversing gearbox and will be out of service for several weeks. Member Henry Cuttriss gave a presentation on speed cameras as applied to the NZ police. He did not have a sample but most members did not want to get too close to one anyway! Apparently the shutters started to fail some time after 100,000 shots, which is apparently the guaranteed number. Is this built-in obsolescence? The club are awaiting permission from Hutt Council before carrying out some track level changes and improvements. Drivers have been asked to warn passengers not to grab the trees while riding on the trains as a train was recently pulled off the track because of this.

Members of **Maidstone MES** have been operating public passenger hauling using a mixture of their own club petrol engined locomotives and those brought by members. This has ensured a good mix of steam and electric locomotives at recent running sessions. The locks on the station building have also been changed with four keys being held by senior members. This is to better protect the club property and assets stored at the station. Security of club sites is obviously a world-wide problem. A new battery locomotive and driving truck are in the process of being finished and are described as *"an impressive vehicle, of good size, with a comfortable traverse seat and a high sided body with a swing door on one side."* A new passenger vehicle is also being worked on.

### South Africa

The Editor of the newsletter of **Centurion SME** is wondering about how model engineering societies start up. He illustrates the cycle of events from a small group meeting in each others' homes and developing to installing a small track followed by public running to raise money for improvements leading to a need for lots of officials to control and manage all this. He makes the point that it seems to be still the same dozen or so faces that appear to do the work that started the club in the first place. Another thing that seems the same all the world over! Some discussion has taken place about re-siting the ash pits to make things easier for the drivers but still ensuring passengers are safe. The society now boasts a fully functional library and the rules for its use have been published. Several visits to members' workshops have taken place, one of which was likened to 'a miniature factory'. It is used to make commercial miniature injectors as well as being a hobby workshop.

The **Rand SME** newsletter has drawn attention to the *"alarming trend in the UK"* of compensation claims causing massive increases in insurance costs. This was reported in an unidentified UK daily paper. They quoted several cases, some frivolous, but all costing money. The article warns members to take care and to caution people about coming to the club in their 'Sunday best' and getting close to steaming locomotives. UK readers will no doubt have much experience of this. At a recent exhibition of mini stationary engines held by member Gerald Buitendach a small six-cylinder engine of unusual design was running on compressed air. It was described as a *"six-cylinder right-angle engine"* and had six pistons made in pairs from a piece of rod bent at right angles in the middle. The geometry was described as *"impossible to describe in words"*. The owner thought it had been described in *Popular Mechanics* but did not know when. Any information on this engine would be greatly appreciated. A novel method of constructing the large T-wheel rims for large scale traction engines was also described. This involves making the webs and rims separately and then plug-welding the two together through small holes in the rims directly in line with the webs. Others may find this useful as it seems to avoid the generation of copious amounts of swarf!

17 **York City & DSME.** *Running Day.* Contact Ken Bateman: 01904-421445.
18 **Lancaster and Morecambe MES.** *Meeting.* Contact Harry Carr: 01524-411956.
18 **Salisbury DMES.** *George Ray: Bluebell Railway.* Contact Pete Parrish: 01980-610346.
18-25 **STAAR Research.** *International Rocket Week* at Kelburn Castle & Country Centre, Largs, Ayrshire. Contact John Bonsor: 07733-250135.
19 **Basingstoke DMES.** *Meeting.* Contact Ian Shanks: 01420-561741.
19 **Chesterfield MES.** *Barry Handford: Little Midland Society.* Contact Mike Rhodes: 01623-648676.
19 **South Durham SME.** *Evening Steam-Up.* Contact B. Owens: 01325-721503.
19 **Taunton ME.** *Meeting.* Contact Don Martin: 01460-63162.
20 **Bournemouth DSME.** *Barbecue.* Contact Mike Baker: 01202-383653.
20 **Bristol SMEE.** *Bernard North: Walschaerts Valve Gear.* Contact Trevor Chambers: 01454-415085.
20 **Historical MRS (North West Area).** *Track Night.* Contact David Goodwin: 01224-880018.
20 **Hull DSME.** *Running Evening.* Contact Brian Rylance: 01482-647032.
20 **Maidstone MES.** *Members' Afternoon Playtime Run.* Contact Martin Parham: 01622-630298.
20 **MELSA.** *Meeting.* Contact Graham Chadbone: 07-4121-4341.
20 **Oxford (City of) SME.** *Running.* Contact Chris Kelland: 01235-770836.
20 **West Wiltshire SME.** *Steam-Up.* Contact R. Nev. Boulton: 01380-828101.
21 **East Somerset SMEE.** *5in. gauge Track Evening.* Contact Roger Davis: 01749-677195.
21 **Sutton MEC.** *Evening Steam-Up.* Contact Mike Dean: 0208-657-5401.
23 **Andover DMES.** *Evening Barbecue & Steam-Up.* Contact R.W. Hanman: 01980-846815.
23 **Chesterfield MES.** *Running Day.* Contact Mike Rhodes: 01623-648676.
23 **Hornsby ME.** *Family Day.* Contact Ted Gray: 9484-7583.
23-25 **Harrow & Wembley SME.** *Open Weekend.* Contact Dr. Roger Greenwood: 020-8427-2755.
23-25 **Ryedale SME.** *GL5MLA Rally.* Contact Doug Hewson: 01652-688408.
23-25 **Stockport DSME.** *Exhibition.* Contact Nick Russell: 0161-427-6967.
24 **Amnerfield Miniature Railway.** *Running.* Contact David Jerome: 0118-9700274.
24 **Ascot LS.** *Members' Steam-Up.* Contact Ivan Hurst: 01276-28803.
24 **Harlington LS.** *Open Day.* Contact Peter Tarrant: 01895-851168.
24 **Maidstone MES.** *Charity Run.* Contact Martin Parham: 01622-630298.
24 **MELSA.** *Bracken Ridge.* Contact Graham Chadbone: 07-4121-4341.
24 **Ottawa Valley Live Steamers.** *Steaming Day.* Contact John Bryant: 761-1109.
24 **Staines SME.** *Running Day.* Contact Mike Kingham: 01932-788793.
24 **Surrey SME.** *Free Day.* Contact John Cook: 020-8397-3932.
24 **Talyllyn Railway.** *Land Rover Rally.* Enquiries: 01654-710472.
24/25 **Cardiff MES.** *Summer Open Weekend.* Contact Trevor Jenkins: 029-2075-5568.
24/25 **Chesterfield MES.** *Steaming at Papplewick.* Contact Mike Rhodes: 01623-648676.
24/25 **Claymills Pumping Engines.** *In Steam.* Contact B. Eastough: 01283-812501.
24/25 **Elmdon MES.** *Running at Wythall Transport Museum Open Days.* Contact Chris Giles: 0121-458-1291.
24/25 **Northern Mill Engine Society.** *Open Days.* Contact John Phillp: 01257-265003.
24/25 **Nottingham SMEE.** *Running.* Contact Gerry Chester: 0115-9259096.
24/25 **Romney, Hythe & Dymchurch Railway.** *Bank Holiday Intensive Service.* Information: 01797-362353.
24/25 **Guild of Model Wheelwrights** at Sandwell Show, West Bromwich. Contact Biddy Hepper: 01492-623274.
25 **Canterbury DMES.** *Meeting.* Contact Granville Askham: 01227-463295.
25 **Hornsby ME.** *Meeting.* Contact Ted Gray: 9484-7583.
25 **Oxford (City of) SME.** *Running.* Contact Chris Kelland: 01235-770836.
25 **Saffron Walden DSME.** *Running Day with Barbecue.* Contact Jack Setterfield: 01843-596822.
25 **Stockholes Farm MR.** *Open Day.* Contact Ivan Smith: 01427-872723.
25 **Talyllyn Railway.** *Duncan's Special Day.* Enquiries: 01654-710472.
25 **Taunton ME.** *Running.* Contact Don Martin: 01460-63162.
27 **Oxford (City of) SME.** *Running.* Contact Chris Kelland: 01235-770836.
28 **Leyland SME.** *Geoff Baxendale: Things to do with an Oscilloscope.* Contact Mark Entwistle: 01772-422411.
28 **Worthing DSME.** *Toy Steam-Up.* Contact Bob Phillips: 01903-700642.
30 **National $2^1/_2$in. Gauge Ass'n.** *Locomotive Rally* at Fylde SME. Contact Clive Young: 01233-626455.
30/31 **Chesterfield MES.** *Open Weekend.* Contact Mike Rhodes: 01623-648676.
30/31 **Guild of Model Wheelwrights** at Chatsworth Country Fair, Bakewell , Derbyshire. Contact Biddy Hepper: 01492-623274.
31 **Lincoln DMES.** *Running.* Contact Paul Thompson: 01522-888228.
31 **MELSA.** *Sunday in the Park.* Contact Graham Chadbone: 07-4121-4341.
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