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MODEL ENGINEER

Vol. 202 No. 4347

13 – 26 March 2009

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Specifications:		
Swing Over Bed		180mm
Distance Between Centres		350mm
Hole Through Spindle		20mm
Spindle Taper		MT3
Tailstock Taper		MT2
Spindle Speed	Low Gear:	100-1200 rpm
	High Gear:	100-3000 rpm
Motor Output		350w DC
Range of Threads (imperial machine)		12-52 TPI (8 thread pitches)
Overall Dimensions		750x320x330mm
Weight (net/gross)		44kg/56kg
Standard Equipment: 80mm 3 Jaw Chuck, Oil Tray, MT2 Dead Centre, Gear Set, Wrench Set, Oil Can		

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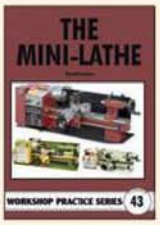

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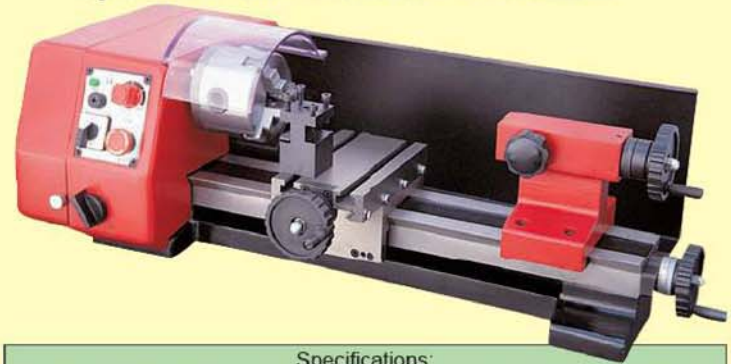

Specifications:			
Swing Over Bed	140mm	Spindle Speed	0-2000 rpm
Distance Between Centres	250mm	Range of Threads	0.5-1.25mm (5 thread pitches)
Hole Through Spindle	10.5mm	Motor Output	150w DC
Spindle Taper	MT2	Overall Dimensions	540x300x270mm
Tailstock Taper	MT1	Weight (net/gross)	23kg/32kg
Standard Equipment: 80mm 3 Jaw Chuck, MT1 Dead Centre, Tool Kit			

C1 Lathe - Metric: £261.00 Incl. VAT (subject to availability)

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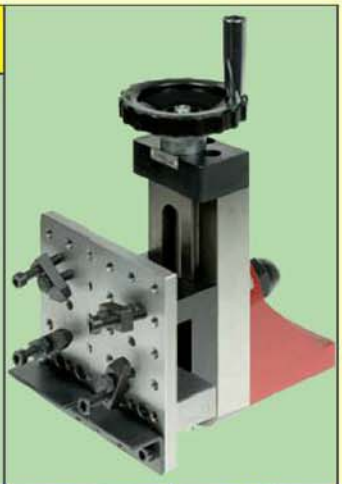

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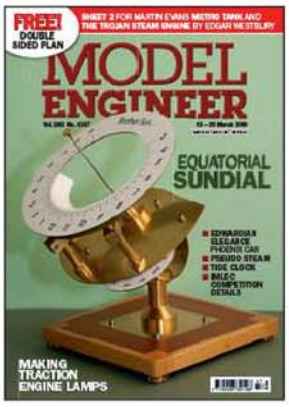

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This equatorial sundial, designed and made by Roger Bunce, indicates 'clock time' throughout all sunshine hours. (Photograph by Roger Bunce)

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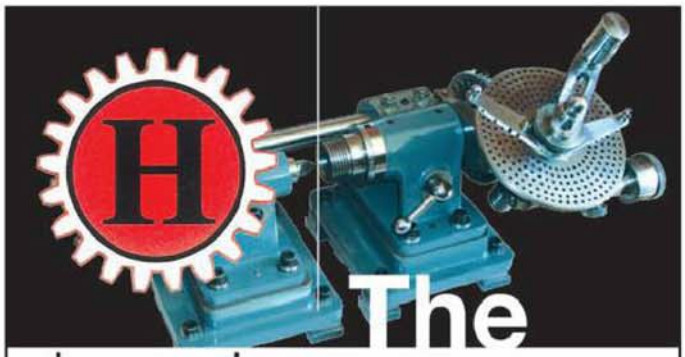

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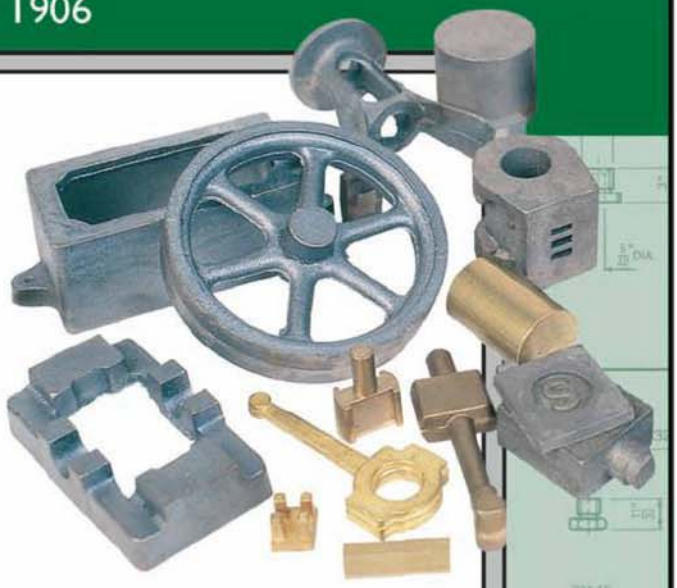

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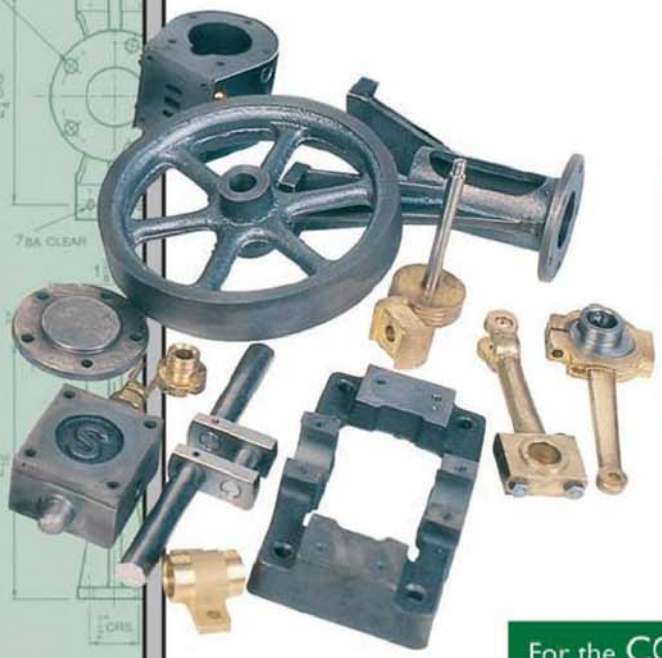

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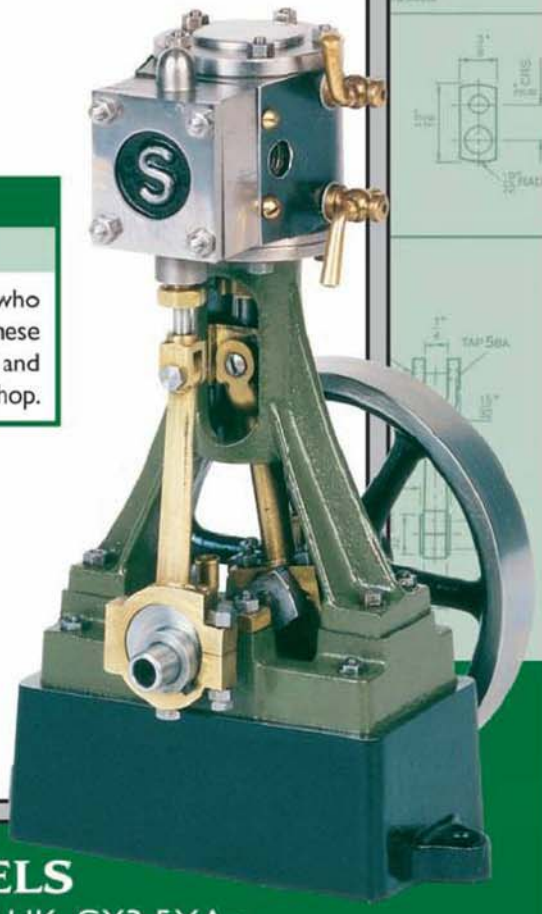

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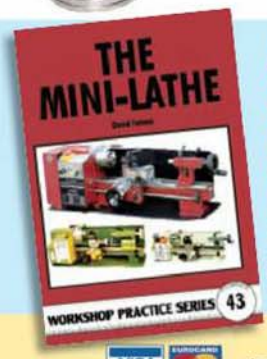

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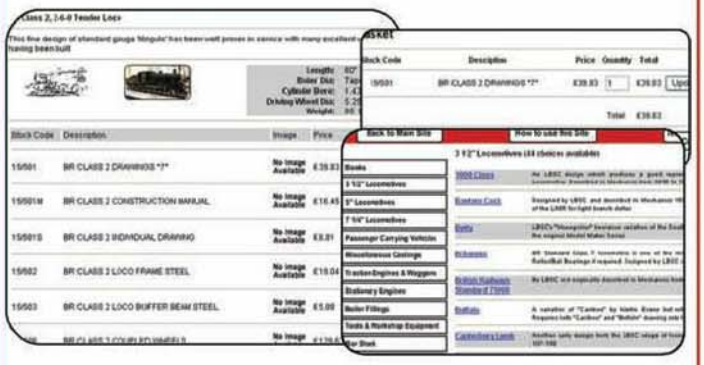

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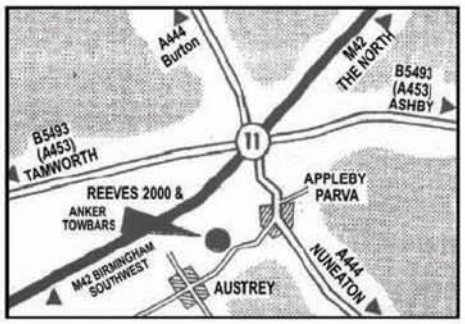

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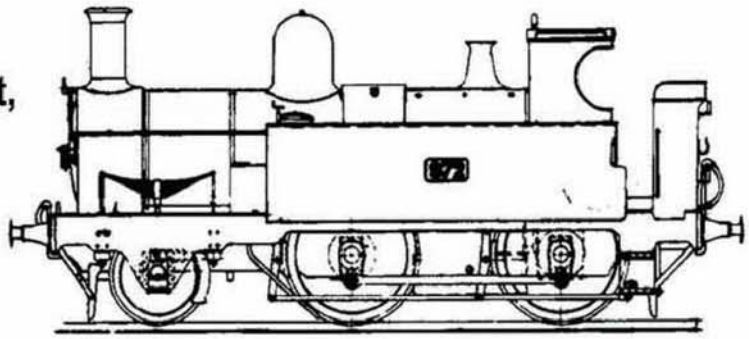

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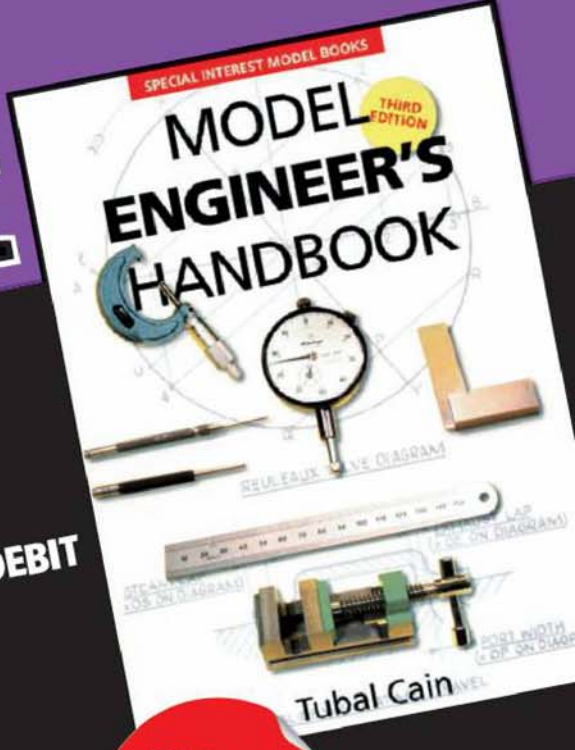

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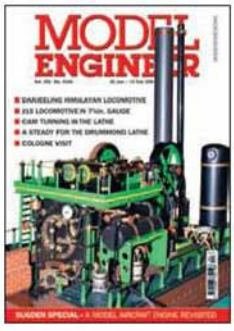

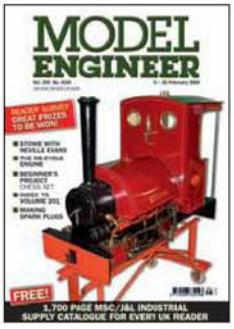

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Editor

MIKE JONES
Assistant Editor

ROGER BUNCE
Technical Editor

A small change to *Model Engineer*

I don't get many complaints about the content or layout of *Model Engineer* but a few things have been mentioned more than once recently. They are, captions not on the same page with the photos, captions not next to the photos and caption text too small. All three of these problems have been addressed and the caption is now underneath the photo and in a slightly larger font size.

16mm National Garden Railway Show

The 16mm Narrow Gauge Association are holding their annual show at the National Agricultural Centre, Stoneleigh, Warwickshire on Saturday 4 April. There are 70 traders confirmed to attend and upwards of 2,000 visitors are expected. There is sufficient free parking for all and there is also a free vintage bus service from Coventry Station. Full details are available at www.16mm.org.uk and www.stoneleighpark.com has travel directions and venue information. Even if you don't model in 16mm scale, this is a fantastic day out with several layouts on show, lots of live steam and even coal-fired Garratts running on the day.

Readers' Survey 2009

I won't have the results of the readers' survey for some time and then it will take me a while to read and analyse them. What I have received are photocopies of the first 10 received in the office, seven *Model Engineer* surveys and three *Model Engineers' Workshop* ones (*Workshop* went on sale a week later).

I can see by your comments in the freeform boxes that this information is going to be very useful when planning future issues of *Model Engineer*. For instance, 50% of readers would like to see 1-2 pages of *News* and the other 50% would like to see 3-4 pages. It is early days yet but perhaps one fortnight, we could run 2 pages of *News* and the other fortnight we run four pages. Perhaps a compromise might be 2½ pages of news with the next issue at the bottom of the third page.

One reader commented that the survey asks for detailed workshop information and also had his address on. Please rest assured, the workshop information (list of machines) will not be stored on a computer. The only information stored will be a few of the numbered questions together with your name and address by a reputable company for our marketing department. The forms will then be passed to me and I will read them, enter answers to the numbered questions into a spread sheet without names and addresses included and then they will be shredded.

Please fill in the survey, it will help me to give you the magazine you want to read. Photocopies of the survey are fine, but please staple them together.

IMLEC and the Bristol Society of Model and Experimental Engineers

Entries are invited for the International Model Locomotive Efficiency Competition for the Martin Evans Challenge Trophy to be held at Ashton Court, Bristol on 4/5 July 2009. Please see page 315 for competition details.

Polly Owners Group

The Polly Owners Group has been formed by people who enjoy building and running their locomotives, which have been produced by Polly Model Engineering. This includes the Polly range of kit built locomotives as well as the Practical Scale range and those designed by J. G. S. Clark.

The aims of the Polly Owners group are to:

- Bring together individuals owning any of the Polly range of locomotives.
- Provide help and encouragement to the members of the Group, whether they are building or running a locomotive.
- Organise meetings during the year to enable the coming together of members of the group and their locomotives.

Following the rallies held last year, we have organised two rallies for this year. The first being on 9 May 2009 at the Bracknell Railway Society and the second over the weekend of 12/13 September 2009 at the **Peterborough Society of Model Engineers**. This rally will also include our AGM.

The Bracknell Railway Society is located in the Jocks Lane Recreation Ground, Jocks Lane, Bracknell, Berks. They have a 970ft. raised track with a maximum gradient of 1 in 160 catering for 3½in. and 5in. gauges.

The Peterborough Railway Society can be found at Thorpe Hall, Thorpe Road, Longthorpe, Peterborough, Cambs. Their track is also raised level and has gauges of 3½in., 5in. and 7¼in. The length of track is just over 1,100 feet.

So if you own a Polly or any locomotive from the Polly Model Engineering or J. G. S. Clark ranges or are building or thinking of building one you and your family are welcome to join us for these rallies.

If you would like any more information about either rally please contact:-

Neil Mortimer, 108 Copthall Road West, Ickenham, Middlesex UB10 8HT.
T. 01895 635596.
E. **Neiljmortimer@aol.com**
W. www.pollyownersgroup.org.uk

POSTBAG

FIRST CLASS POST

Mystery tool

SIRS, - Attached is a photo of a tool given to me several years ago in the hope that I could identify it. This I could not do and from many attempts since, its purpose has still not been established. It was covered in rust and well pitted when it was given to me, so I had it grit blasted to get the finish you see now.

The overall length is 7in. with the screw jack fully out. The head measures 3¾ x 1½ x 7/16in. thick. The screw jack is threaded ⅜in. x 32tpi with a ¼in. square end for the tommy bar. The end of the screw jack inside the head is free to rotate and inside the arched portion of the head are two ribs.

Tony Meek, by email.

The age of model engineers

I was interested in the letter from Paul J. Weighell regarding the age of model engineers (*M.E.* 4345, 13 February 2009). We have had this discussion on numerous occasions and in these pages. I have been attending model engineering exhibitions for several decades and model engineers have always looked that age to me. I was dead keen on model engineering in my teens, but then fast motorbikes and girls came along and I didn't lose interest but just didn't have time for all three, the girls won! As with most people I did marriage, the family and the house bit, but just didn't have the money or time for model engineering. It was not until in my late 40s that I was able to get back into it. I speak to many of our customers and they all say the same.

From a business point of view I have to say that we have to add at least three or four new customers to our computer every week. When I speak to them they are all in their late 40s or early 50s or recently retired and have gone through the same process as described above. As far as we are concerned the hobby is expanding quite quickly, well, the 5in. Ground level movement certainly is, but it gets scant publicity in the magazines as we get the impression that it is regarded as "Playing Trains". Well, that's what we call it anyway. The new modellers of today are far more discerning than the model engineers of old as they do not want to make things from scraps, they want exactly the right castings and parts for the job; they want every nut and bolt in the right place and the right size and they want the drawings fully detailed and correct because they do not have time to waste on making things twice. We are finding that a lot of people have a lot of money to spend on the hobby and most of our customers don't ask the price, they just want to know if we have it in stock and can I get it in the post tonight. The hobby is certainly changing and on the increase but not dying.

Over the past few years we have had to produce far more in the way of machined kits and ready-machined parts, not because the purchasers can't do it but mainly because they haven't got the time. Our biggest problem is trying to keep ahead of the game and anticipating what people want. It doesn't seem to matter what I have on the drawing board (or CAD) but I have a queue of people wanting the bits before I have even got the drawing finished. They want all laser cut parts and lost wax castings as they do not want the drudgery of cutting everything out when it is so cheap to get things laser cut. At present we have at least 80 people actively building my BR Std 2-6-4 Tank plus about 12 completed and we have sold over 250 sets of drawings. At least 60 customers are building Britannia's and want all the detail; about 30 are building *Black Fives*. We have about 10 building Springboks and can't wait to get them finished so that they can build something decent. This is just a sample.

At the moment we can't build our BR Mk. 1 coaches

Foden C-Type help sought

Whenever I read the *Postbag* pages I am impressed by the wealth of knowledge put forward by readers. Most of this knowledge seems to be rail related but is there someone out there who can help me with a road steam related problem?

I am converting my 3in. scale Foden C-Type flat bed to a 3-way tipper and have been fortunate to meet a very helpful exhibitor with a full-size version. I have managed to photograph many of the details of the chassis, ram and body which have started the metal cutting process. Now for the problem. On most 3-way tippers the ram is held in a pivoted frame, allowing the ram to tilt backwards, and the ram is pivoted to give side-to-side movement. However, this does not seem to be the case with the Foden water ram. The cylinder is bolted between two large 'triangular' plates which are then bolted between the chassis rails allowing no movement of the ram cylinder. Unfortunately, the top of the ram is hidden by crossmembers and the exhibitor did not know how the ram was attached to the body as it had only been tipped once and the leather seal leaked badly and has not been replaced.

Can anyone tell me what the top of the cylinder is like, open or closed, and how the ram is linked to the body. I can think of a number of ways of overcoming the problem but would prefer to follow the full-size method if possible. Yours in anticipation

Brian Chatburn, by email.

Write to us

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Responses to published letters are forwarded as appropriate.

fast enough to keep up with demand (£4,000 each complete and ready to run) and people are constantly asking what new wagon kit is in the pipeline. We have at least a 2-year waiting list for building Winson Britannia's and other locomotives for people.

I am well on the way to completely re-designing the 5in. gauge Britannia but I haven't publicised it too much yet until we receive all the new patterns. However, over the past two weeks I have had enquires for it from South Africa, Zimbabwe, Kent and New Zealand and an order for everything available from the Zimbabwe enquiry.

We have a lot of new young members at Gilling and I think it is because of what we do. They all get involved from the age of about 8 and once they can handle a shunting pole they can work in the Yards with the Yardmasters who mentor them in both working the yards and in working to the timetable. They just love it, as it as near to running a real full-size railway as one can get. One has just left college now and got a job with the Network Rail timetabling department in Leeds and another is now a chief engineer with First Group at Norwich running trains all over East Anglia. Another has now got a holiday job as a guard on the Ravenglass and Eskdale railway and another has just finished a proper apprenticeship in the locomotive shed at the Llangollen Railway. He started coming to Gilling when he was 14. The young lads working the yards at Gilling are brilliant as one only has to tell them something once and they can do it. It takes ages trying to train some of the older members and some are just a blooming nuisance in the yards as it doesn't seem to matter how many times you tell them what needs doing they just don't get the hang of it.

A typical instruction would be "The "305" Parcels is due to arrive in five minutes, can you set No. 7 road up for it, hook "A" Pilot on the back to release the train engine and put the stock in the carriage sidings then set the road for the train engine to go off to Shed". Then, get "A" pilot up to the yard exit signal with the stock ready to go across to the station, I will ring the signalman to get him a road out" If one of the young lads is doing the job I come off the telephone and it is all done, but if one of the older members is asked to do it I come off the phone and they say "what did you say?".

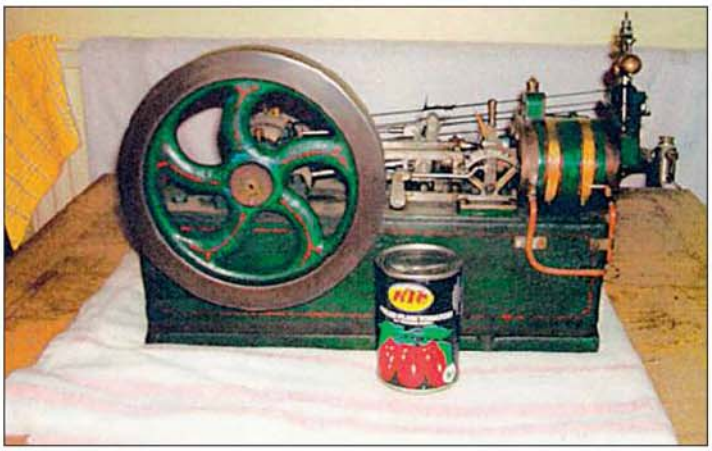
Model engineering is very much alive and well, especially if the young ones can get involved.
Doug Hewson, by email.

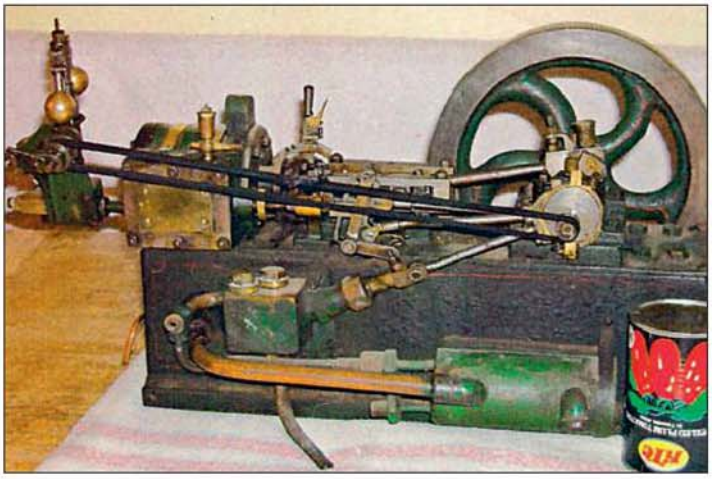
Unknown mill engine

SIRS, - My 90 year-old father-in-law has an old mill engine. It is quite large as can be seen by the tin of vegetables in the photos (right). The main dimensions are:

Bore	70mm
Flywheel diameter	230mm
Flywheel width	37mm
Height	310mm
Length	530mm
Stroke	52mm
Weight	21.5kg

The model includes three valve arrangements, though I do not understand their purpose except that the piston is pushed in both directions. As the photos show, there is a speed control governor. There is also a condenser for the steam and oil is introduced into the cylinder with the steam input.





I would like to know what it is a model of and to locate drawings for the boiler. Details of boiler construction including safety valves would also be of great help. What would be a suitable fuel supply and fuel control arrangement? Also, how do I operate the final model safely to ensure our survival! Does this type of model have an output capable of useful work?
Eric Crawford, West Sussex.

Black Five help?

SIRS, - I am currently building the 7¼in. *Black Five* as designed by Martin Evans and have run into a problem when fitting the leading brake shoes. There is insufficient clearance between the leading edge of the wheel and the rear of the motion plate.

All dimensions and the position of the motion plate have been checked against the drawing (#6). This calls for the centre line of the motion plate to be sited 5⅜in. from the rear face of the cylinder. Having measured a friend's *Black Five* to the same design, his motion plate is sited 5⅛in. from the rear cylinder face, thereby allowing room for the brake shoe and hanger to fit as expected. Can any of your readers clarify the position as to whether there is an error on the drawing or simply that the builder of the *Black Five* I took measurements from ran into the same problem and decided to move the position of the motion plate?
Ian Parsons, by email.

Steamship *Sir Walter Scott*

SIRS, - Following the article *An Engineer's Day Out - Loch Katrine - Steamship Sir Walter Scott* by Roger Backhouse (*M.E.* 4343, 16 January 2009), readers may be interested to know that the following original builder's plans for *Sir Walter Scott* are obtainable from the National Maritime Museum under the reference DBA/623/089:

1. Profile Main/Lower Decks Scale 1:48
2. Sheer lines (1954) 1:24
3. Stem stern post and rudder 1:12
4. Midship section 1:12
5. Displacement scale

The cost is £16.56 per sheet (plus 'Research Handling' of £11.50 plus p&p of £8.05 for a total of £103.35) so they are not cheap but they are good.

I was inspired to seek them out by Roger's article because from his photographs, especially that of the engine room, I think that this might be the ideal model in which to put the triple expansion engine >>

and boiler for which I already have castings. The National Maritime Museum contact details are:

Graham Thompson
Curator Historic Photographs and Ship Plans
National Maritime Museum
Greenwich
London SE10 9NF
E. plansandphotos@nmm.ac.uk

First though, as a relative newcomer to 'steam' modelling, I need to finish the Stuart twin compound that I am building in order to get my skills up to a level at which I do not reduce the rather nice triple castings to expensive swarf.
Richard Brickwood, Hertfordshire.

Not the worldwide web!

SIRS, - Will editors, suppliers and anybody connected with computers, please remember there are thousands of model engineers out here who are not interested and do not have the time or the inclination to understand the WWW. So please stick to "LONGHAND" and we will just get along fine.
G. W. Judge, Grimsby.

Thanks for the help

SIRS, - Could I through the columns of *Postbag* offer my very sincere gratitude to 'Chris' at Quiltedsteam who has most helpfully and generously forwarded all the details that I needed to make a proper start on my latest I/C project. I never cease to be amazed at the help given of the legendary worldwide brotherhood of model engineers.
James Wells, Saudi Arabia.

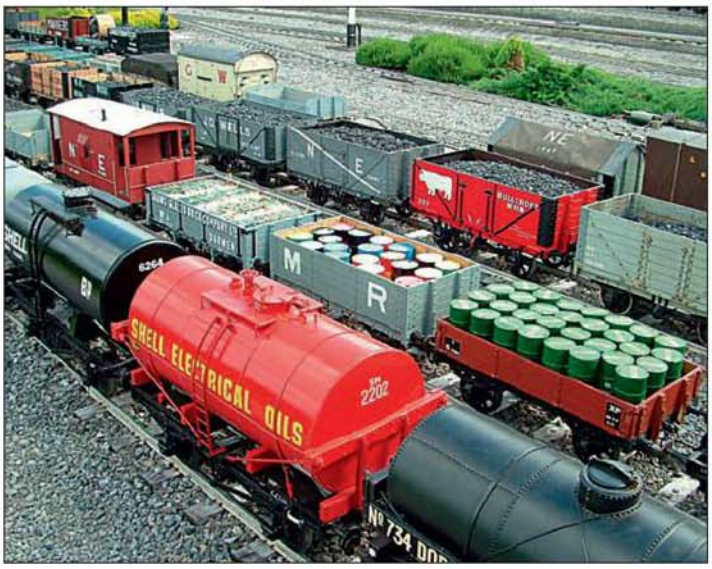
Gear ratios

SIRS, - In his article on gear ratios, (*M.E.* 4340, 5 December 2008) Mr. Lavis introduces a method of calculating gear ratios, which, to me is quite unusual, so I found it very interesting. The ratio used as an example in the article is obviously intended purely to illustrate the method, which it does very well. The resultant gear ratio has some gears which are quite large and I thought it would be a useful exercise to try and find a ratio with smaller gears.

I have always found that the continued fraction method usually gives the most accurate ratios, so this was the first method to be tried. The required ratio, 1.095679/1, has first to be converted to a fraction without decimals, and multiplying numerator and denominator by 1000000 converts it to 1095679/1000000. After expanding this into a continued fraction, it will be found that the sixth convergent is 355/324 which factorises to 5/81 x 71/4, and a gear ratio of 50/81 x 71/40 gives the ratio l.0956790 123.

Both 81/50 and 71/40 are in the tables used by Mr. Lavis but as he pointed out, the difficulty is in selecting two suitable ratios. As my 1941 edition of *Machinery's Handbook* has these tables, some people must have overcome this problem and found the tables very useful over the years.

Machinery Publishing Co. Ltd. used to publish a series of booklets, of a very practical nature, on various engineering subjects. They were called *Machinery's Yellow Back Series* and No. 27 has the title, *Compound Change Gear & Indexing Problems*. Anyone wanting to study the ways of finding or calculating gear ratios might be advised to try and obtain a copy, as the author gives a full description of the calculation of gear ratios and the calculation and use of continued fractions as well as various other ingenious methods of obtaining suitable gear ratios. The use of different methods for calculating the same ratio is tabulated and the errors for different methods compared. A dozen or so ratios are calculated by five or six different methods and the results displayed in tables. The method Mr. Lavis uses and the use of Brocot tables is not covered.
H. D. Turner, Wakefield.



Rolling stock construction

SIRS, - I couldn't help noticing the letter from Shaun Trewinnard about rolling stock (*M.E.* 4345, 13 February 2009). He is obviously not aware (and doesn't read our M.E. adverts!) that I described all the wagons seen at Gilling in *E.I.M.* from March 1987 onwards. I described them all particularly for beginners as I knew at that time that there were not many people who had built wagons. We do sell all the parts and drawings for building them and provide kits or just a box of parts to make them.

Since the *E.I.M.* articles, rolling stock building has taken off like a new hobby within the hobby as a lot of our customers ring me to say that they don't think they have got the skills or equipment to build a locomotive but they can build wagons and some build more than three a year. We now have more than 2,000 wagon builders on our computer.

Hopefully, Mr. Trewinnard will find the coach building articles interesting as well, assuming you will be publishing them.

I can't remember what I have said in the articles on building the Mk. 1 coach bogies but as they are all riveted I can also answer the query by Mr. Griffith-Jones. If I have not described the riveting, I can add it in and send you a revised copy. I will have a look to see what I have said.
Doug Hewson, by email.

I will be publishing the coach building articles in the near future, Ed.

DON CORDALL

IMLEC 2009

Don Cordall, IMLEC Group Leader at Bristol SMEE, tells us about this year's competition.

This year sees the 100th anniversary of the **Bristol Society of Model and Experimental Engineers**. As part of their celebrations, BSMEE are hosting this year's International Model Locomotive Efficiency Competition (IMLEC) on the weekend of the 4/5 July. This is the sixth time that BSMEE has run the event.

Track

The competition will be held on the society's track in Ashton Court Estate at the edge of Bristol. The raised track is dual gauge of 3½in. and 5in. gauges and the length of run per lap is 1,650 feet. The maximum gradient is 1 in 120 and the minimum radius 78 feet. Since the last IMLEC at Bristol in 2003, the track has been completely replaced with 2lb/yd mild steel, flat-bottomed rail mounted on wooden or plastic sleepers.

Competition

A total of 27 locomotives are expected to take part in the competition; 15 runs on Saturday and 12 on Sunday. The first run will start at 8:30am on both the Saturday and the Sunday. The Bristol dynamometer car will be used for the competition. It has recently been modified to ensure that the driver can sit much closer to the locomotive than in the past.

Entries

A separate section in this article describes the conditions for entry and how to apply. Successful applicants will have their entries confirmed and will be provided with a pack containing details of the timing of their run, the procedure to be followed on arrival, complimentary tickets and a copy of the rules, etc.

Admission

Spectators are most welcome. The admission fee will be £6 per head and under-16s will be free. No unaccompanied children will be admitted. The admission fee covers both days of the weekend and will include an event programme.

Railway location

The IMLEC page of the society website, **www.bristolmodelengineers.co.uk** shows the location of the railway site relative to the major approach roads in the city. Access to the estate and railway for everyone will be via the Clifton Lodge gate only. Using any other gate will lead to confusion as there are no other roads within the estate which will give access to the railway or car park. Please follow the map instructions carefully. Care is needed along the A369 from Junction 19 on the M5, since it is not possible to turn right off the A369.

Satellite navigation

If you are relying on SatNav for guidance, the postcode of the Clifton Lodge is BS8 3PX. Furthermore, if you are using SatNav and approaching along the A369 from Junction 19 on the M5 (see above), you should ignore your SatNav instructions once you join the A369 at Gordano and rely on the website map otherwise you may arrive on the wrong side of the road. You will then need the website map to recover the situation.

Car parking in the estate

Free car parking will be available about 200yds from the railway site exclusively for IMLEC visitors. Note that there will be no parking alongside entrance roads from the gate. The car park will be signed and should be used by all. Remember BSMEE shares the estate with the public and July is a busy time. No visiting vehicles will be allowed on the railway site. Special arrangements will be made to give elderly and infirm visitors direct access to the venue, but cars must be returned to the car park after unloading.

Camping

A site will be available for tents, caravans and campervans. The site will be open from about 2pm on Friday 3 July until about 12 noon on Monday 6 July. A charge of £10 per tent, caravan, etc. will be made regardless of duration of stay. Prior booking is essential and enquiries should be sent to Eric Lindsay by phone on 01761 434208 or email to **eric.lindsay@blueyonder.co.uk**

The camping site will not be adjacent to the railway site. It is situated inside the estate about a 10-minute walk from the railway. Alternatively, an internal road will give car access from the campsite to the IMLEC car park without going back onto public roads. Caravans and campervans must not enter the estate at Clifton Lodge but should follow the directions in the campers information pack.

On-site activities

An exhibition of Bristol SMEE work will be on display in the marquee. Refreshments will be available throughout the event and a hot communal meal will be available on Saturday evening. Bring your own favourite liquid refreshment for this event and book in advance with Cherry Trotham on 0117 968 2983. A number of traders are expected to be present. The ground level 7¼in. gauge track and miniature road vehicles will be operating throughout the weekend.

Finally, if you don't want to camp, hotel and B&B accommodation is listed on **www.visitbristol.co.uk**

Conditions of entry

1. The competition is open to owners of 3½in. and 5in. gauge coal-fired steam locomotives whether previous entrants, previous winners or newcomers.
2. The competition will be held in two parts. Entrants who have never previously won the Martin Evans Challenge Trophy will be entered in the main competition for the trophy. Previous winners of the trophy will be entered into the separate previous winner's competition.
3. A maximum of 27 locomotives will be accepted for the event on a first-come, first-served basis. Entrants for the main competition for the Martin Evans Challenge Trophy will constitute the bulk of the total entries. The organisers' discretion will determine the number of entrants accepted for the previous winner's competition.
4. Locomotives to which ballast, including water, has been fitted externally to the scale outline, or the likely outline of a freelance model, will not be accepted
5. A competitor may nominate another person to drive on his behalf.
6. Prizes will be awarded for competitors finishing in 1st, 2nd and 3rd places in the competition for the Martin Evans Challenge Trophy, for the best 3½in. gauge entrant and for the winner in the previous winners competition.

How to enter

Entries can be arranged by either ringing the Entries Secretary, Sandra Pearce on 01275 856887 for an entry form or by downloading the form from the IMLEC page of the BSMEE website **www.bristolmodelengineers.co.uk** and then posting to the Entries Secretary. Alternatively, a form may be submitted directly from the website.

The closing date for entries is 31 May 2009. After that date any enquiries about entries, etc. should be directed to Don Cordall on 0117 962 4073 or by email on **doncordall@blueyonder.co.uk**

Finished lamps.

Traction Engine Lamps


TONY MEEK

Tony Meek describes making lamps for his 3in. scale Allchin.

PART 1

Early in 2006, I made a set of lamps for my Midland Single - *Princess of Wales*. These are only a small feature on a relatively large model, but I felt they made such a big improvement on the overall appearance. With this in mind, I planned to make a set for my 3in. Allchin - *Ruby Swann*, but only when I had sufficient details to make reasonably accurate models. Drawings of the lamps in Bill Hughes' book on the Allchin were reduced so much that they were too small to read and I didn't have a copy of the 1½in. scale drawing at the time, so I deferred making the lamps until I acquired appropriate details. I had plenty to do in the meantime, so nothing was lost.

Then, at one of our meetings, my friend John Jopson asked if I would like to have a look at an old *M.E.* magazine - the *Centennial Celebration Collection* featuring *Road Steam Engines* (one of 10 special issues published in 1999) - saying that there were lots of interesting articles in it.

Well he was dead right! There was plenty to read in it, but what really interested me was an article by Bill Hughes on making lamps for the 1½in. Allchin. Just what I had hoped would turn up one day.

The best thing about this article was that the drawings and dimensions were legible but, being for the 1½in. Allchin, they were lacking in a lot of detail that could easily be added in 3in. scale.

Finding photographs of full-size lamps to match Bill's drawings wasn't too difficult and, with the aid of both sets of information, I was able to make a set of drawings for my 3in. scale traction engine.

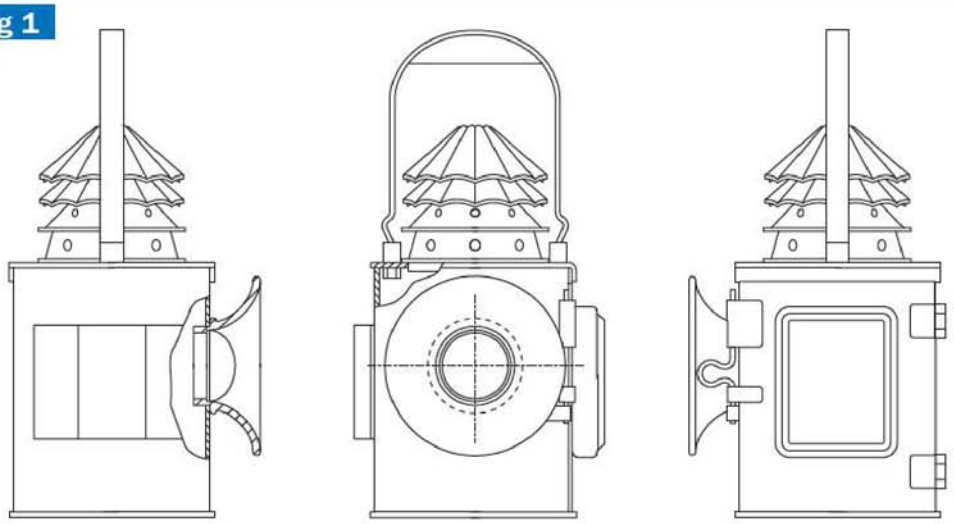
Only one thing eluded me and that was how the wire door bolt worked. The photographs I had seen did not show that particular detail well enough; however, a chat with Stephen Ross, soon cleared that up for me. He kindly sent me some excellent photos of the lamps on his full-size steamroller, which enabled me to complete the general arrangement drawing (**fig 1**). The finished lamps are shown in **photo 1**.

Lamp body

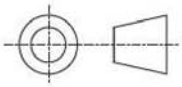
The first part to be made was the body - the box shaped piece onto which all other parts would be fixed (**fig 2**). This part comprises wrap round sides, back, top and bottom plates. I have a small press brake that I could have used to form the sides and back. However, it allows no control of the sharpness of the bends and leaves deep marks in the sides of the material being formed. Hence, I opted for a method I used in the past, which gives nice sharp corners to the bends.

The blanks for the sides and backs were cut from 0.036in.

Fig 1



RIGHT HAND LAMP FOR 3in ALLCHIN TRACTION ENGINE



brass sheet, which was filed parallel and square. To make sure the sides were square to the back after bending, I used a former made from a block of Tufnol (other materials would do just as well), machined to the width of the inside of the box (**photo 2**).

A recess was milled in the back face of the block about 0.025in. deep, and wide enough to be a tight fit for the blanks. This recess was to hold the blank square, while the bends were formed.

The blank was placed in the groove, spaced equally about the block (**photo 3**), and clamped in the vice with the block level with the front vice clamp (**photo 4**). At this stage ≫

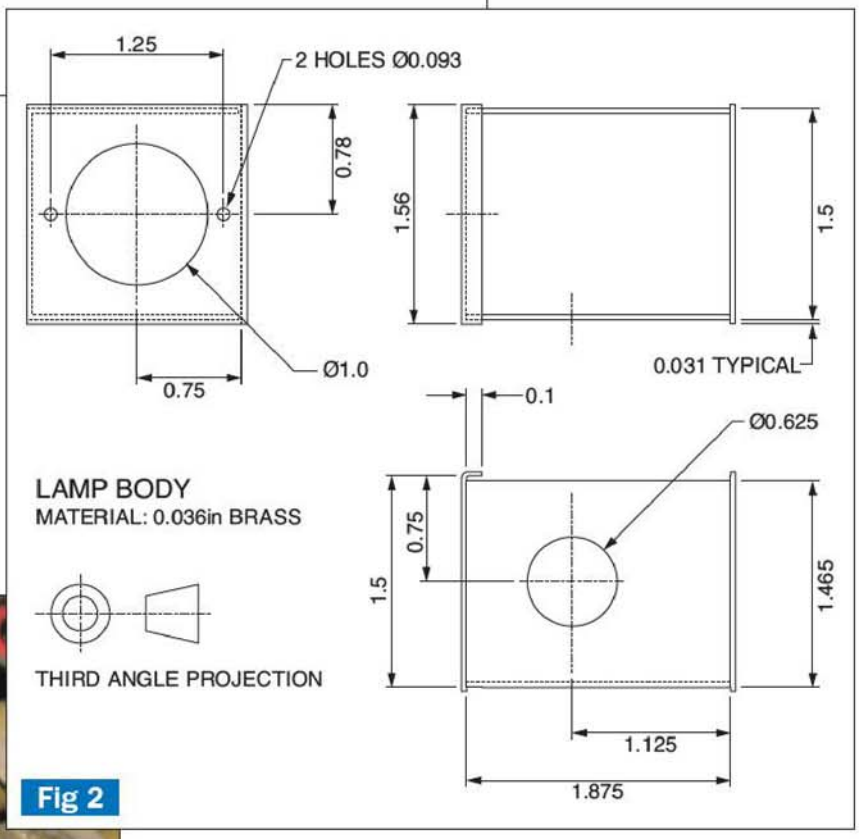
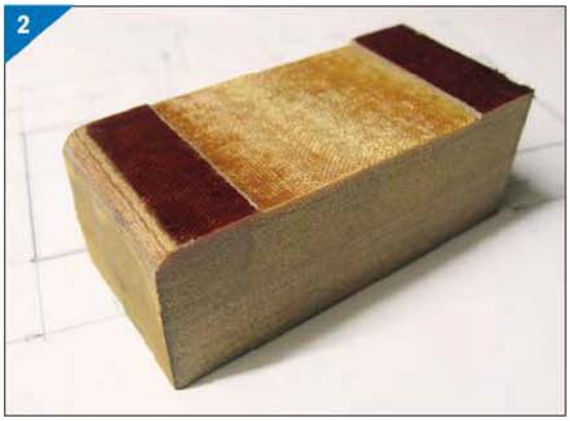


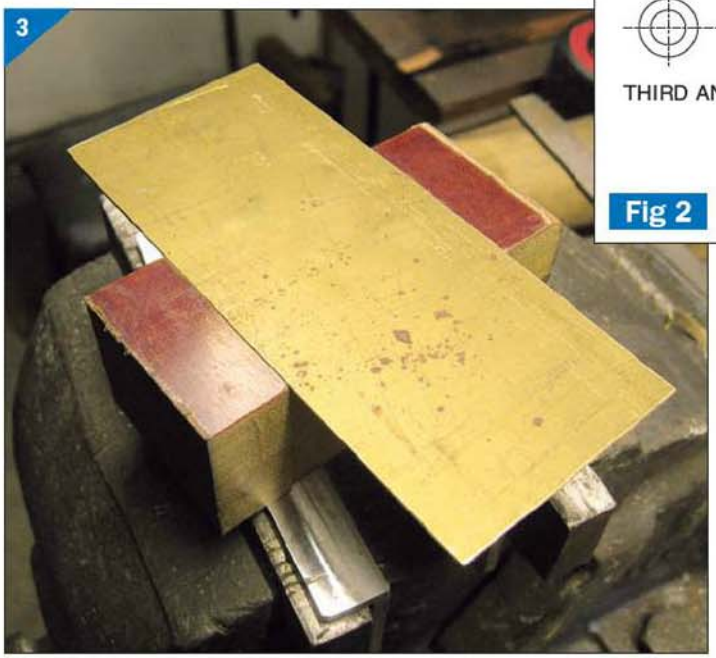
Fig 2

2



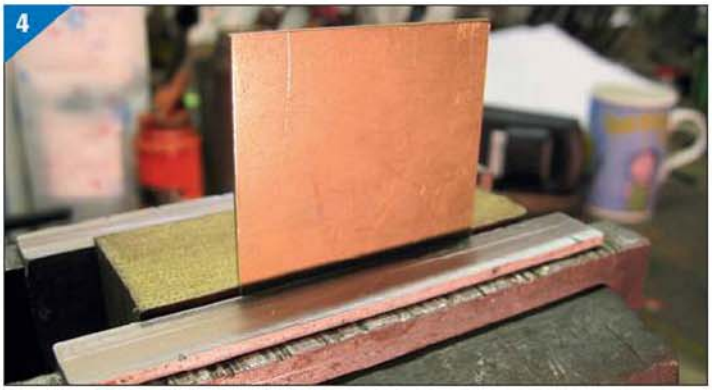
Former for bending lamp body.

3



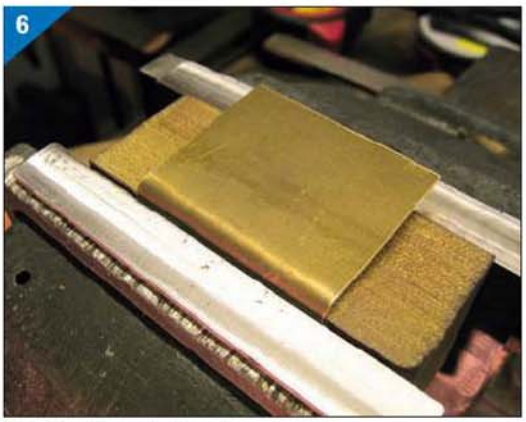
Body blank in position on the bending former.

4



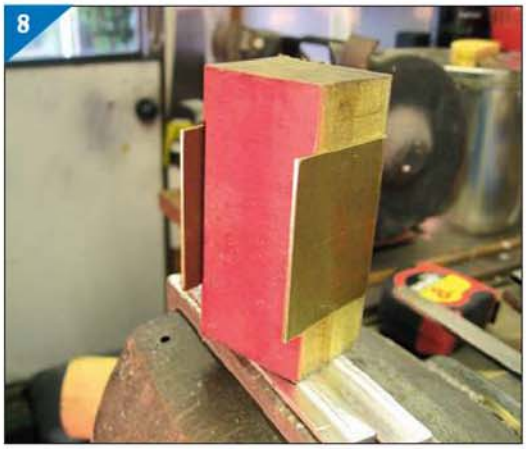
Former and blank in vice ready for bending.

Bending using a wooden roller.

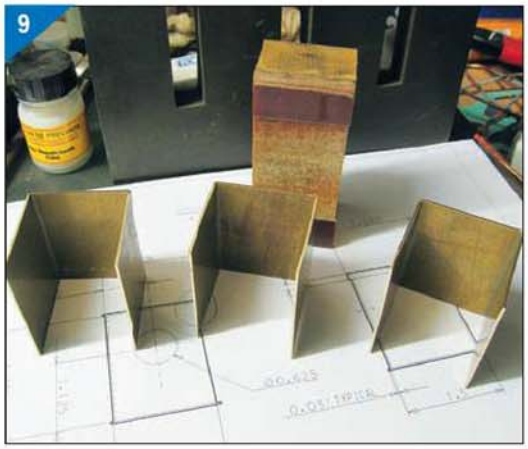


After bending with the roller.

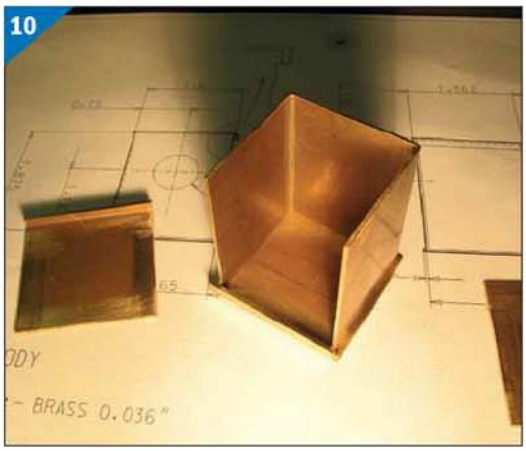
Using a flat-faced hammer to 'sharpen' the bend.



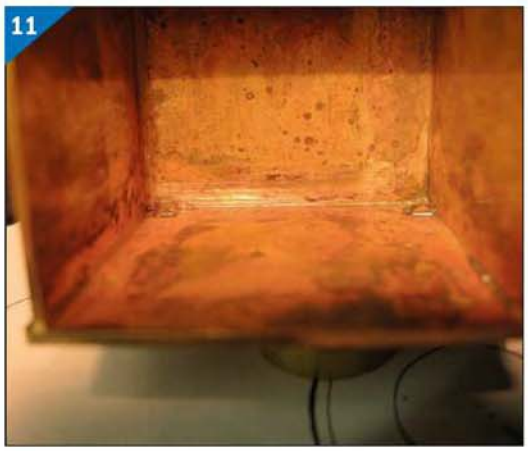
Other side of the body bent using a similar method.



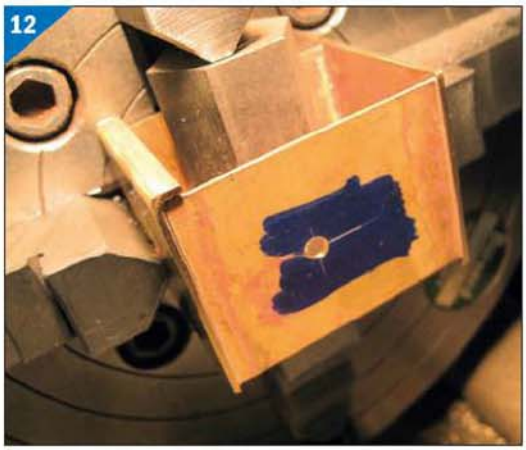
Bodies bent up for front left, front right and rear lamps.



Body parts ready for silver-soldering.



Silver solder joint along inside of seams.



Pilot hole for lamp hood.

Lamp hood hole.

I used new aluminium vice clamps, but later these were replaced with new, unblemished, mild steel vice jaws.

The first side was bent over as far as possible using a wooden roller, then finished off with a smooth, square-faced hammer; this was kept flat to ensure marking the metal around the bend was kept to a minimum, and to give fairly sharp corners on the outside (**photos 5**, **6** and **7**). The block was then turned in the vice and the other side bent over in the same way (**photo 8**).

As there are three lamps for a set - left and right front lamps, and a rear lamp - two more sides and backs were made (**photo 9**).

Tops and bottoms were cut from the same material as the sides and back. These were made a little bigger than shown on the drawings (**photo 10**). The front edges of the tops were bent over in the vice, again using the square faced hammer.

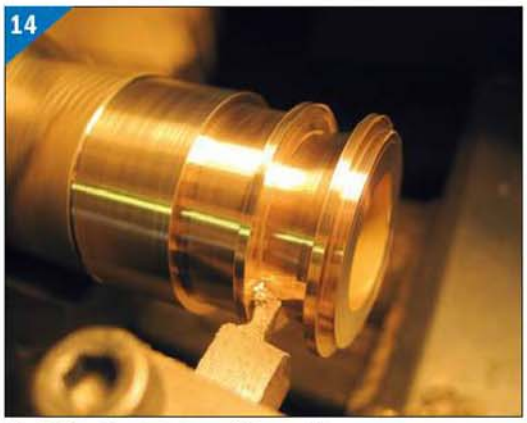
To solder these parts together, a small piece of silver solder was placed on the inside corners of the sides and back, so that the solder would 'wick' along the joints. The solder could have been applied along the outside edges, but applying the solder to the inside meant that there was no cleaning up to do afterwards (**photo 11**).

With all the parts of the boxes soldered together, the excess material was milled off the top and bottom edges, according to the drawing. At this stage the holes for the handle, lamp hood and vent base were machined (**photos 12** and **13**).

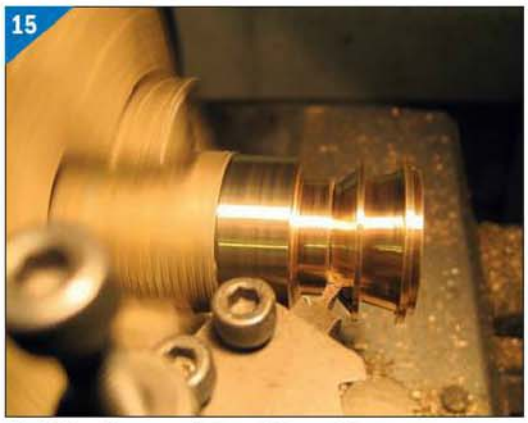
Turned parts

The next items to be made were the turned parts, namely: vent bases and lamp hoods. The vent base (**fig 3**), involves turning, milling and drilling (**photos 14** and **15**) - more about the vent base later. The lamp hoods (**figs 4** and **5**), involve machining to coordinates, then smoothing the curves using inside and outside form tools (**photos 16**, **17** and **18**).

●*To be continued.*



Machining the first step of the vent base.



Machining the second step of the vent base.

Fig 3

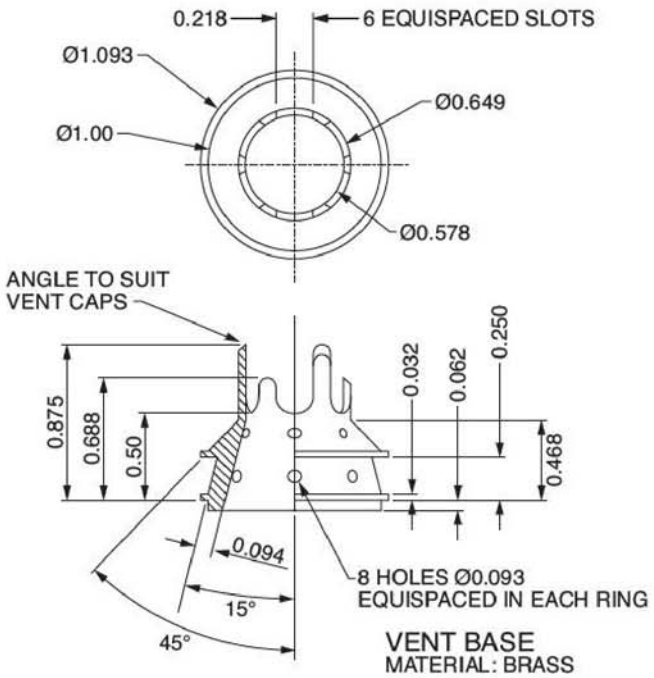
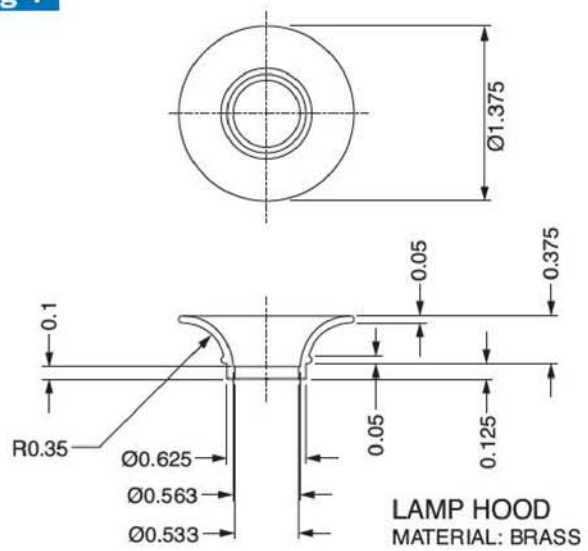


Fig 4

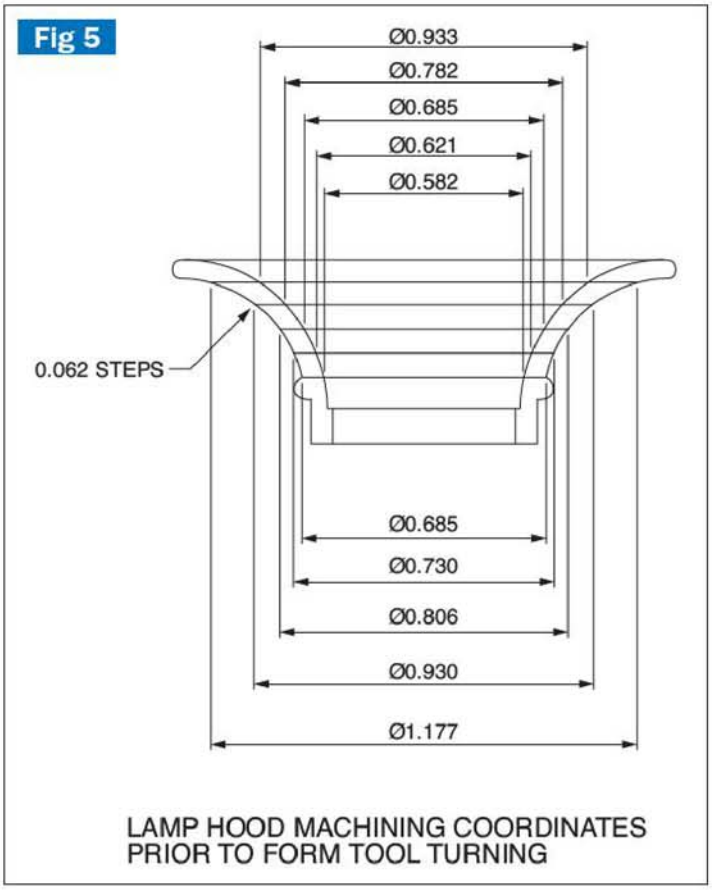


Form tool used to machine the inside curve of the lamp hood.

Form tool used to machine the outside curve of the lamp hood.

Lamp hood ready for parting off.

Fig 5



Equatorial Sundial

ROGER BUNCE
Technical Editor

Roger Bunce describes a sundial that indicates 'clock time'.

PART 1

I am interested in the design of clocks (**ref 1**). But, as we all know, clocks evolved from sundials. In fact, sundials were more reliable than early mechanical clocks and were used by some authorities to set clocks to time as late as the mid-1920s. So, for those of you who like clocks, but dislike cutting wheels and pinions, here is a sundial that indicates 'clock time'.

Background

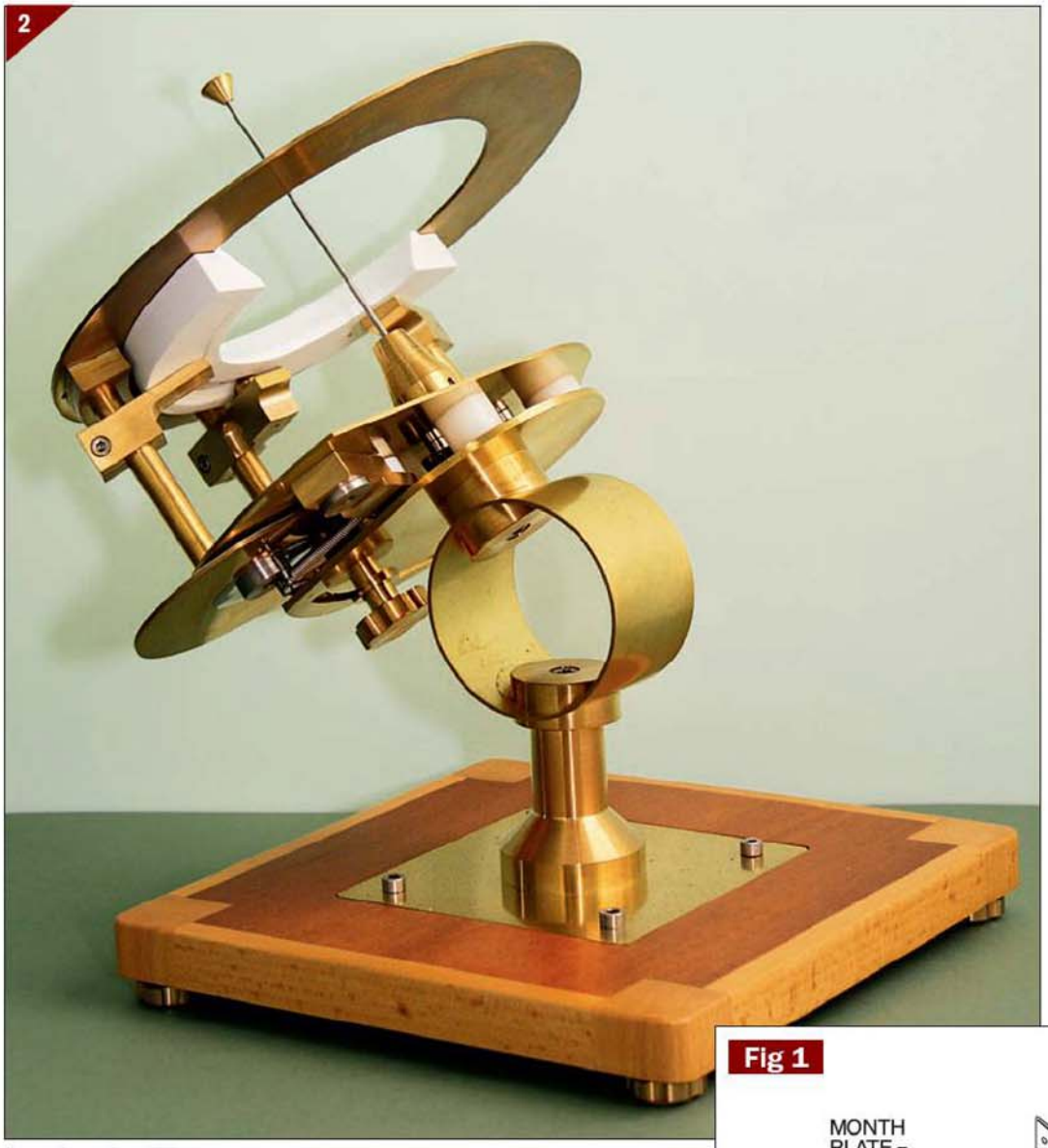
In order to understand the design of this sundial it is important to distinguish the difference between 'Greenwich Mean Time' (GMT), which is the time shown on accurate clocks and watches in England, and 'Local Apparent Time' (LAT), which is the time shown by 'ordinary' sundials. The difference between these two time defining systems is significant: for example, in early November an ordinary sundial, located at Greenwich, would be about 16.5 minutes fast, and in mid February about 14 minutes slow, relative to a clock set to GMT. This difference varies in a quite a complex manner throughout the year. In addition, the difference between GMT and LAT also varies as the ordinary sundial is moved in any direction away from Greenwich. The reason for this is outside the scope of this article but for more information on this and many other aspects of sundials see **refs 2** and **3**.

In fact, it was the spread of railways across England, in the mid-19th century, which bought about the introduction of GMT. Incidentally, GMT has been replaced by 'Coordinated Universal Time' (UTC). GMT is based on astronomical observation and UTC on atomic clocks. GMT and UTC are virtually identical, the difference being no more than a second.

Before the introduction of the BBC time signal in 1924, some railways still set their clocks using a sundial. However, for the reason mentioned earlier, common sundials were somewhat difficult to use because they did not indicate GMT directly. The solution came with the invention of a special sundial called the Pilkington & Gibbs Heliochronometer (**ref 4** and **5, fig 1**). The PGH indicated GMT directly and was reputed to be capable of being read to about one minute of GMT during the year (provided the sun was

1

Front view of sundial.



Rear view of sundial.

out!). Unlike 'ordinary' clocks and watches of the time, once it was set up properly, it was never slow or fast and, in fact, it was always as good as the earths motion about the sun which, as the basis of a time standard, was good enough in those days.

The working of the PGH depended upon, amongst other things, an understanding of the relationship between GMT and LAT - this is expressed by the equation of time (EoT). The EoT normally takes one of three forms: a table of numbers, a graph, or a mathematical expression. Confusingly, any of these forms is normally referred to as the EoT. In fact, the PGH used a polar graph arranged to act as a cam. The cam was fitted to a dial called the month plate. Before reading the time from the instrument, the operator had to turn the cam to the correct date. In addition, the PGH would also have to be set up according to its location relative to Greenwich but, provided this location was not changed, the setup procedure only had to be done once. Since the invention of the PGH many other ingenious sundials have appeared commercially and in the patent literature (**ref 6**).

The PGH was no doubt an accurate sundial. However, the price paid for accuracy was that, for 'a quick look at the time', it was not so easy to use as an ordinary sundial or a clock. One had to ensure that the month plate was set correctly and then, to read the time, physically rotate another dial so that the sun shone through the pinhole sight to project a spot of light centrally onto an engraved line on the screen (fig 1). Both the sight and screen are fixed to the dial and the time read from a scale engraved on the dial. Incidentally, both dials have auxiliary scales for added accuracy.

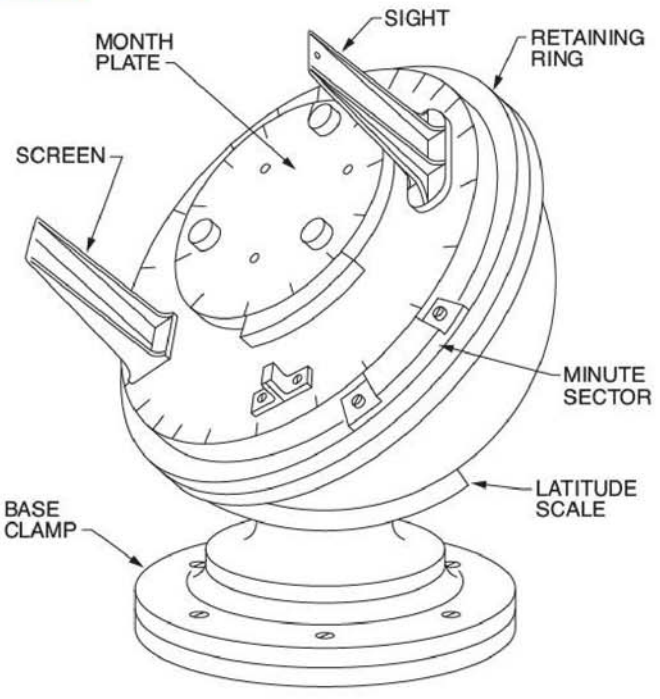
I wanted to make a sundial which indicated UTC but which could be read more easily - rather like a clock.

Equatorial sundial

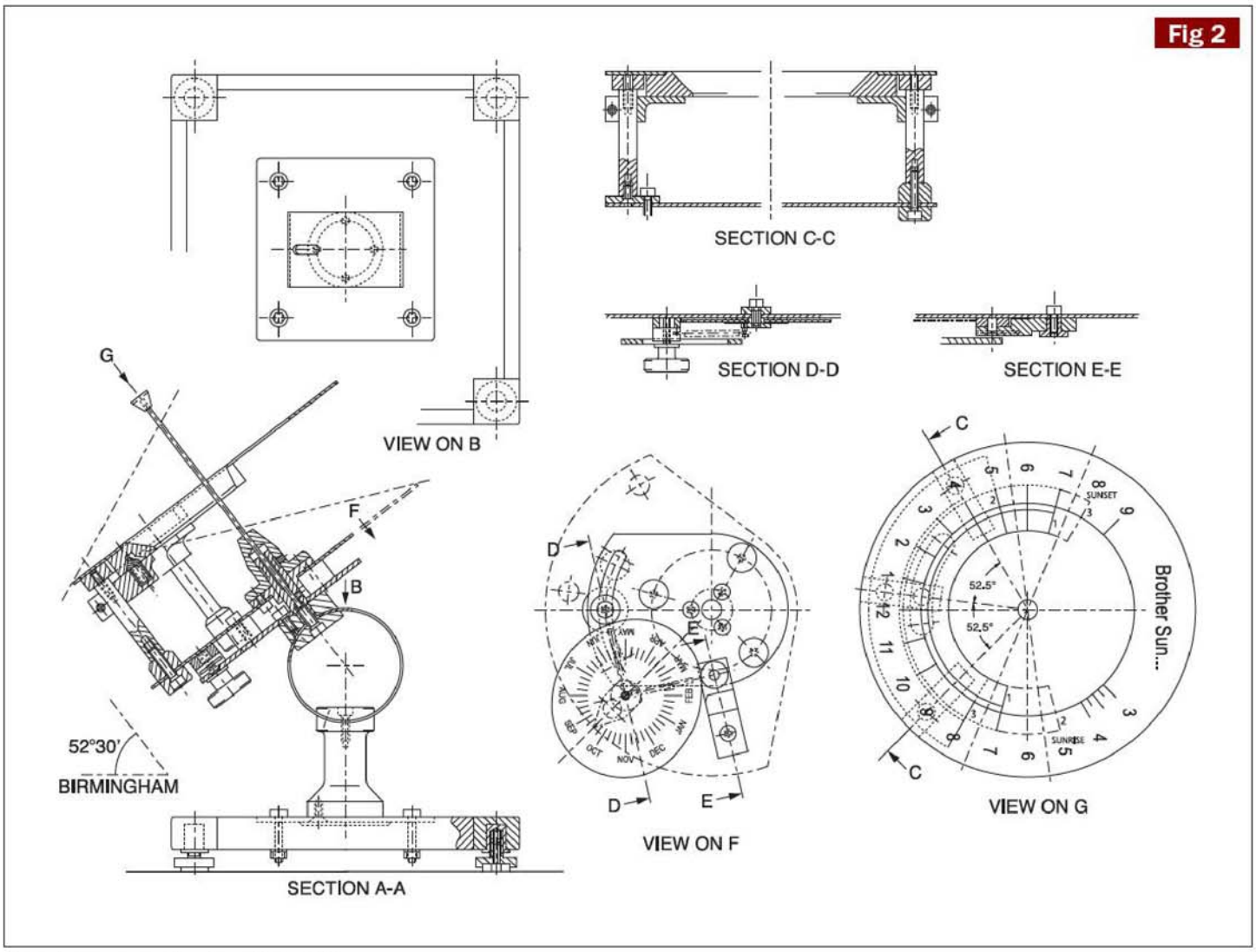
My design is based on an equatorial sundial. The important features of this type of sundial are: 1) The gnomon (the axial rod which casts the shadow), is parallel to the earth's rotational axis. 2) The hour dial is set at 90deg. to the gnomon. 3) The hour dial is divided into equal radial divisions, whereas, in an ordinary sundial the dial plate is horizontal and the divisions are unequally spaced.

The equatorial arrangement has a number of important advantages over the common sundial: 1) It does not have to be individually designed for a particular location relative to Greenwich. 2) It can easily >>

Fig 1



The Pilkington & Gibbs Heliochronometer based on an illustration in their original catalogue.



General arrangement drawing of the sundial.

be arranged to display UTC directly rather than LAT. 3) It can easily be adjusted to display either UTC or British Summer Time. 4) The hour dial looks rather like a 24hr clock dial - which was part of my design criteria.

General description

Figure 2 shows the general arrangement drawing of the sundial and **photos 1** and **2** show front and rear views respectively. The hour dial measures 220mm diameter. This sundial was very much a concept model designed to explore new ideas.

The base is made of mahogany with beech lipping. There are four leveling feet with cork protective discs. The wooden base is merely for development purposes and is not weatherproof. Most of the other parts are made from brass.

The sundial mechanism is supported on a column via a short horizontal tube. The tube is fixed to the column and the sundial mechanism by large washers; each washer has a cylindrical face. The tube is provided with slots, rather than holes, so that the sundial mechanism can be set at a particular angle to the horizontal.

The mechanism assembly includes three main plates (fig 2, Section AA and View on F): The lower plate has a curved slot and is fixed to the tube via the special washers. The intermediate plate is sector-shaped and pivots about the central axis of the sundial. The intermediate plate has three bearing pads, which slide on the lower plate. Projecting from the intermediate plate are three columns, which support the third plate - the hour dial.

Underside view showing the EoT cam and the thumbscrew for longitude adjustment.

Screwed to the intermediate plate is the EoT cam (**photo 3**). This has a months dial glued to the upper side. A pointer fixed to the intermediate plate indicates the setting of the EoT cam. The EoT cam is spring loaded against a follower, which is pivotally mounted in the curved slot of the lower plate. Hence, by turning the EoT cam the intermediate and therefore the hour dial pivots about the axis. The position of the cam follower

Spring-loaded follower to provide balancing action for the EoT cam.

Month dial fitted to the EoT cam.

can be moved and locked along the slot - this also has the effect of turning the hour dial.

A second spring-loaded follower acts on the EoT cam at 90deg. to the first follower (**photo 4**). This is merely to provide a balancing action and avoids the need to physically lock the EoT cam after changing the month. However, the balancing action is not perfect due to the asymmetric shape of the cam and a shim-steel 'curved' friction washer is used under the EoT cam.

Located under the hour dial is an auxiliary dial. This is held in place by three 'fingers', each one being clamped to a column. The centre finger incorporates a spring-loaded plunger to bias the auxiliary dial against the bore of the hour dial and keep it in position. Hence, the auxiliary dial can be pivoted about the main axis of the sundial.

Materials

Most of the parts are made from brass. This was purely for convenience at this stage of development. If ever I were to design and make the 'new improved model', I would use mainly stainless steel. Various pivots and the springs are already in stainless steel.

The three bearing pads, supporting the intermediate plate, are made from white polyacetal (Delrin), and the cam followers are PTFE.

The hour dial is brass on which is glued a paper dial made using CAD. The paper dial is covered with 'sticky-backed' plastic for protection. This is obviously not suitable for continuous outside use but is fine for development. If I were to make another dial, particularly one in stainless steel, I would consider using laser or water jet methods to cut and engrave the dial.

The auxiliary dial is made from plywood and painted gloss white - again, not suitable for outside use. In future, I would consider using opaque white Corian. This is an acrylic polymer filled with alumina trihydrate, made by DuPont.

The gnomon is made from NiTinol super elastic metal (**ref 7**). This is a nickel/titanium alloy discovered by the Naval Ordinance Laboratory, US, in 1962. NiTinol is difficult to machine - I could not cut it with a hacksaw and had to resort to grinding. The problem with the gnomon used in this type of sundial is that it is 'free-standing' and, if bent, will ruin the accuracy of the sundial. Figure 1, Section AA, shows that the maximum the gnomon can be deflected is about 90deg.; even this amount of deflection is within the elastic limit of NiTinol and, if bent, it springs back 'good as new'. A remarkable material!

Adjustments

As indicated earlier, in order for any sundial to function properly it has to be adjusted according to its latitude and longitudinal location. This, together with other adjustments and features, are as follows:

Orientation: As with any equatorial sundial, the gnomon is aligned parallel to the earth's rotational axis and the plane of the hour dial is parallel to the equatorial plane. So, in the upper hemisphere, the person reading the time would be facing south. An easy way to set the orientation is, assuming the sundial is mounted accurately on the base, use a compass to set the L-H or R-H side of the base to true north (not magnetic north).

Latitude adjustment: To make this adjustment, the two screws within the large supporting tube are slackened and the dial mechanism turned about the axis of the tube to set the plane of the hour dial relative to the horizontal (photo 2). This is only necessary when first installing the sundial or if it is moved to a different location. In Birmingham, UK, the latitude is about 52deg. 30min., the angle the gnomon makes with the horizontal is also 52deg. 30min (fig 2, Section AA). However, it is generally more convenient to measure the angle the hour dial makes with the horizontal; this is called the colatitude which equals 90deg. - latitude, so, in Birmingham, this is 37deg. 30 minutes. >>

Photograph taken at the end of the first week in February 2009. The time shown is about 11.35.

Longitude adjustment: This is made by slackening the thumbscrew under the lower plate and rotating the dial assembly about the gnomon axis. An easy way to set this is: first set the month dial to the correct date then, using an accurate clock, turn the dial so that the sun's shadow indicates that time, then lock the thumbscrew.

UTC and British Summer Time: This is also done by slackening the thumbscrew under the lower plate and turning the hour dial forward or backwards an hour.

EoT correction: This is done simply by turning the month dial so that the correct month and week are adjacent to the pointer (**photo 5**). The month dial incorporates the EoT cam, which turns the hour dial, via the sector-shaped plate, and so effectively converts LAT to UTC. Several people have asked me how to design and make an EoT cam so that will be described in the next issue of *Model Engineer*.

Summer and winter months: Like many other equatorial sundials, in the summer the sun shines on top of the hour dial and in winter below the dial (according to the dates of the spring and autumn equinoxes, which, for 2009, are March 20 and September 22. For ease of reading during the winter, I wanted the shadow cast by the gnomon to be visible from above. To allow this, the main dial is provided with the auxiliary dial with a non-graduated inclined surface (painted white). **Photograph 6** was taken at the end of the first week in February 2009 and the month dial is set accordingly. The sun is shining on the underside of the dial and so the shadow is cast on the auxiliary dial and not on the upper surface of the hour dial. The time shown is about 11.35.

During the winter months, the difference between the earliest sunrise and latest sunset in Birmingham (and other places) is greater than 12 hours. This means that the auxiliary dial would need to encompass a span of greater than 180 degrees. However, this would mean that on some days, in the early morning or late evening, one end or other of the auxiliary dial would obscure the suns rays from casting a shadow on the opposite side of the dial. To avoid this problem, the auxiliary dial can be turned axially relative to the hour dial (**photos 7** and **8**). This allows the time to be read during all winter sunshine hours.

Accuracy: The dial is graduated in hours and quarters and can be read (estimated) to within about 2 minutes of UTC. This may be unimpressive by modern standards but, on the other hand, it never gains, never looses, doesn't go wrong and doesn't need batteries!

Motto

All sundials should have a motto! The motto on my dial reads: *Brother Sun...* from: Saint Francis of Assisi, *Canticle of the Sun*, c1225: "Be praised, my Lord, with all They creatures, above all Brother Sun who gives the day and lightens us therewith."

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7. Supplier of NiTinol super elastic metal: Memry GmbH, www.memory-metalle.de

To be continued.

Auxiliary dial turned to 'catch' the morning sun.

Auxiliary dial turned to 'catch' the evening sun.

ROGER BUNCE
Technical Editor

Roger Bunce looks at a new range of products from Steam and Diesel Castings.

PART 1

Dan Jeavons in his workshop.

Pseudo Steam

Steam and Diesel Castings (S&DC) is a small, family-owned, business which has been supplying components to model locomotive enthusiasts for over 40 years. The proprietor is well-known model engineer Dan Jeavons (**photo 1**), and the business is based in Kidderminster, Worcestershire.

As the company name suggests, Dan began by supplying castings and designs for all types of locomotives, and that is still an important part of his business. There are 22 locomotives and items of rolling stock in the current range, most of which are diesel electric models in 5in. gauge with some in 7¼ and 7½in. gauge. The business remit is more extensive than the name suggests: Dan can supply anything from a locomotive windscreen wiper blade to a custom made locomotive complete with driving and passenger trolleys.

The business may be small but the range of expertise is vast. Dan firmly believes in seeking out the very best skills available in order to provide quality products second to none. The West Midlands has always been known for its engineering skills and local companies are used for services including: pattern making, cast iron and aluminium castings, machining, laser cutting and fabrication, >>

NER Y7 Class 0-4-0 Dock Tank Engine.

glass reinforced plastic (GRP) moulding, precision resin moulding, and painting.

Pseudo Steam

The range of diesel electric locomotives available from S&DC is considerable, so much so that Dan asked the question - what next? Now, in order to appreciate the validity of the answer, readers need to appreciate that Dan is not just a 'battery on wheels man', he has many years experience in building and running live steam, passenger carrying, model locomotives. Dan recognised that, while there are many passenger carrying electric locomotives that looked like diesel locomotives, there are almost no electric locomotives that looked like steam locomotives. Could this be the next model engineering challenge? - a challenge which Dan recognised and calls 'Pseudo Steam' (PS).

The idea is not entirely new - Hornby is the obvious example - but on a somewhat smaller scale! Dan thinks that the reason for the lack of pseudo steam in larger gauges is because, technically, it is a much more difficult problem to solve than diesel electric 'silhouette' models. For example, there are much greater geometric and dimensional constraints with steam locomotives.

3

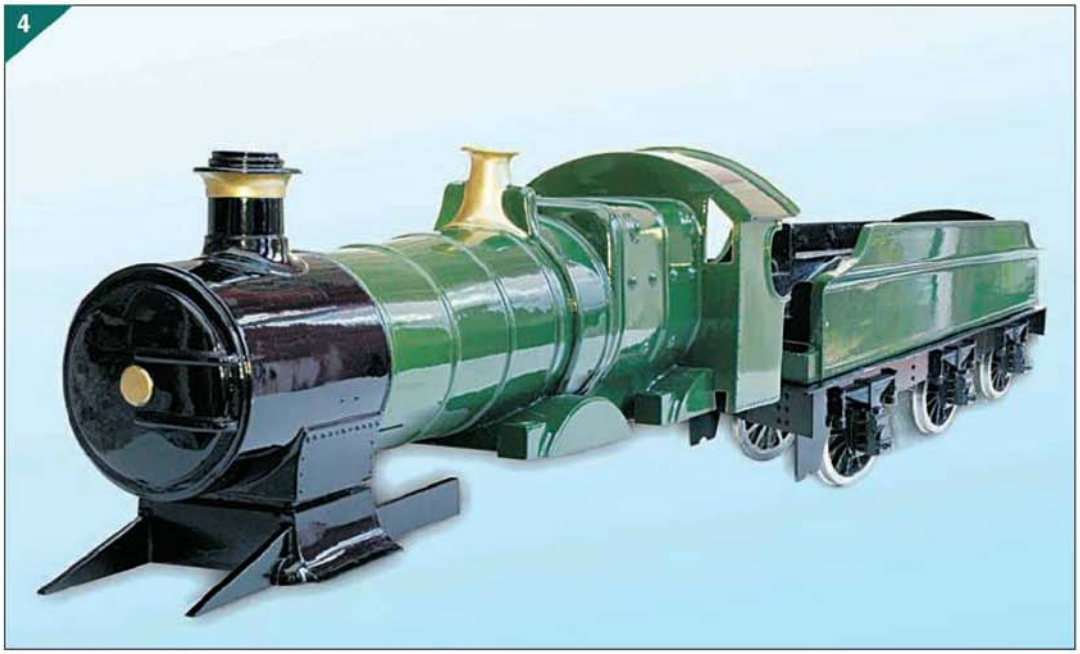
GWR 51 Class 2-6-2 Prairie Tank Engine.

There are of course advantages and disadvantages with any new concept and it is unlikely that live steam enthusiasts will suddenly switch to PS. However, it is a fact that diesel electric locomotives have been a successful addition to the modelling repertoire - so why not PS? Let us examine the relative merits.

There are two aspects of PS that we, at *M.E.*, find particularly appealing: Firstly, it is a relatively new concept - and we are always looking out for new ideas. Secondly, it could appeal to a younger generation of model engineers. Indeed, Dan's Y7 Class entry level locomotive was conceived with that very market in mind. So parents and grandparents, that's something to bear in mind for that special birthday or Christmas present!

Advantages	Disadvantages
Safer	Traditionally, not the 'real thing'
Instant running	Deskills the driving challenge
More reliable	No smell
Less maintenance	
Less expensive	
Easier to drive	
Easier to construct	
Quicker to construct	
Machine tools not necessary	
Cleaner	

4



GWR City Class 4-4-0 City of Truro, *under construction.*

Pseudo Steam models

Dan does not do things by halves! He now has four prototype PS models, either finished or at an advanced stage of construction and plans to produce them in small batches. As Dan said, "One thing just led to another." Dan's enthusiasm for PS is such that he now provides a

brand new catalogue devoted entirely to, and called, Pseudo Steam (and it's free).

The first models to be chosen for the PS range are all in 5in. gauge and in order of power and cost are:

NER Y7 Class 0-4-0 Dock Tank Engine
GWR 51 Class 2-6-2 Prairie Tank Engine
GWR City Class 4-4-0 *City of Truro*
LNER A4 Class 4-6-2 *Mallard*

These are well-known locomotives that have all been the subject of conventional live steam models.

The **Dock Tank**, as the name suggests, was intended mainly as a dock shunter were an important requirement was for a small locomotive with a short wheelbase. They first appeared in 1888 and were originally known as the H class

The **Prairie** Tank first appeared in 1932 and remained in service until the end of steam. They were used mainly on suburban and branch lines because of their good acceleration.

City of Truro was built in Swindon in 1903. It was unofficially timed at just over 100mph while hauling a Plymouth to Paddington mail train in 1904. It would be another 30 years before the Flying Scotsman was officially timed at over 100mph.

Mallard was built in Doncaster in 1938 and was in service until 1963. It remains the world speed record holder for a steam locomotive at 126mph, which was achieved in 1938 on the East Coast Main Line.

Model construction

The vast differences in layout between the four prototypes presented numerous challenges when modelling in PS. These will be discussed in detail in subsequent articles but, very briefly, the construction is as follows:

Dock Tank uses a single electric motor with a worm and wheel gearbox. The batteries are housed in the side tanks of the locomotive. The main construction is a sheet steel fabrication.

Prairie also uses a single electric motor with a worm and wheel gearbox. Again, the batteries are housed in the side tanks. However, the main construction is a precision aluminium casting.

City of Truro is a departure from the two previous locomotives: There are four electric motors - two to each axle. The batteries are located in the tender, which is a sheet steel fabrication. The engine itself is a one-piece aluminium casting.

Mallard is a major challenge to convention: The motors and batteries are all housed in the sheet metal tender (available with or without a corridor). So, essentially, the tender drives the locomotive! The wheels of the locomotive are turned merely by frictional contact with the track. The connecting rods and valve gear are all modelled in detail and are driven by the cranks. The locomotive is built on a conventional chassis and the streamline bodywork is a high quality, detailed, GRP moulding.

Livery

The livery of these four engines is well documented. Dan favours the original livery and his finished engines would normally be painted accordingly. As I mentioned earlier, Dan's locomotives are painted professionally - no point in spoiling the ship for a ha'p'orth of tar! Do bear in mind - if you intend to make your locomotive from a kit, you need to paint many of the parts before assembly.

Performance

By performance, I mean how many passengers will it pull, how fast will it go and what is the minimum radius of track needed (**table 1**). This is of course a much-simplified list and the figures given are approximate. In addition, I have included the overall length of the locomotive including the tender if fitted:

Table 1

Class	Passengers*	Speed (mph)	Length (in.)	Radius (ft.)
Y7	2	8 +	22½	8.2
51	8	8 +	45	14.75
City	10	8 +	63	11.5
A4	12	8 +	73	14.75
*Number of passengers of average weight on a level track.				

Controls

All of Dan's electric locomotives are fitted with 4QD electronic control systems, which use a flying lead control box as standard. Dan is particularly pleased with these control systems and would like to thank 4QD for all their help and encouragement over many years.

Model Engineer would like to wish Dan every success with Pseudo Steam - an exciting concept in large gauge model locomotives.

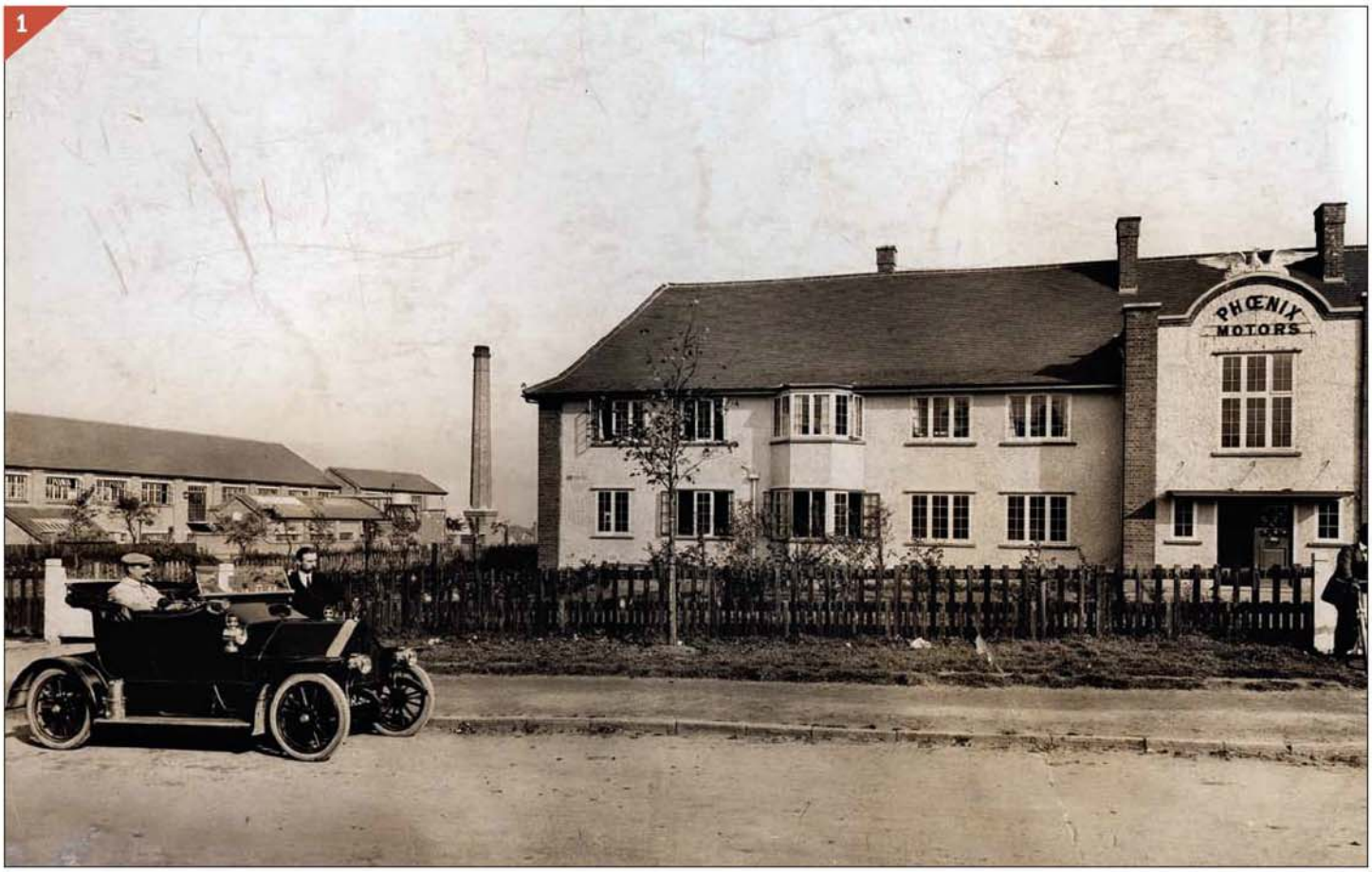
Contact details

Dan Jeavons, Steam & Diesel Castings, (Pseudo Steam), 59 The Foxholes, Kidderminster, Worcestershire DY10 2QR.
T. 01562 754530

●*To be continued.*

5

LNER A4 Class 4-6-2 Mallard, *under construction.*



1

EDWARDIAN ELEGANCE
The Phoenix motorcar

RON ISTED

Ron Isted looks at the strange saga of a Belgian marzipan maker, the secretary of a model engineering society and a Phoenix in borrowed colours!

Regular readers will, no doubt, have noticed over the last few years a gradual process of rejuvenation of this venerable magazine, now 110 years-old, together with a welcome increase in the variety of its contents. Since *Model Engineer* can only publish what its writers actually write, I felt it was about time I conquered a few of my own prejudices and described a machine that neither runs on rails nor floats. Even more unusual for these articles, the subject of this one does not even derive its means of propulsion from a combination of external combustion and boiling water. In fact, I have wanted to write about a motorcar for some time, the main problem being that so many of those made during the reign of King Edward VII were anything but elegant. To put it bluntly, a lot of pre-First World War internal combustion road vehicles look like a random collection of components knocked up in sundry backyard sheds without reference to each other and then forcibly joined together in very unholy matrimony to produce what can only be described as a (hopefully) mobile visual monstrosity. As with the railway locomotive, the aeroplane and so many other examples of man's mechanical inventions, three or four decades elapsed before the majority of motorcars attained their optimum proportions. However, there were a few exceptions, for example some of the early French cars, those produced by Rolls-Royce almost from the firm's foundation, and a vehicle produced by a small company in Hertfordshire, the subject of this article.

Chanced upon

I first came across the Phoenix 8-10hp Voiturette (**figs 1** and **2**) quite by chance in a slim little book with a rather lengthy title: *A Pictorial History of Kingsbridge and the Surrounding Area.* One of the many illustrations, all superbly reproduced, was a photograph taken about 1910 near Kingsbridge (an attractive small town in South Devon), of the second man in the area to own a car. It was

immediately obvious that this vehicle, unlike so many of its contemporaries, had been designed by somebody blessed with a fine sense of shape and proportion, and I decided there and then that here at last was a suitable subject for one of these articles. At the time I had never heard of the Phoenix car and certainly had no idea that its designer was none other than A. E. Bowyer-Lowe, a distinguished model engineer who in later years wrote for this magazine and donated a trophy, the Bowyer-Lowe Challenge Cup, for the best design and craftsmanship in the tools section at the Model Engineer Exhibition. He also became the secretary of the newly formed Letchworth Society of Model and Experimental Engineers, while his boss, Joseph van Hooydonk, Founder and Managing Director of Phoenix Motors Limited, the company that built the car, was the first chairman of the Letchworth SMEE. All this was duly reported at the time in the *Model Engineer and Amateur Electrician*, along with the fact that Joseph very generously donated a lathe to the new society - I wonder what happened to it or for that matter to the society itself?

As is evident from his name, Mr. van Hooydonk was not a native of this country, his parents having emigrated from Belgium when he was a child. That country was, and still is, famous for its sweets, especially chocolate, so it's perhaps not altogether surprising that when he left school, Joseph went to work for James Pascall, the well-known confectionery firm, now part of the Cadbury empire. The young van Hooydonk did very well in the confectionery business and, according to one contemporary account, acquired the reputation of being Pascall's best marzipan maker. He was, however, also passionately interested in bicycles and besides racing them himself, began a lucrative sideline in repairing other people's machines. The story goes that Pascalls (a family firm) were somewhat put out when they discovered that one of their star employees was doing a spot of moonlighting, with the result that J. van H. resigned altogether from the marzipan day job to set up his own company in London's Holloway Road, probably in the late 1880s or early 90s, though reported dates vary. He began by continuing the cycle repair business, but soon started to design and build new machines, and was then persuaded by his brother to produce a motorcycle, subsequently marketed under the title of The Phoenix. The inspiration for the name came from the Phoenix Cycling Club, of which Joseph was a keen member. Two interesting features of this pioneering and highly successful bike, which preceded the iconic Harley-Davidson, were the excellent Minerva 2-cylinder engine, imported from Hooydonk's native Belgium, and the fact that it was mounted transversely. Both the engine and its unorthodox position were later to re-appear in the Phoenix motorcar.

Trimo and Quadcar

The success of van Hooydonk's motorcycle led in 1903 to a three-wheel version, equipped with a basket-work seat between the front wheels for the unfortunate passenger, who apart from being completely exposed to the elements, was obviously very vulnerable in the event of an accident. This two-speed vehicle was known as the Phoenix Trimo and incorporated various improvements in order both to improve stability and also to strengthen the frame at the front end, a weak spot on many contemporary three-wheelers. These modifications were patented by van Hooydonk and were so successful that they were soon adopted by other manufacturers, to his pecuniary advantage, naturally. His financial position received a further welcome boost from substantial compensation, according to a contemporary report, because a railway line was to be built on the site of his premises, although I have failed to discover any further details. The company made use of the extra cash to decamp a few blocks further along the same street to a larger site at No. 736 Holloway Road, whence the Phoenix Quadcar emerged in 1905, by which time the company had become Phoenix Motors Ltd. Unlike its predecessors, the Quadcar was a four-wheeler, as its name suggests, although still based very much on the original two-wheel technology. Also in contrast to previous Phoenix machines, it was an unmitigated disaster and I believe only one vehicle was built to the original design, which was seriously deficient in certain basic essentials such as brakes. These consisted of 'strip-brakes' fitted to the front wheels and were said to have had a life expectancy of one trip, while the clutch lasted little longer!

Bowyer-Lowe, quite a catch!

Just how Joseph van Hooydonk managed to produce such a turkey after his previous successful efforts remains a mystery, but on the other hand, had he not done so, A. E. Bowyer-Lowe might not have been asked to join Phoenix Motors. This he did on 1 January 1906, having spent just under four years with J. A. Prestwich of Tottenham, North London, a firm probably better known to readers of this magazine as JAP, manufacturer of very successful small internal combustion engines. They were not only used in countless motorcycles, not to mention Morgan and Reliant cars, but have even been known to provide the power plant for some of our miniature 'diesel' locomotives. Rather less well-known is the high reputation achieved by the firm in the manufacture of projectors and other precision equipment during the early years of the cinema industry. B-L, as he was generally known, had joined JAP at the age of 18, and during his relatively short time there, designed both the first OHV and the first Vee-twin engines in this country, together with a 3-cylinder Dual car. This vehicle was fitted with an epicyclic gearbox, steel-plate clutch (in contrast to a flimsy cone clutch fitted to Hooydonk's contemporary Quadcar), worm back axle and was generally considered to be at the forefront of design technology. He was, therefore, quite a catch for Phoenix Motors, where he was specifically entrusted with re-designing the disastrous Quadcar, although Joseph van Hooydonk was not slow in putting forward his own ideas, as we shall see.

The revised version of the Quadcar appeared within a few months of B-L's appointment, but does not appear to have been much more successful than the original. I have failed to discover any illustrations of either vehicle, and the only technical information I have is that the new version was powered by a 2-cylinder water-cooled engine manufactured in Aachen, Germany, by Fafnir. Also, that it incorporated an American epicyclic two-speed gearbox and that the differential back-axle came from 'Geo. Adams of Drury Lane' - was this the same firm that advertised lathes and other tools from an address in High Holborn in early issues of *Model Engineer and Amateur Electrician*? Incidentally, in April 1915, this magazine carried an article on an ingenious epicyclic back gear mechanism devised by A. E. Bowyer-Lowe for use with the popular Drummond round bed lathe. For ante-deluvian steam men like myself, it is somehow comforting to reflect that epicyclic gearing, still very much in current use, is in effect a development of the sun and planet gear patented by James Watt well over 200 years ago.

The little car with a big heart

Meanwhile, back at Phoenix Motors, B-L immediately set about two completely new car designs. The first one, the two-seater 8-10hp, and the principal subject of this article and shown in figs 1 and 2, was produced early in 1907 and >>

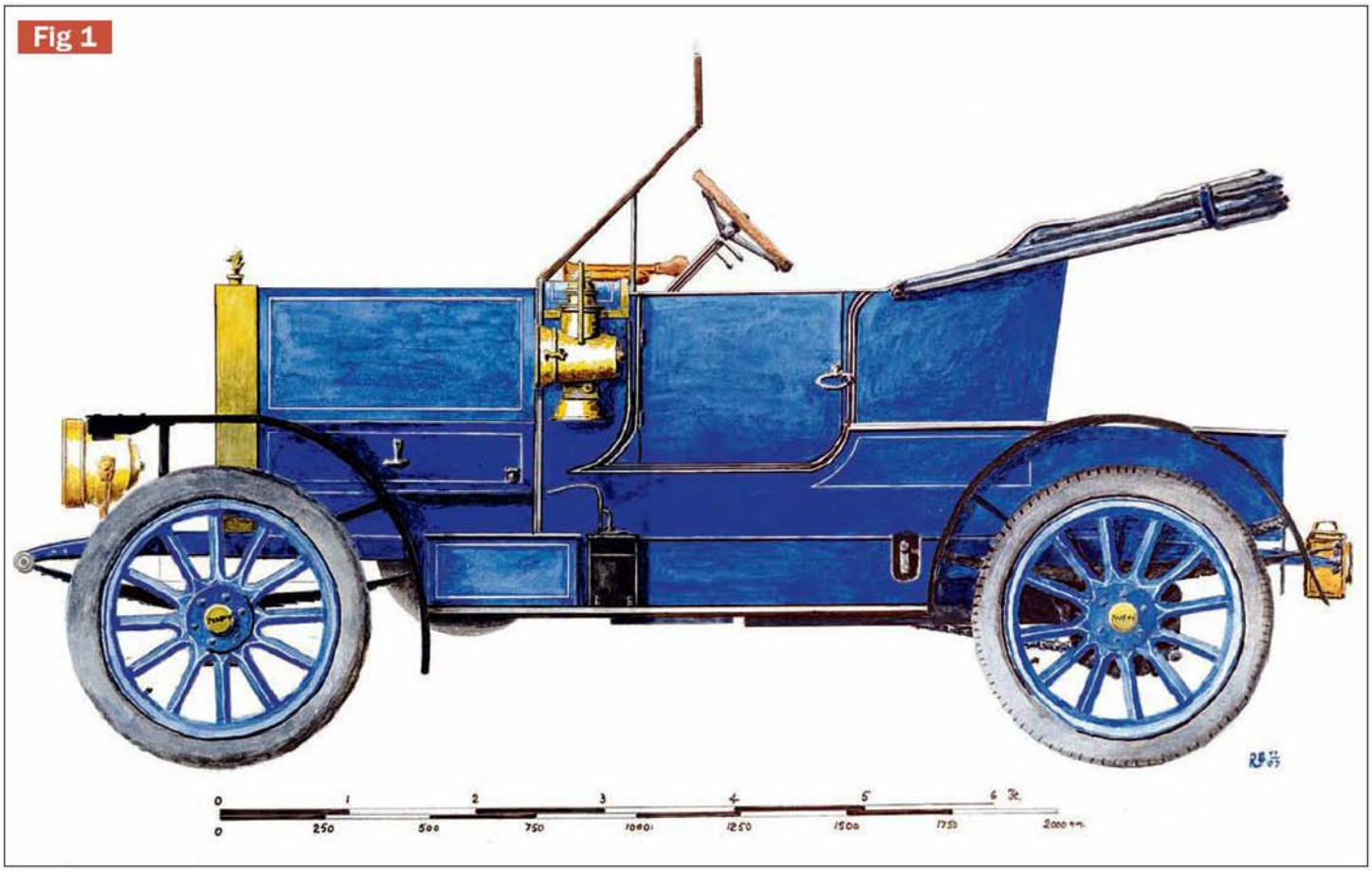
marketed as "The Little Car with a Big Heart", which only goes to show that Edwardian publicity blurb was every bit as cringe-making as 21st century television car commercials. The larger 10-12hp version followed a year or so later. **Photograph 1**, reproduced by kind permission of First Garden City Heritage Museum, Letchworth, shows a 10-12hp outside the elegant new factory in Letchworth to which the firm moved in 1911. I believe the driver is Joseph van Hooydonk, while the smartly dressed and serious looking young man standing next to the car is its designer, A. E. Bowyer-Lowe.

Both the 8-10 and the 10-12hp models were extremely successful and, quite apart from their pleasing proportions by comparison with so many contemporary vehicles, both were unconventional in several other ways. At van Hooydonk's insistence, transmission was by chain drive, although this was already going out of fashion in favour of the cardan shaft. Perhaps as a deliberate policy in the face of that undeniable fact, the publicity material issued with the Phoenix made much of the vehicle's Hans Renold patent silent chain, even reprinting part of an article by Henry Sturmey from *The Motor* magazine, generally singing the praises of chain drive and asserting that it was very much more efficient than cardan shafts with all their associated gearing. This was not an entirely unexpected claim from Mr. Sturmey, of course, since he and James Archer had only recently patented the famous chain-driven multi-speed gear for bicycles. As a matter of historical interest, Sturmey's main points are (i) that the cardan shaft is under very much greater stress than a chain drive, because of the universal joints necessitated by the independent movement of wheels and axles relative to the fixed position of the power source, (ii) much more power is lost in shaft drive than with chain, (iii) maintenance and replacement are much easier with a chain. In his own words: "the removal of a single bolt takes the chain away and it can be properly cleaned and treated, conveniently and comfortably away from the car. Furthermore, if breakage should occur, the repair is an easy matter... in some forms, new links can be put in absolutely without any tools and when the chain wears out, a new one can be... put on by any novice without any need to resort to a workshop or skilled labour". On the other hand, he has this to say about the cardan shaft: "when wear does take place, it cannot be taken up by the chauffeur (!), it is usually a workshop job, needing re-bushing, and in the event of a shaft or a joint breaking, a motorist is absolutely stranded... the only thing is to wait for a new shaft". After once again emphasising the "superior efficiency of a central chain drive", he ends with the following remarkable statement: "My way of thinking may not perhaps coincide with popularly accepted notions of the day, practical trial will ultimately show the correctness of the views put forth". Oh well, you can't win 'em all.

Bought-in engine

In the earlier examples of the Phoenix 8-10hp, and probably at van Hooydonk's insistence, the engine was again bought-in from Antwerp-based Minerva, an up-market firm that has been described as the Belgian equivalent of Rolls-Royce. Minerva's British agent, by the way, was David Citroën, brother of the founder of the famous French car firm. As with the original Phoenix motorcycle, the engine was mounted transversely, most unusual at this period and indeed for another half century until the advent of the Mini in 1959. Since the engine rotated in the direction of travel and the ratio was 1:1 in the highest of the three gears, Phoenix Catalogue No. 26 proudly informed would-be owners: "the drive is direct from engine to road wheels, no gear wheels at all are revolving. The chains are efficiently protected and the drive being straight through from engine to road wheels by the most efficient power transmitter known in engineering, no power is wasted as is the case with

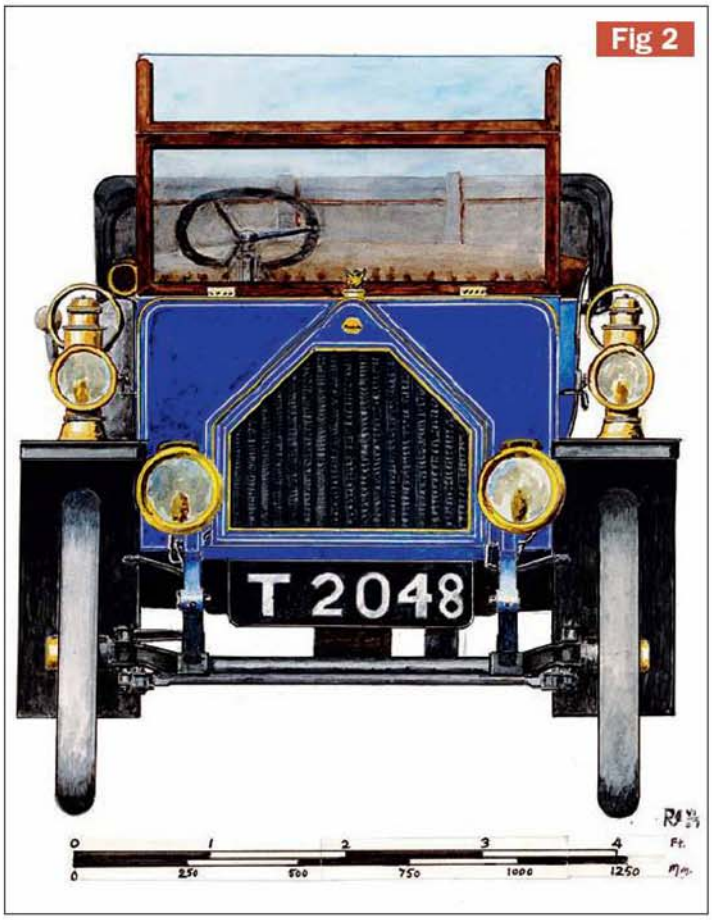
Fig 1



bevel wheels ... as most of the time the top gear only is used, the running is light on petrol and tyres, but in addition a perfectly silent drive is the result... The Phoenix... may be called a top gear car, on which an average of 20 miles per hour, even in very hilly districts, is a long way within its maximum capacity". Later engines were imported from two other Belgian manufacturers, Imperia and Métallurgique, and I believe that later still, engines were built in house, although the castings must still have been bought in from outside firms, since Phoenix Motors did not possess its own foundry. The engine on the only surviving Phoenix 8-10hp in this country, dating from 1910/11 and to be discussed later, is in fact marked 'Phoenix' (**photo 2**). However, as can be seen from the illustration, the name is a separate plate bolted on, so it may very well be in the literal sense an Edwardian example of a practice depressingly common today, namely badge engineering.

Engine specification

The engine featured two cylinders 90 x 100mm, cast in one block, and the Phoenix Catalogue informs us that "in accordance with latest practice, both pistons are mounted on the same line of crankshaft, which results in perfect running at all speeds... while silence is one of the leading features of the engine". Cooling was by thermo-syphon, a system quite common at the time, largely because it avoided the use of a pump, and perfectly adequate with the low engine revs then in use. The water jacket was made in generous proportions, especially round the valves to ensure effective cooling... the top section is detachable and a large cover is in addition, placed at the side, enabling any deposit of fur to be easily cleaned out from the water space - one of many gentle, and not so gentle, hints to the owner/driver to remember to carry out his own regular maintenance. On the engine itself, inlet and exhaust ('outlet') valves were stated to be 'all alike' (i.e. the same size), so that not more than a spare one need be carried, implying that the driver was presumably meant to fit the replacement himself in the event of a failure on the road. In passing, I would have expected the exhaust valve to be somewhat larger than the inlet, to allow for the expansion of the burnt gases, but perhaps I'm just betraying my steamy background. With only two cylinders and low rpm, the flywheel obviously needed to be pretty hefty, but unfortunately, I have no details of its exact dimensions, though scaling it off a small overhead photograph of the chassis suggests a figure of about 15in. diameter.



The publicity material merely states that it was of ample proportions, giving a constant torque and smooth drive to the car. It was combined with the clutch, "a large single hardened and ground steel plate, smooth in action and running in oil... (and) can be slipped with impunity allowing driving in traffic to be done in top gear. It is practically unwearable and needs no attention beyond occasional lubrication - obviously the lessons from the flimsy Quadcar had been well and truly learned. As mentioned above, the Phoenix gearbox was of the three-speed and reverse sliding type on Hoffmann ball bearings. The whole box is cast in one piece, obviating anything in the nature of leaking joints. A plain cover is placed over the top which, when removed, exposes the whole of the gear for inspection...

Home maintenance

It is obvious from the numerous references to ease of access and inspection that Phoenix car owners, as indeed was the case with the majority of makes at the time, were expected to carry out most of their own running repairs and general maintenance. In the words of the Phoenix publicity handout: The design of a car is the basis from which springs satisfaction or dissatisfaction, economy or expense, accessibility or a lack of get-at-able-ness which is not only annoying but which leads to the calling in of outside assistance for an adjustment which could well be made by the owner could he only get at it ... Economy in first cost, running and up-keep, accessibility and simplicity are also necessary points to the man who wishes not only to drive his car, but also to be able himself to keep it in order. However, Mr. van Hooydonk went a stage further and issued the following dire warning to purchasers of his vehicles, combined with a demand for physical effort while actually out on the road: Lubrication is by hand pressure pump. Mechanical lubrication, no matter how well made, is liable to fail. Failure of lubrication means ruin to the engine, and consequently we fit a large transparent oil pump easily operated by the driver, and all that is required is to pull up the plunger and turn the cock round say every 15 miles - not much to do, but giving one the certain knowledge that the oil has actually gone into the crank case. Just the sort of little distraction you needed when negotiating your way through a lethal combination of motorised and horse-drawn traffic round London's Piccadilly Circus in the rush-hour, (no traffic lights in those days!) or trying to avoid getting your wheels stuck in the Deansgate tramlines on a wet day in Manchester.

To be continued.

McONIE'S OSCILLATING ENGINE

ANTHONY MOUNT

Anthony Mount completes the crosshead and tackles a range of other components including the side frame bearings.

PART 15

Continued from page 263 (M.E. 4346, 27 February 2009)

Holding the parts together for soldering is a problem! I tried at first with a couple of toolmakers clamps but the bigger of the two 'sucked' away a lot of the heat, so a couple of 5mm square section straps were made with two 8BA tie rods to pull the parts together. One of the straps was tapped 8BA the other drilled clearance.

To space the two bars the correct distance apart a spacer was made from the same section as the die block (see Part 70). One thing we do not want to do is to solder the spacer! Therefore, the bars were coated with Tipp-Ex correction fluid, which resists silver solder.

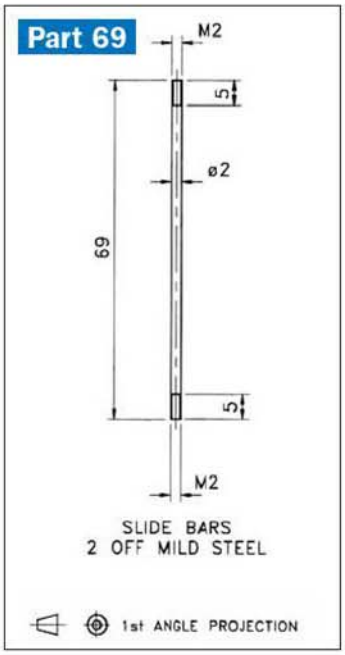
Assemble all the parts with the straps holding the sliders in place and a small toolmakers clamp holding the spacer and nose in position (**photo 111**) - hence the reason for not rounding the end of the nose.

As the parts are quite small there is no need for a huge flame. Flux only those parts where solder is required and use small diameter silver solder wire. Bring up to heat and just touch the joints with the solder wire, it should run quickly around the joints. I turned my assembly over using tongs and found I needed to apply a little extra solder on two joints on the other side.

When the assembly was cold, all the clamps came away easily and the spacer pushed out - much to my relief! A brisk rub with a wire brush removed most of the discolouration.

A word of caution on clamping: It is tempting to tighten up the nuts very tight, but this can lead to the sliders taking a 'set', as they soften with the heat. Also, when holding the part in the bench vice be careful not to squeeze too hard as, since the bars are curved, they will not resist the pressure of the vice as well as if they were straight.

Ream the slider holes 2 millimetres. Try the two slide bars (Part 69) in place and check that they slide easily, their distance apart is correct, and that they are parallel to each other. A measurement across the slide bars at each end of the crosshead will confirm this.



Slide bars (Part 69)

The slide bars are simple 2mm dia. mild steel rods threaded one end.

Die block (Part 70)

This could be made from a small piece of brass bar using the milling machine, fly cutter and end mill. However, I had a short length of brass bar about the right diameter so, as with the curved bars of the cross head, I turned it to size in the lathe (**photo 112**).

A slitting saw was used to cut out a piece for the die block and another piece for the clamping spacer (used when soldering the crosshead). Finally, a 2.5mm hole needs to be drilled through the centre of the block.

Governor balls (Part 71)

There are a number of ways to provide balls for the governor, such as softening ball bearings and drilling holes in them. But it is most satisfying to machine them yourself and to provide them with a little neck, as used on the full-size prototype.

To machine the balls a ball turning tool can be used, either the up and over or the horizontal type. Without such a device I find the quickest way is to make a form tool in gauge plate and harden and temper it, then you can produce standard balls *ad infinitum*.

Always stone the cutting edge after hardening - the better the

Crosshead after soldering with the clamps still in place.

Turning a ring to make the die block and crosshead clamping piece.

Using a form tool to turn the governor balls.

finish on the tool - the better the finish on the job.

As you feed in the tool some cutting fluid can help. However, I find that when nearing the finished diameter, with by now a broad cut, if cutting oil is still used, the tool will suddenly stop cutting and the metal surface will simply slide on the tool. After wiping off any cutting oil, cutting will begin again. Once the finished diameter has been reached, allow the tool to dwell for a while. The tool will continue to take off a tiny cut producing gossamer swarf and a pretty good finish (**photo 113**).

However good your tool, you will probably need to finish off the surface with some fine abrasive paper to remove tiny tool marks.

To drill the ball, make a brass, top hat-section, collet. The underside of the rim bears against the chuck jaws. The ball goes inside the collet, pushing against the bottom, which is split together with the side of the collet. The jaws compress the collet against the ball to hold it tight (**photo 114**).

If you grip the neck of the ball in the tailstock chuck and then offer it up to the collet, it will be orientated correctly for facing off the boss and for drilling the hole for the arm.

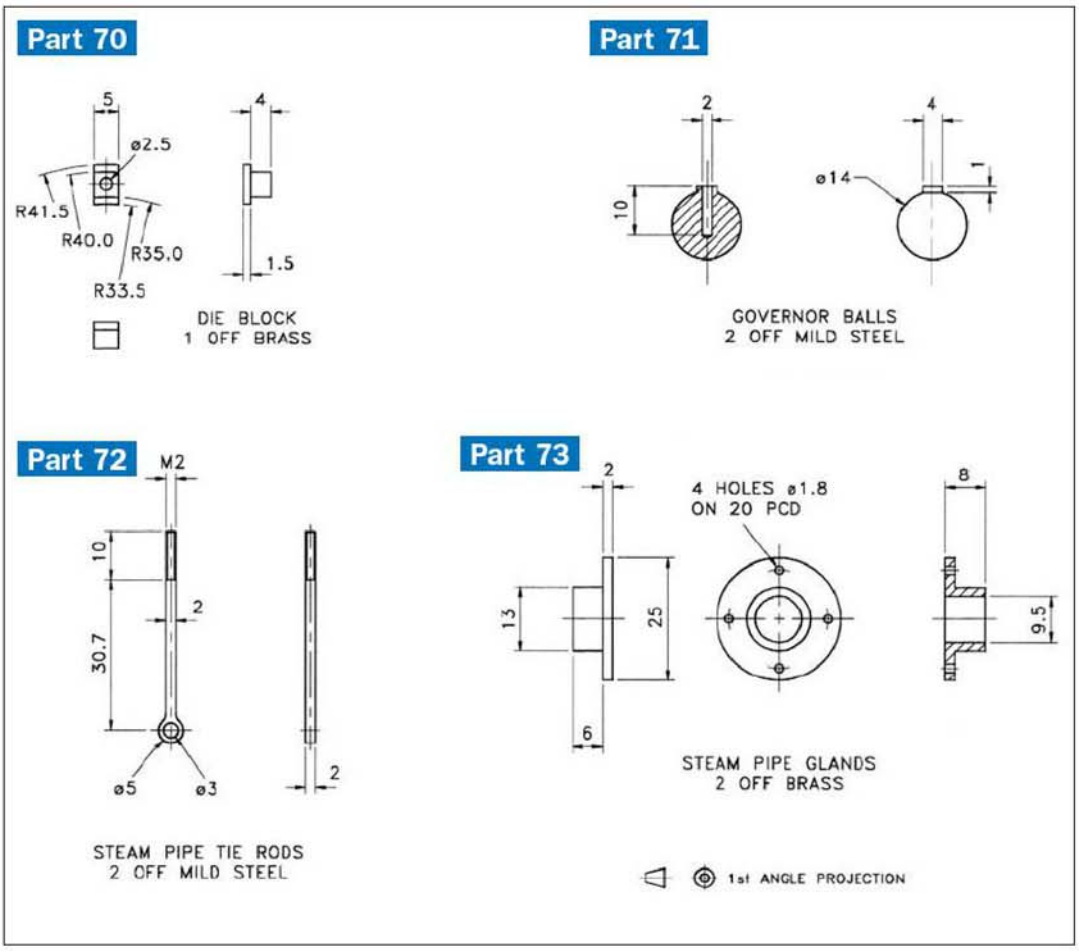
Steam pipe tie rods (Part 72)

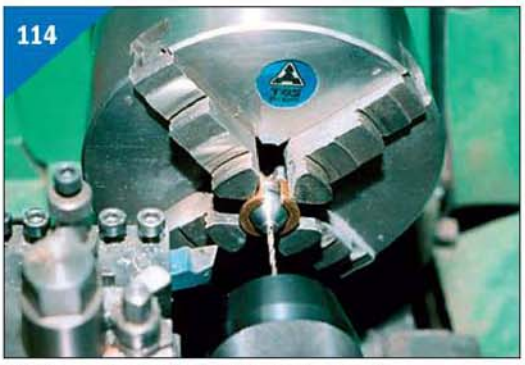
Two tie rods are required to hold the steam pipe elbows at the correct distance from the side frames. Start by drilling the cross-hole and then form the ball end with a form tool. Give tailstock support and turn down the small diameter rod behind the ball (**photo 115**). Finally, part off, re-chuck, and thread the end.

On assembly, two nuts are used either side of the frames to adjust the length of the rods.

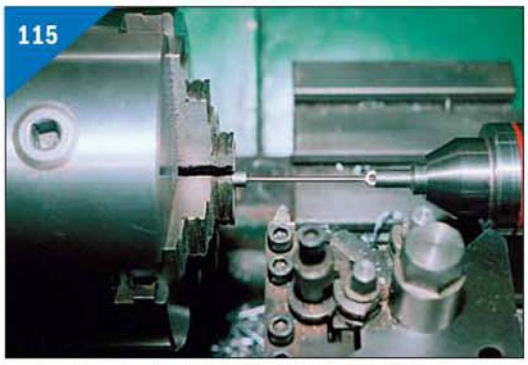
Steam pipe glands (Part 73)

The two steam pipe glands are turned from brass bar. Drill out the hole to be a sliding fit on the pipe and turn down the 13mm dia. to be a close fit in the cylinder pivot ends. Part off and use the dividing head to drill the stud holes.





Holding a governor ball in the 'top hat' collet.



Turning the slender region of a steam pipe tie rod.

Wooden base (Part 74)

The engraving shows the full-sized engine supported on timber bulks, but it may also have been mounted on brick and or stone pedestals. I decided to just mount the model on a polished wooden base - as is my usual practice.

A cut-out is required to clear the bottom end of the cylinder as it rocks. Any quality hardwood can be used, stained and polished to your particular requirements. I would also fit a nameplate, giving a few particulars of the engine and the builder.

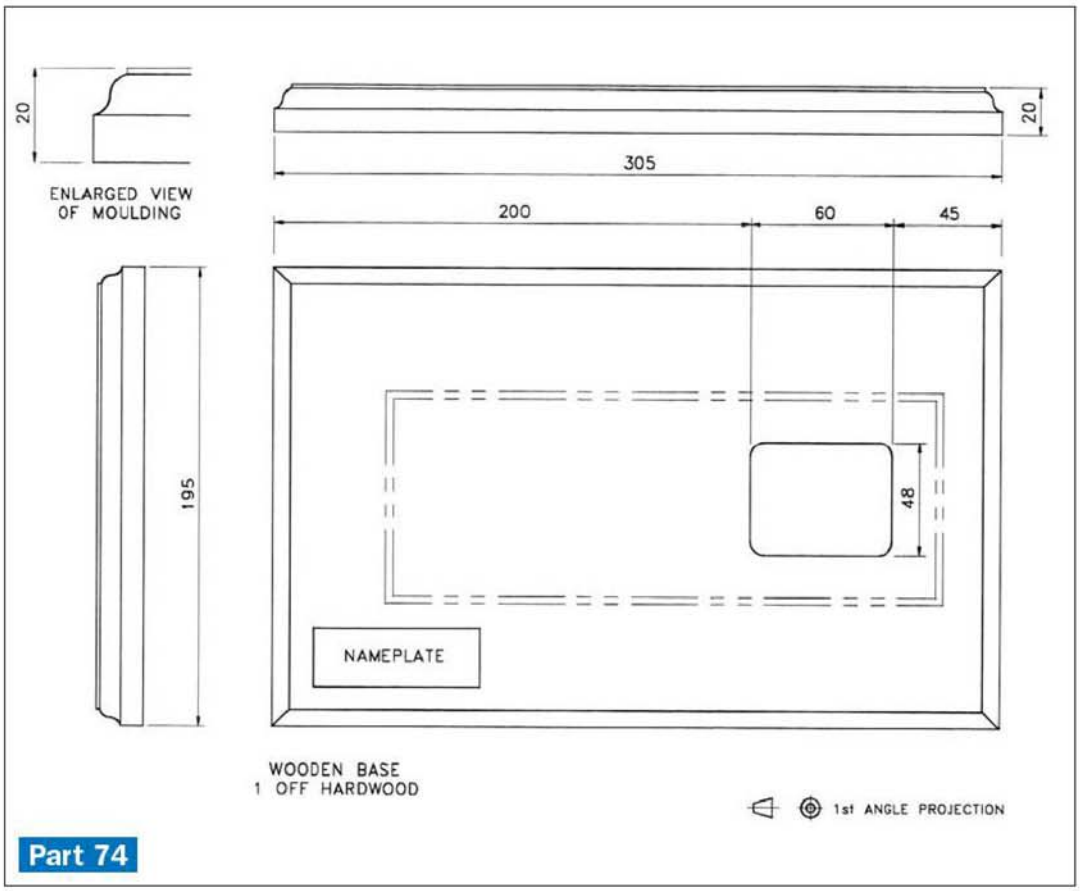
Some model engineers seem to fight shy of using wood. If woodworking is not your forte, look in *Yellow Pages* to see if there is a woodworking shop near you who could make the base - it will only take an off-cut of wood.

If you decide to make your own base, the milling machine can be used to machine the moulding around the edge. The base is clamped to the table and a router cutter used. A slot drill can be used to machine the cut-out and also the recess for the nameplate.

Staining is done using a proprietary water or spirit stain. Bear in mind that water stain can raise the grain of some woods. Several types of polish are available; one of the simplest is sanding sealer followed by a wax polish - use whichever you prefer.

Side frame bearings (Parts 75, 76 and 77)

Fixed to the side frames are bearings for the cylinder pivots (see *M.E.* 4330, 18 July 2008, p. 83). In the full-size engine they were cast integral with the side frames, but for the model it is much easier to make them as separate items. >>



Part 74

The pivots on the cylinders are stainless steel. These need to run in bearings made from a 'dissimilar metal', which in this case is bronze bar. Since we are tight for space, separate shell bearings are not used and the pivots run in imitation shells machined on the bearing blocks themselves.

Start by milling the four parts to their overall finished sizes. As an alternative to milling, the blocks can be turned two at a time in the 4-jaw independent chuck. This would lead us nicely to the next operation: the two caps (part 77), can be set up together in the 4-jaw chuck and a hole drilled and reamed 10mm (**photo 116**). The hole is reamed 10mm initially so that when the mating parts 75 and 76 have been made, and the pairs mounted together in the 4-jaw chuck, if there is any misalignment, the holes can be opened out by boring and reaming to the finished size of 12 millimetres.

As well as drilling the hole, the body is turned down leaving a 14mm dia. ring around the hole. The parts are then reversed in the chuck and the ring on the other side turned - being careful to ensure that the hole runs true.

Parts 75 and 76 can be machined to the same stage, but they will have to be worked on singularly as the holes are not on the edge of the blocks. While the parts are still 'blocked up', it is best to drill the stud holes.

The next job on the bearing caps is to mill one side where the cap sits against the main frames. Take care to hold the cap firmly in the machine vice - even a 6mm end mill imparts considerable force.

Similarly, mill the bearing bodies (parts 75 and 76), to fit against the main frames. Reverse and machine the smaller rebates on the other side.

Hold the caps in the machine vice and mill the 14mm wide tongues (**photo 117**). Do not use big cuts. They are quite small items and it would be a shame to spoil them at this stage.

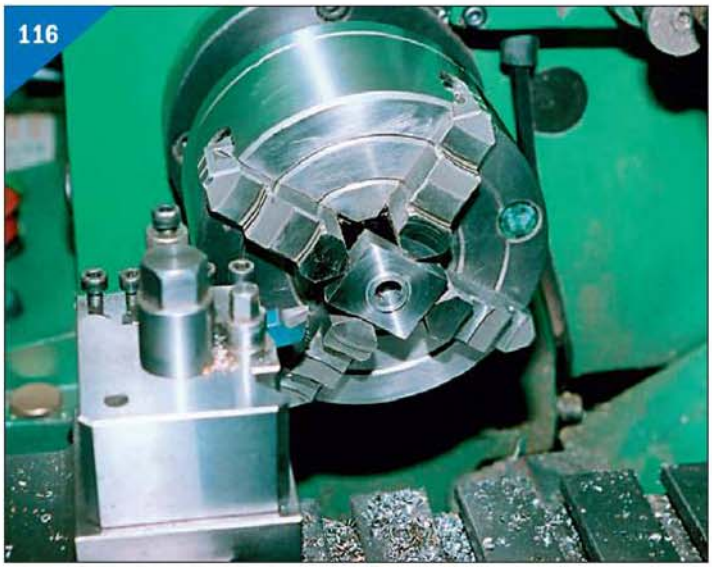
Now mill out the slot in the bearing bodies to receive the tongues of the caps. Make careful measurements of the cap so that the slot is correctly positioned for alignment of the imitation bearing shells - even if this means that the tongue is slightly off centre.

Fit the two parts together and mount in the 4-jaw independent chuck setting the boss or hole to run true. With a small boring tool open out the hole to almost 12mm and finish with a reamer running at a slow speed.

Make up a couple of cup bushes to fit over the bosses on the caps and set up in the 4-jaw chuck again to turn the oil cups (**photo 118**). All that now remains to complete the caps is to round the ends of the stud flanges.

There is still more work to do on the bodies. For this the rotary table needs to be used with a 12mm locating spigot in the middle. Also needed is a 14mm dia. cup washer to go over the spigot and clamp the body down to the rotary table. A sacrificial washer is placed on the table to raise the bearing body and protect the rotary table surface from the cutter.

The side of an end mill can now be used to form the curve of the body (**photo 119**). This is semicircular for Part 76. Also semicircular is Part 75, but with straight side wings. It



Turning the imitation bearing shells of the bearing caps.

Milling the tongue of a bearing cap.

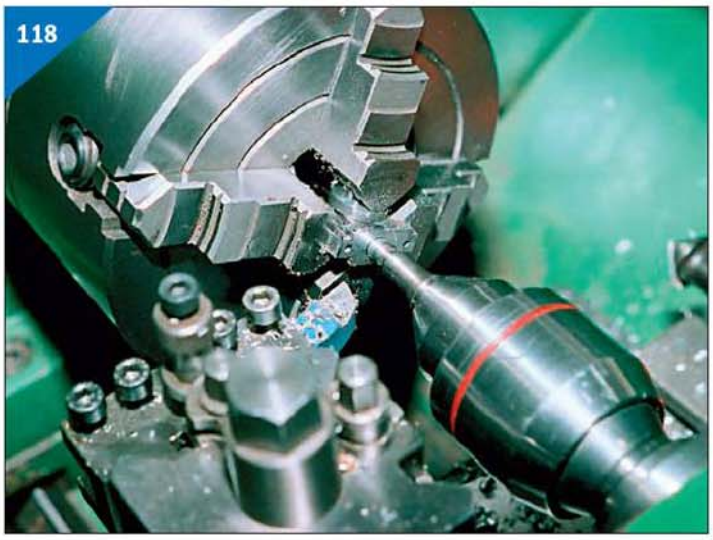
is easier to machine the side wings before the bottom radii because the part is easier to clamp and the slots thus formed provide an indication of the finishing positions of the ends of the curve.

The bearings can now be fitted to the side frames. You will see that at a few locations the bead around the edge of the frames needs to be cut away for the bearing to sit flat. Also, on the other side of the frame, just the ends of the bead at the cut-out for the bearing need to be removed. This is so that on assembly, the cylinder can slide into the bearings without fouling the ends of the bead.

To fix the bearings into the slide frames I decided to forgo silver-soldering and use Araldite glue, with a couple of screws fitted flush into counterbored holes in the frame. The bearings were clamped into position on the frames and the holes spotted though into the bearings. They were then drilled and tapped 8BA.

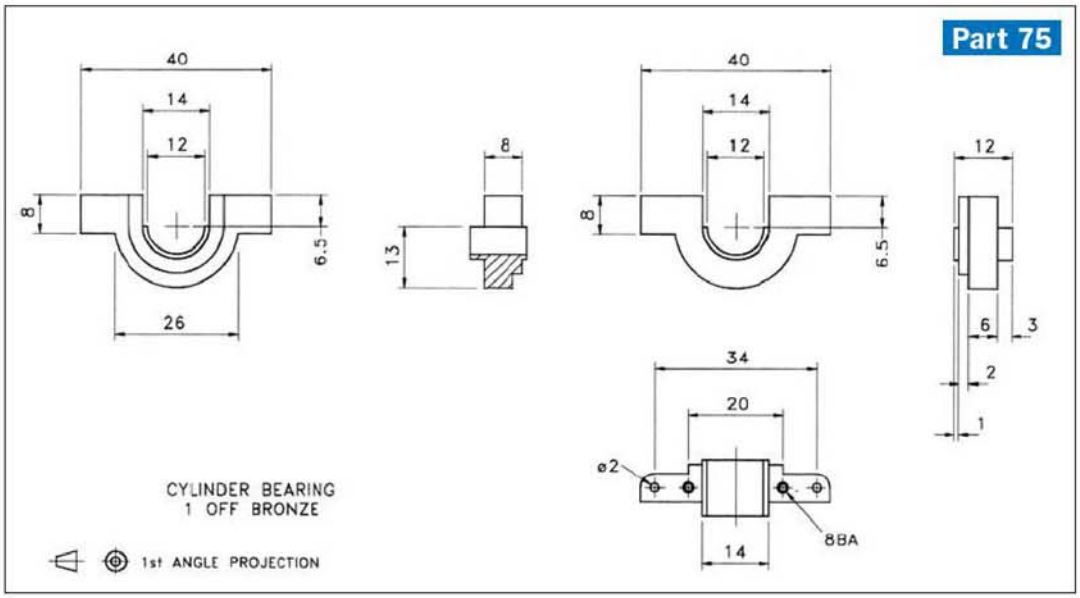
After assembly, the heads of the fixing screws were covered with epoxy filler and, when dry, rubbed down flush with the frames. After painting, the screws are invisible.

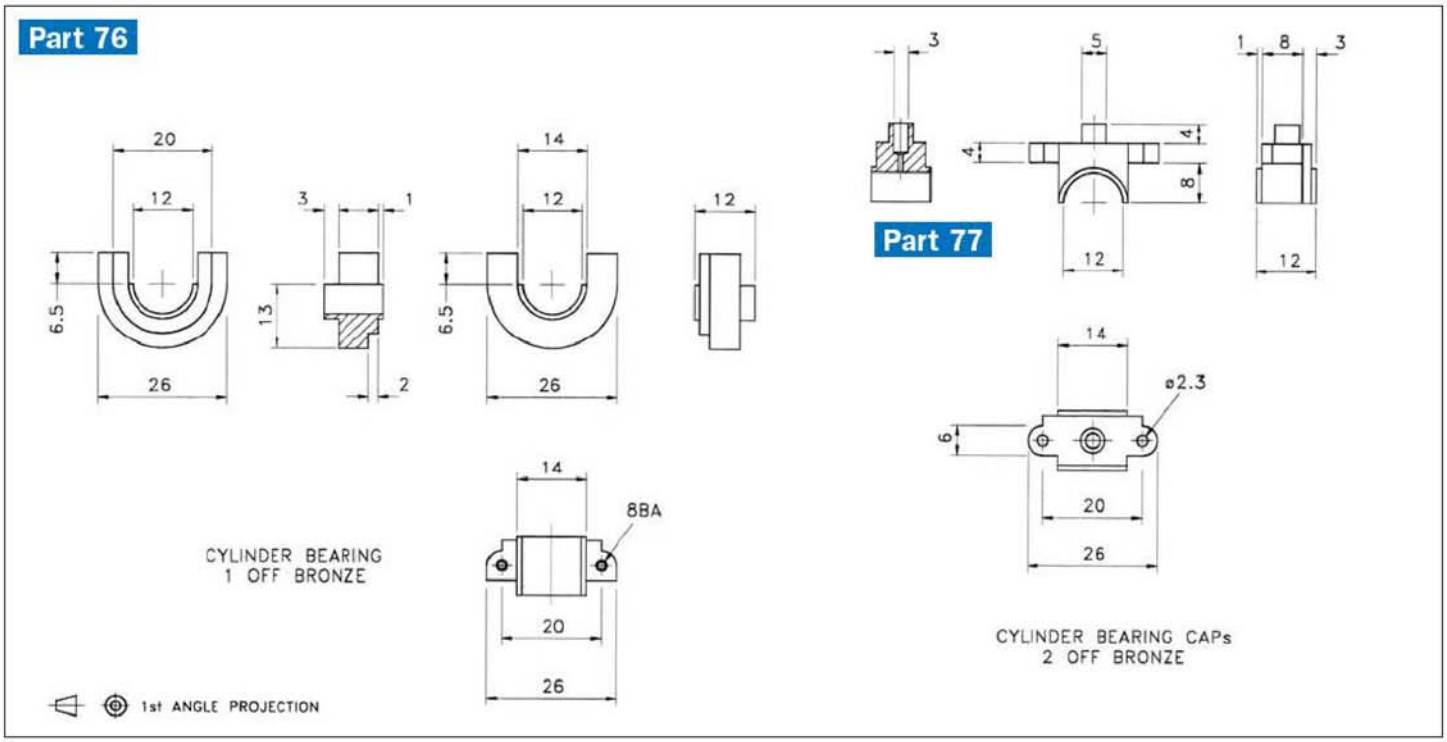
To be continued.



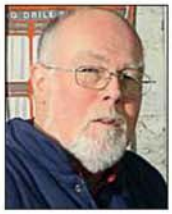
Turning the oil cups of the bearing caps.

Milling the curve of a bearing body.





The Re-Cycle Engine



DAVE FENNER

Dave Fenner finishes the bearing housings, covers the cylinder stanchion and starts the main crank assembly.

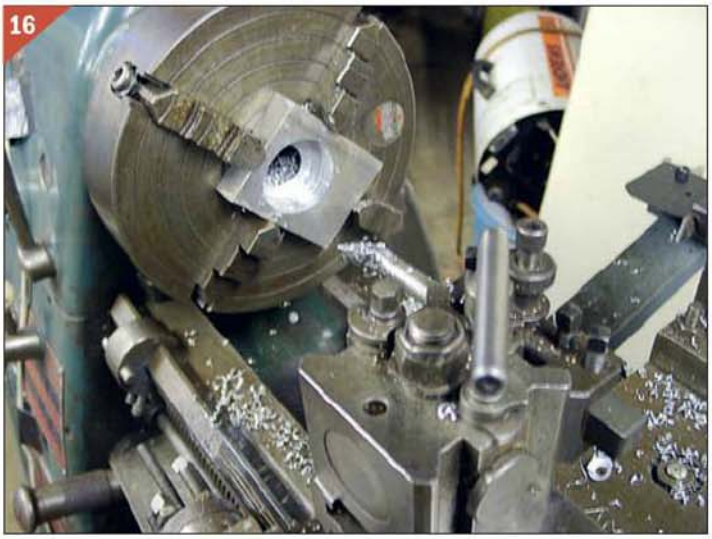
PART 3

Continued from page 280 (M.E. 4346, 27 February 2009)

The bearing housings can now be machined in the lathe to create the bearing locations. **Photograph 16** shows one of these after centering up (done by locating a Morse taper centre between the drilled 10mm hole and the tailstock centre, then checking with a DTI) in the 4-jaw chuck and boring to diameter and depth. A close fit to the bearing is required, and as the size is approached, it may be useful to take one or two extra passes at the same setting to compensate for any spring in the boring tool.

As regards the slave housing, note that the shaft centreline spacing is 1in. (25.4mm) to suit the gears. If achieving this dimension accurately is a problem, then a few thou. over will be okay, but do not make it less or the gear sizes will need adjustment. Here, I chose to bore the two bearing locations on the mill, using a boring head made about 30 years ago (**photo 17**). The bores are taken right through, and the bearings would be fitted later from each side, retention being by the use of Loctite. You may wish to include a spacer between each pair of bearings, in which case, the spacers may be turned as thin walled items, a little smaller in O/D than the bearings, with a length to bring the bearings flush with the outside faces of the housing. **Photograph 18** shows one of the main housings along with that for the slave shaft with its bearings in place.

16

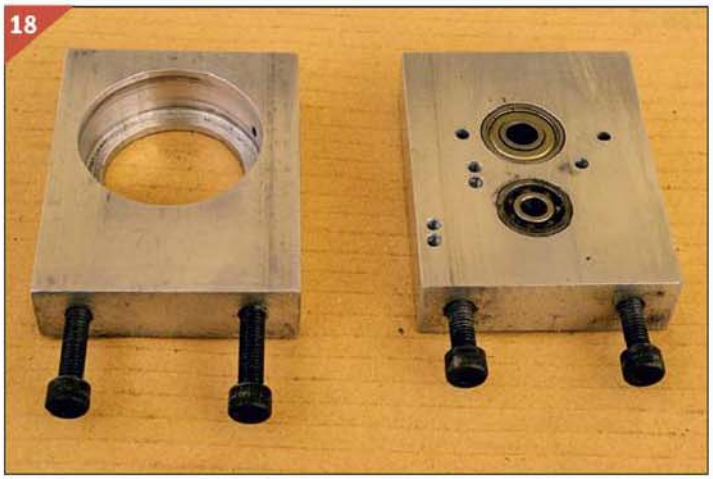


Work held in a 4-jaw chuck to bore main bearing housing.

17

Boring bearing locations for slave shaft and camshaft.

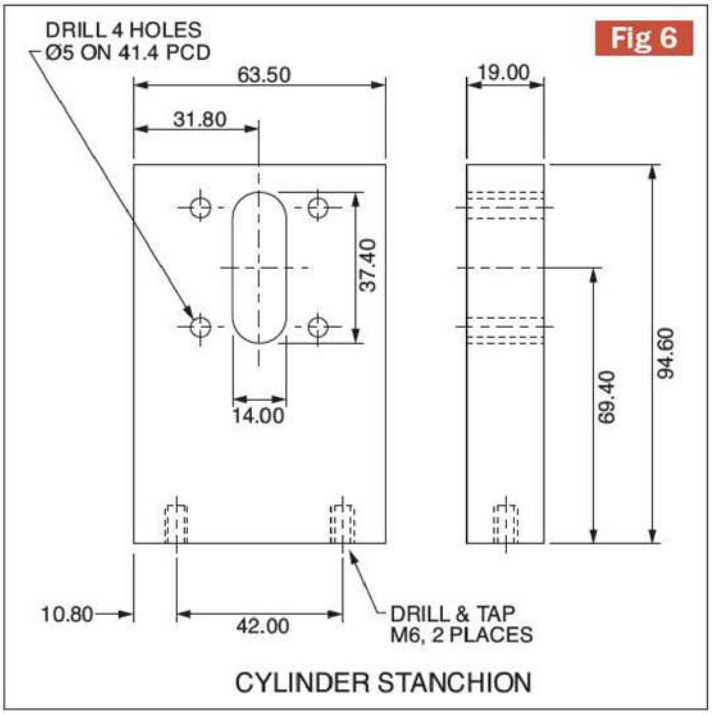
18



Main bearing housing (left), slave housing (right).

Cylinder stanchion

Again the material used is the 63.5 x 19mm aluminium flat bar (**fig 6**). This time all the work is undertaken on the mill. The essential features, which need to accurately placed, are the four 5mm dia holes on a 41.4mm pcd for the cylinder studs and the two M6 holes for attachment to the main base. I have given dimensions for the slot as 14 wide by 37.4mm high, these being measured from mine as made. It should, however, be noted that this is just clearance for the connecting rod and mine was finished by hand after assembly. **Photograph 19** shows slot



milling in progress. I would suggest that the slot be cut to the dimensions given, then checked and filed, if necessary once assembly is under way.

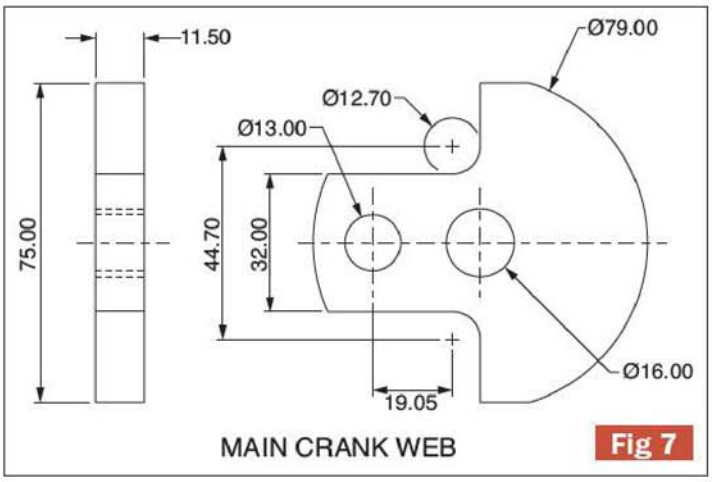
Photograph 20 shows the components made thus far, loosely assembled, and it may be observed that the steel base has now been treated to a coat of paint in an effort to make it just a little more photogenic.

Reinforcing yoke

This is probably a good time to add the reinforcing yoke as shown in **photo 21**. I made this from strips of bright steel flat bar, sawn, filed, drilled, attached and then tack welded on the job prior to fully welding on the bench. If you do not have welding facilities, then you may choose to go for a silver-soldered or bolted arrangement. I used countersunk Allen screws as these give a more positive positional location, without the added complication of dowels. These alternative production methods will probably mean that it is better to fit to the job (positioning the drilled and tapped attachment holes) after silver-soldering or initial bolting. The yoke has not been drawn, but the bars used would be one at 6 thick by about 25mm wide, and two at 8 thick by roughly 19mm in width. The part is shown placed in position with its countersunk screws, in **photo 22**. As may be seen from the photos, some sawing and profiling may be needed to clear the screw heads, and in due course, the lubricator.

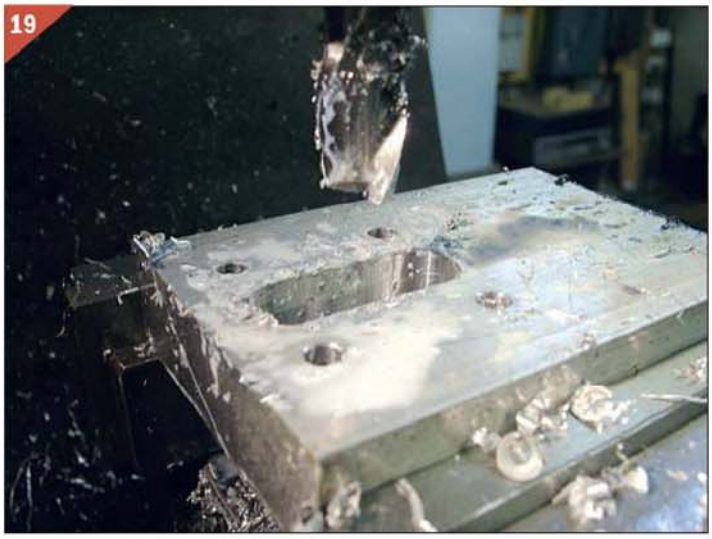
Main crank

The raw material used for both webs was a length of 75 x 12mm black steel flat bar. After completing the basic operations, these two parts were cleaned up by giving a lick on the surface grinder, reducing the thickness of each to 11.5 millimetres. It is unlikely that you will have one of these in the typical amateur workshop, so I suggest cleaning up either on the mill, or using bright bar and adjusting the main shaft shoulder location and nylon bush size, to accommodate material supplied to 12mm thickness.

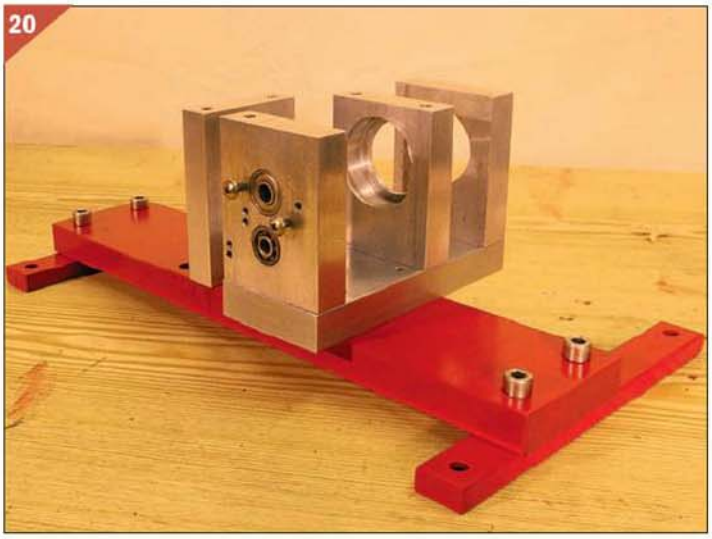


MAIN CRANK WEB **Fig 7**

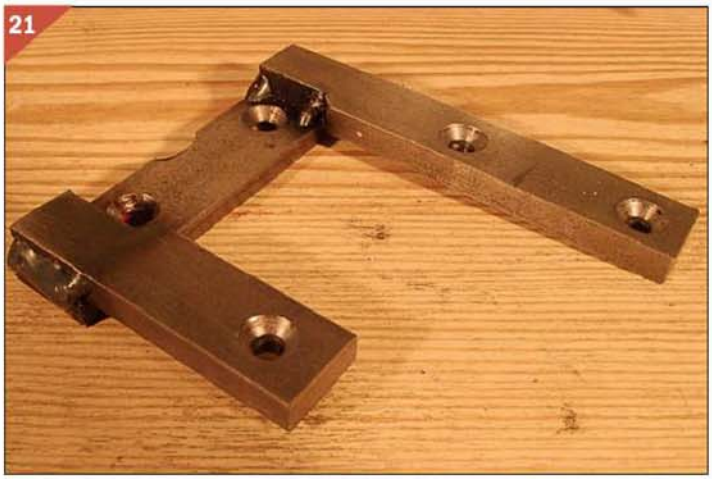
After sawing to the approximate length, the blank for the main web (**fig 7**) was set up in the mill (**photo 23**) and four holes drilled, one was drilled 13 and later opened up and reamed out to 16mm in the centre, one is 13mm dia. for the crankpin, and two are 12.7mm (½in. dia.) which form fillet radii for the counterbalance ≫


19

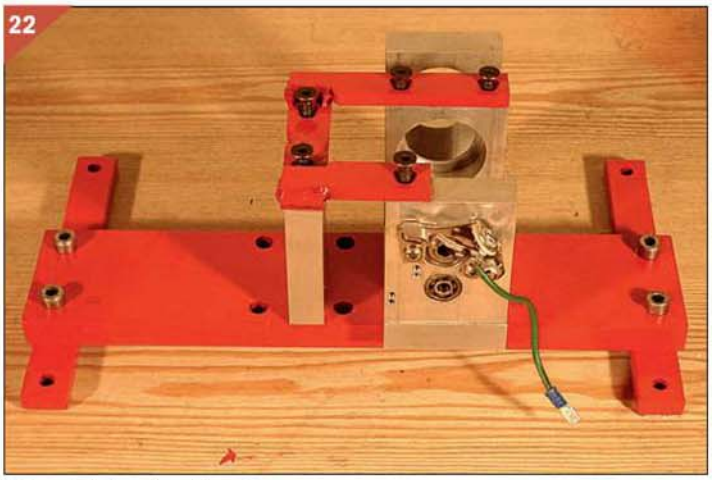
Milling slot in cylinder stanchion.


20

Principal structural parts built up.

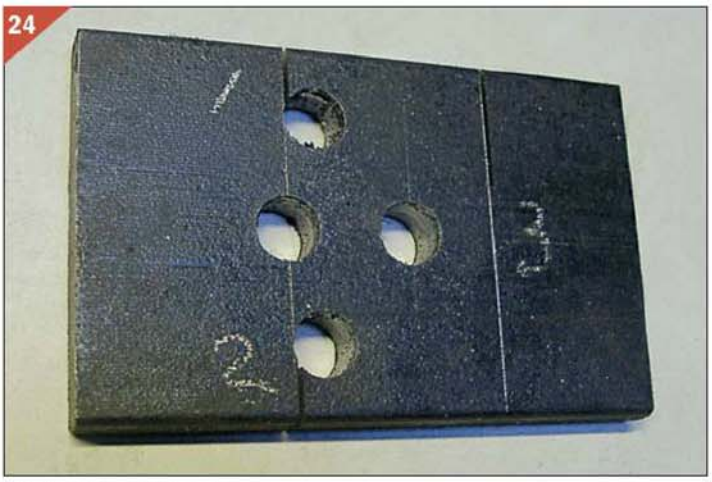

21

Reinforcing yoke made as a welded fabrication.


22

Yoke painted and positioned.

Starting work on the first crank web.



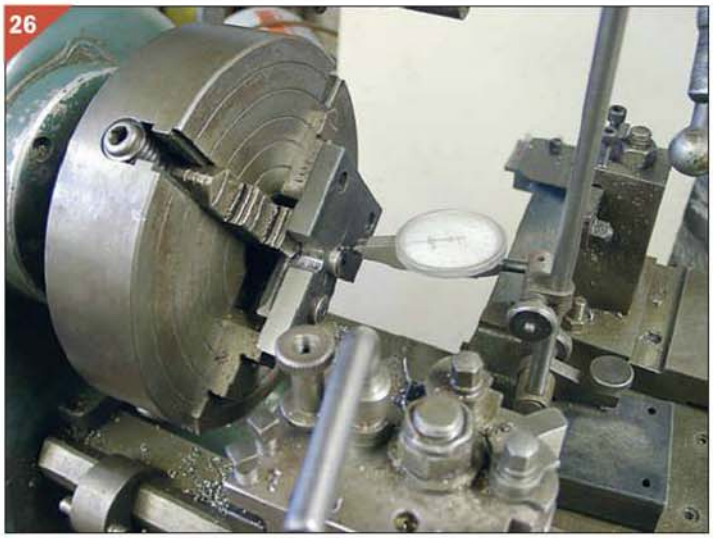
Initial sawing on the web.

feature. The drilled plate was then attacked with a hacksaw to remove the areas on each side of the crankpin position. The initial saw cuts may be seen in **photo 24**.

A small fixture was then made, as shown in **photo 25**. This has two buttons pitched at 1in., their relative diameters being chosen to match the holes in the web. I believe that fixing by countersunk screws gives a more accurate location. The web was bolted to the fixture which could then be held in the 4-jaw chuck, to turn the outside diameter. To ensure squareness, the work was pushed back to contact the jaws. The outer end of the central button could be touched with a DTI to enable centering, (**photo 26**). Turning could then proceed as seen in **photo 27**, cutting being stopped a few thou. short of the chuck jaws, leaving a thin sliver to be removed by filing afterwards. The web, still on its fixture, was then transferred to the mill (**photo 28**) where the counterbalance cut outs were tidied up, after which it was back to the lathe, where, gripped now in the 3-jaw, the central hole was opened up and reamed out to 16mm (**photo 29**). If you decide to deal with the flywheel next, then when it comes to turning the main shaft, you have both the mating parts to check against.

My original intention was to use a 9in. dia. cast iron flywheel, but when looked at in perspective, this seemed a little on the large side, so a slice

Fixture to hold web.



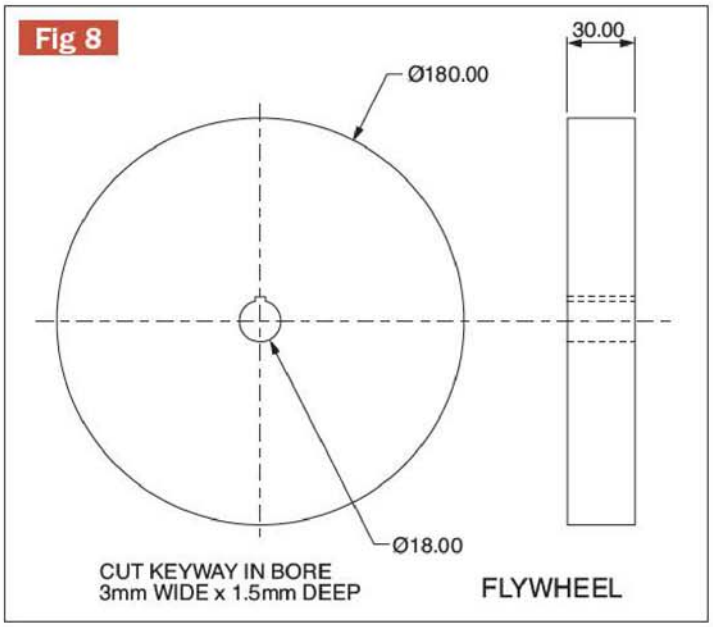
Work is centred by reference to the button.

Turning the outside diameter of the web.

Web is back on the mill to clean up the profile.

Main web is reamed to 16mm bore.

No fancy profile; just cleaned up.

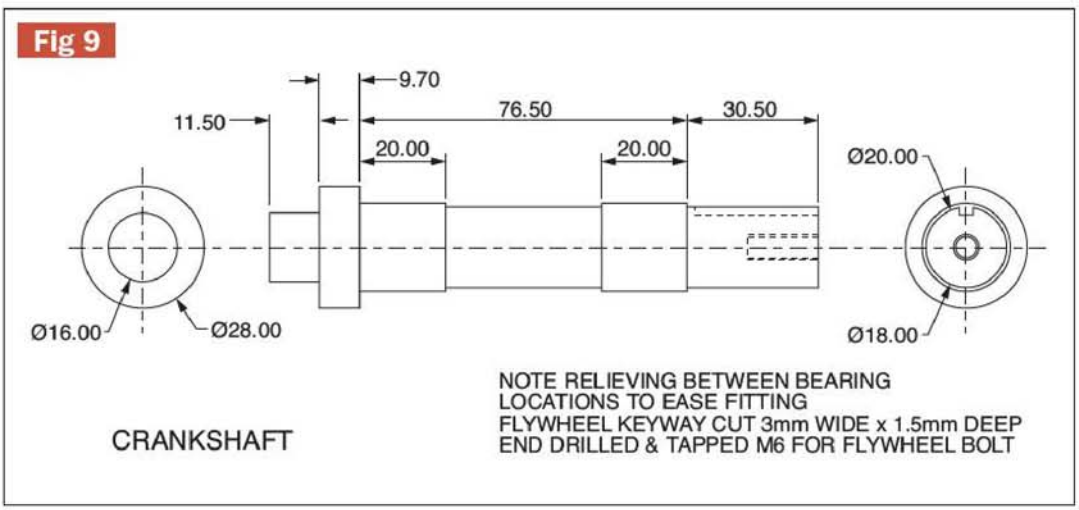


Diameter between bearings is slightly reduced to make fitting easier.

of steel approximately some 7in. or 180mm in diameter was liberated from the scrap box. No effort was expended in turning a fancy profile; it was just cleaned up, drilled, and bored to 18mm diameter. **Photograph 30** and **fig 8** give the general form.

The main crankshaft component (**fig 9**) is a relatively straightforward turning exercise, which I chose to do between centres as this would ensure concentricity of all the essential features, whilst also allowing the work to be removed from the machine to check against the mating parts. **Photograph 31** shows this at an intermediate stage, where a Greenwood Tools profiling tool is being used to marginally reduce the diameter between the bearing locations, so that sliding on the inner bearing would become an easier operation later in proceedings.

●*To be continued.*



KEITH'S COLUMN

KEITH WILSON

Keith Wilson talks about dies, sanding gear and oil pumps.

WILSON'S WORDS OF WISDOM

The trouble is that people WILL take Authority to be Truth, whereas they should take Truth for Authority.

Francis Bacon
(believed to be eldest son of Queen Elizabeth I)

I am glad to mention that my *GWRILLIAN* boiler has turned out okay (**photo 1**) and I can continue with the building. It is always a relief to get a boiler officially approved; especially when it is so big. I made a minor error in plate thickness (darned Metric system) and all the barrel and firebox plates are thicker than I planned. I designed for 4mm copper, but due to the error, barrel and wrappers are 5 millimetres. This pushes the barrel safety factor up to 12.5, so a) I could work with higher boiler pressure and b) it will give plenty of adhesive weight. This latter has some importance, but is not necessarily vital.

I recall a certain contest (c.1924) when a certain 4-4-2 beat another 2.5in. gauge 2-8-2 (or was it 2-8-0) with heavy lead blocks under the running plates, hauling a driver some 4-stone lighter then the 4-4-2's driver. A bit of oil on the rails (usually at departure point in the station) or a light amount of rain and any engine will slip. There is also the problem of grass-cutting and falling leaves especially on up gradients (Sod's Law). A small amount of rain merely 'muddifies' the almost invisible layer of dust on the rails; whereas a good shower, annoying though it might be to crews, will wash this mud away, allowing - or causing - better adhesion.

Although working sanding gear is quite possible in our sizes, there are two important matters to be considered. One is that the distance from rail-top to main axle bearings is so much less (about ⅛ of full-size) so that sand can get easily to the place where it's wanted least. The other - oddly enough - is our old friend the square-cube law which states that retaining the same shape reduces the relevant quantity of sand in its box, and therefore only about 1:475 of full-size capacity is available. Mark Bedford's letter (*M.E.* 4335, 26 September 2008) reminds me that several years ago we visited North West America. In the museum in Seattle there was a duplicate copy of the *Titanic*'s whistles/hooters. I would love to have heard them - probably from a safe distance - but no luck! As far as memory goes there are one or two other copies in existence, possibly from the *Olympic* or the *Britannic*.

It was on this trip that we went right down into the South-East corner of Oregon (Chiloquin is the town) to visit Train Mountain, written up in 'ours' some years ago. I was talking to someone (back in Blighty!) about Train Mountain and he asked me if I had read the article concerned. "Read it? I wrote it!" Incidentally, if you have Google Earth on your computer (it is free) you might enjoy the satellite views of Train Mountain.

We had a telephone call from Pennsylvania about a week after we got back and already the news had spread. "I hear you have visited Train Mountain." I do not know off-hand the distance from Train Mountain (Oregon) to Pennsylvania, but it must be about the 2,500 mile mark.

Richard Clifton's *Postbag* letter (*M.E.* 4335, 26 September 2008) on the subject of Paternoster lifts recalls a memory of some 44 years ago, when I attended an interview in Acton, just west of London.

There was a Paternoster lift (I believe it translates to 'Our Father') in operation with the warning "all visitors must be accompanied by a member of staff when using these lifts". There were some of these lifts in other parts of London I believe.

If and when a newcomer was in the firm and noticed the lifts, on occasions a more experienced person would enter the upward side lift at the top floor, directly he was out of sight he would stand on his head when the lift came down, producing some astonishment or temporary consternation!

'Perfection at its best'

About 40 years ago I was asked to sort out a 7¼in. 'George the Fifth'. On removing the boiler from the chassis, I discovered that the steel ashpan was bolted to the foundation ring of the boiler proper. Ugh! The state of the ashpan left somewhat to be desired, but when I had unbolted it a 'spare' fire grate was in the ashpan, together with quite a lot of ash, all a bit soggy with condensation. No wonder steaming was not as it should be.

The locomotive owner told me that he didn't know much about steam locomotives, but then he took me into his workshop and showed me his work on carriages - two LMS carriages. I am not prepared to swear that the toilet rolls had scale perforations, but would not be in the least surprised if they had. The interiors defied description - the words brilliant, magnificent come to mind.

The carriages were 7¼in. gauge, and superb is understating the case. Although not too familiar with rolling

1

"Ain't no such things as skyhooks. Oh yeah?

stock in general - apart perhaps for GWR Toads - I certainly would take some convincing that they were not 'perfection at its best'.

This reminds me of something I noticed years ago. Magnificent as some 'competition' entries are, you will often find even better work on individual club stands. Some years ago when I was 'shanghaied' into being one of three judges at an exhibition, we were so impressed by a locomotive that was immaculate but not entered that we awarded it a well-deserved prize.

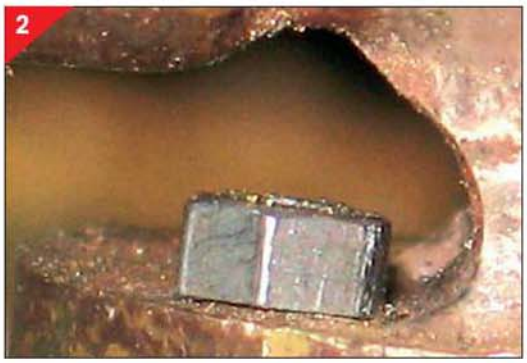
We had great difficulty in deciding which of the two top locomotives should be given the top prize. Eventually we decided to look for the slightest apparent flaw and found a very tiny mar indeed. That was the occasion when one of the judges insisted on being anonymous, and another was carefully ill, leaving me to award everything. That made twice that I was a judge - the first time and the last!

Material sizes

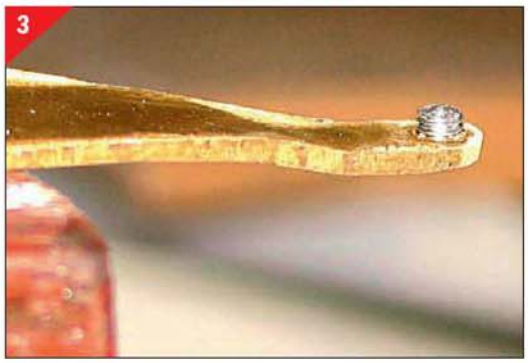
I have just learnt something new to me, information via a metal supplier and Alan Howarth - a Leyland club member.

In view mainly of the very high cost of new dies (drawing type, not thread type) there are what might well be called crossover points. If, for example, you order ⅛in. dia. silver steel, you might very well get 3 millimetres. Now ⅛ is 0.125in. and 3mm is 0.118in., the difference being only just under 7 thou. so it is quite easy to miss. In the same way, you might get the nearest Imperial size when ordering metric, or vice versa. 5/16in. is very close to 8mm and ⅝in. is just under 16mm (about 0.005in. difference).

Sometimes this can be very useful, sometimes not. To give an example of not, in making a batch of four Kings a few years ago, I used (without realising it at the time) 3mm with ⅛in. non-return clutches for the lubricator drives. Result: - lots of backlash, which I did not understand at the time. I carefully gave the lever a lot more travel than necessary. Unfortunately, this led to excessive wear despite hardening and the drives packed up after a few months' operation. Some owners replaced the drive with ratchet wheels as per LBSC type, but there is a potential snag with this system to the effect that missing just one tooth cattles up the system, once again rendering the system useless. It is by no means easy to adjust so that it is dead reliable.



Nut in place.



Insertion tool.

After learning of the matter two paragraphs ago, I checked all my stock of ⅛in. silver steel and found three lengths of 3mm and just one of ⅛ inch. Having got some clutches in stock, I checked them with the silver steel, finding that the 3mm had lots of backlash whereas the operation using the ⅛in. piece worked perfectly.

It so happens that the shaft used with these clutches must be dead hard, and therefore very brittle. If you drop just the shaft onto a hard floor, it can break easily. Another matter is the thread on the outside to prevent the lever working its way off the end, and also for a knurled knob in order that a bit of pumping can be done by hand as occasionally it is very helpful. It follows that the less stress the better.

This can be done with two actions. One is to tap the outer end 6BA and after hardening, screw in a stub of 6BA screwed rod (mild steel of course) and the other is to harden only just enough length to go through both clutches.

With the clutch drive, no way can a tooth be missed; there is no difficulty in adjusting it to get 'just one tooth' operating.

Whilst on the subject of oil pumps, Jack Shilling's *Postbag* letter (*M.E.* 4335, 26 September 2008) on the Ewins lubricator shows a fatal flaw in reasoning. There is no possibility of a hydraulic lock on the upstroke for the maximum force available for the possibility of locking is atmospheric pressure only. On a ram ⅛in. dia. this amounts to 0.875oz. There is nothing that can lock the pump as the ram moves upwards. A near vacuum is formed as the ram moves upwards; once it uncovers the feed ports oil will be sucked in - or rather pushed in by atmospheric pressure. A close comparison is the discovery of atmospheric pressure. A chap named Torricelli - not sure of the precise spelling - filled a one-end-sealed glass tube with mercury then inverted it keeping the open end under mercury. To his surprise, only a little mercury fell out leaving the height of the contents at about 30in. above the mercury-in-bowl surface (762mm) In tribute to him, the volume above the 'tube' mercury is called a Torricellian vacuum.

The Ewins pump works perfectly. "The greatest danger of saying that something is impossible is that you might be interrupted by someone doing it".

This reminds me of an article in a private journal refuting a semi-automatic points-changer, which if run through in the trailing direction against the points, the changer automatically changed the points and locked them in the new position. "It will not work" was the claim in the refuting article. In point of fact it had been working perfectly for about 18 months on a semi-commercial railway. I witnessed its working on site.

A nut fitting tip

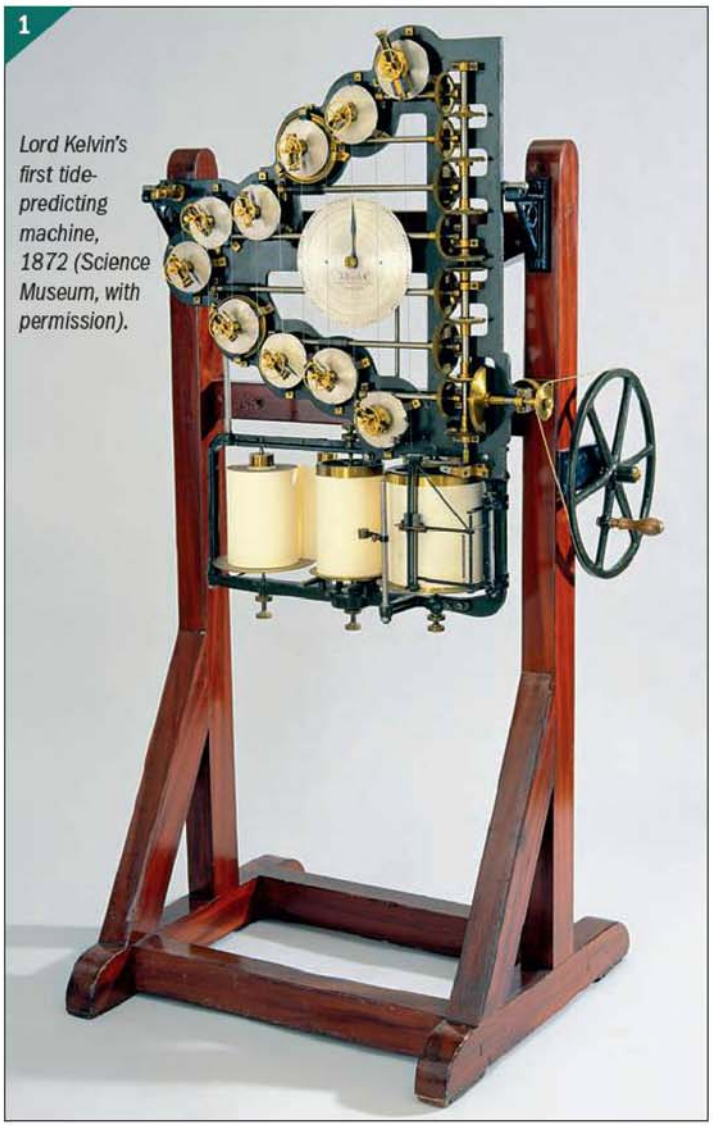
On assembling, especially a 'true to scale' model, there arises frequent problems of getting a nut onto its stud. If the stud points towards you - in other words if the stud were much longer it would have to go right through something else, the easiest way is either to use a box spanner, or a piece of metal with a couple of threads on the end even if it has to be kinked to line up. The nut is put on the far end, and can be 'twiddled' around with the point of a scriber and finally tightened with a spanner.

If, however, this cannot be used due to covering of the stud by a fitting (**photo 2**) then the device shown in **photo 3** can succeed. The size of the nut is 5BA and the 'handle' is an odd bit of scrap brass (18swg) rescued from the scrap box.

The fitting is the driver's brake valve on *GWRILLIAN* being fitted to the boiler, hence the use of a steel stud and nut - on final assembly after painting they will be replaced by a bronze stud and brass nut.

The tool to place the nut is made by tapping a hole in the end of a piece of metal and screwing a screw into it so that about two threads are protruding (photo 3). In my case I set the screw in with Loctite 601 and when it was set cleaned the head off flush on the linisher. It was also needful to trim the tool tip for narrowness. It was still tricky to get the nut on, but at least it was possible. **ME**

Tide Clock



1

Lord Kelvin's first tide-predicting machine, 1872 (Science Museum, with permission).

ROGER CASTLE-SMITH

Roger Castle-Smith airs some ideas for the design of a tide clock.

My first clock, a Synchronome, was made during the school holidays almost 60 years ago. Moving around in the army with the Royal Signals, and a busy second career as Chief Engineer (communications) with the Foreign and Commonwealth Office precluded any serious workshop activity until after retirement in 2000 when my interest in horology was revived. I completed a clock that was loosely based on the Murday battery clock (**ref 1**). I am in the process of making a Shortt clock and, while doing this, I am sketching out ideas for my next project namely: to design and make a tide clock. This choice arose out of my enjoyment of sailing and I was also inspired by an article serialised in the *Horological Journal* (**ref 2**).

For those not familiar with tidal matters, I will introduce a few salient facts, although the subject is complex. However, they should be sufficient to enable readers to understand the background to my ideas.

Main tidal influences

Roughly two-thirds of tidal motion is due to the gravitational influence of the moon and one third due to the sun, although there are many other smaller influences with different periods. Centrifugal forces also come into the picture. A twice-daily influence, due to the moon's gravity, is known as the M2 tide and likewise S2 for the sun. The M2 tide has 57 high water peaks every lunar month and S2 has 59. It is the beating together of these two components when they are added which produces so called Spring and Neap tides. The rise and fall of the tide at Springs is greater than that at Neaps. Spring tides occur, on average, about two days after full or new moon at about fortnightly intervals. The two-day delay is known as 'the age of the tide'. Exceptional tidal forces occur around the Vernal and Autumn equinoxes, in March/April and September/October respectively, due to the alignment of the Moon and Sun. At these times the Spring tides are significantly greater than at other times.

Other tidal influences

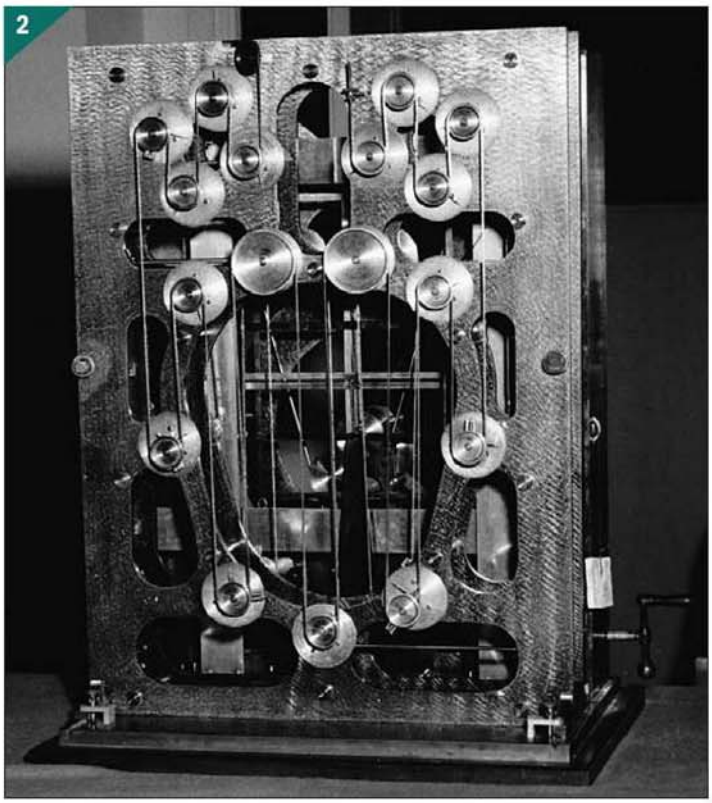
The rise and fall of the tide follows a height/time curve which is approximately sinusoidal for many places - but is not always the case. Southampton is a classic example that has a so-called double high water. After the first high water, the level goes down just a little and then rises again, before falling rapidly to low water. Elsewhere, there may be a stand at high water during which time the level remains almost static. Conversely, some places exhibit a double low water or a stand at low water.

It is tempting to think that the double high water at Southampton is something to do with the fact that there are two entrances to Southampton water around the northern coast of the Isle of Wight - but this is not the case. It is due to the effects of a so called shallow water tide that distorts the effects of the M2 and S2 astronomical tide components. The Hydrographic Office notes that this probably starts somewhere off Start Point, which first shows up as a double low water at Portland and then as a double high water at Southampton.

In addition to the M2 and S2 twice-daily components, the next most significant ones, at least in UK waters, are the once daily K1 and 01 components which are related, between them, to the declination of the sun and moon relative to the earth's equatorial plane. This is far from the end of the story as other components known as N2, M4, P1 and K2 come into the picture to a greater or lesser extent. For example, the time taken for the moon to travel between each perigee, that is its closest approach to earth, is one of the factors. It will be gathered from all of this that the factors that influence the rise and fall of the tide are far from simple.

Harmonic components

The relative phase and amplitudes of each tidal component are not the same for each place and the period of all components is not always the same. Most readers will know that any graphical curve can be made by adding together simple harmonic components. One way to predict the tide a long time ahead, for a particular place, is to measure the tide height at frequent intervals



First tide-predicting machine used in the USA, designed by William Ferrel and completed in 1882.

over a long time and then break down the resulting curve into its harmonic components. It is these components that can be used for long-term predictions. Obtaining figures, which are good enough for accurate predictions, is complicated by the fact that, for example, abnormal barometric conditions and wind can significantly affect the height of the tide. Even if totally accurate figures could be obtained, they would have a limited life as local conditions and other factors can change. It is for this reason that the Hydrographic Office limits its prediction to 50 years.

There are many mechanical clocks of yesteryear, typically grandfather clocks, which depict the rise and fall of the tide by means of a ship rising and falling against a painted sea background. These only crudely approximate the real world because they almost always just take into account the moon's M2 tide and assume a sinusoidal rise and fall. For the unwary, modern clocks and watches are available that only use the M2 tide. These can give errors in the time of high water of at least an hour or so.

Early developments

Taking a step back in time: in 1872 Lord Kelvin invented a tide predictor (often spelt predicter), which took into account several sinusoidal components. These, when summed, gave a tide rise and fall curve as shown in **fig 1**. In this figure, just the M2 and S2 components are taken into account. The summing of them is accomplished by means of a cord running over pulleys, the operation of which is clear from the figure. The principle can be extended to include many more components. The ratio of the gears on the hand driven time input shaft, at the bottom, determines the frequency of each component. An arrangement on the driven gear of each pair allows amplitude and initial phase settings, relative to a datum, to be adjusted. Kelvin's first tide-predicting machine (**photo 1**), is now in the Science Museum. **Photograph 2** shows the first tide-predicting machine that was used in the USA. It was designed by William Ferrel and completed in 1882. It summed up to 19 harmonic tidal components. Finally, it is worth mentioning a Kelvin tide-predicting machine of the German Hydrographic Institute which was massive at some 2.7m long and could sum up to 62 tidal components.

The essential difference between a tide clock and tide predictor is that the former just indicates the current state of the tide, and possibly the time to the next high tide, while a predictor has a means of recording what will happen to the tide beyond the current time. So, there is no reason why the tide clock, which I am proposing to design and construct, should not simply follow the predictor principle shown in fig 1 but with the input handle driven by a clock.

Practical considerations

It will be evident from the above theory that a large number of components need to be summed for those places with a complicated tidal curve. Furthermore, beyond the M2 and S2 components, there is the added difficulty that the period of some of the sinusoidal components are not related by a convenient ratio. This is an aspect that I am studying in some detail, as a lot of extra complexity will only lead to a marginal increase in prediction accuracy. My intention is to include M2, S2, K1 and O1 but how far to go beyond that, if at all, remains to be determined.

My idea is that it would be nice to make a clock which is truly universal in that it would be possible to enter each tidal component; this would need a dial, or similar means, to input amplitude, phase and frequency. Arranging for variable amplitude and phase is not difficult but obtaining sufficiently accurate gear ratios, without too much complexity, is another matter. Details of tidal components for 400 ports in the UK are available in Admiralty Tide Tables.

The authors of ref 1 give some very neat ideas for generating and combining components by means of gears. However, I propose to use the Kelvin method with pulleys, as I feel that it gives the onlooker a better idea of what is happening.

As a nice add on, I would like to include a facility which enables a pre-cut plate, or similar device, with a port name engraved on it, to be inserted into a slot which sets up the harmonic components for that port. One could have several such plates for favourite >>

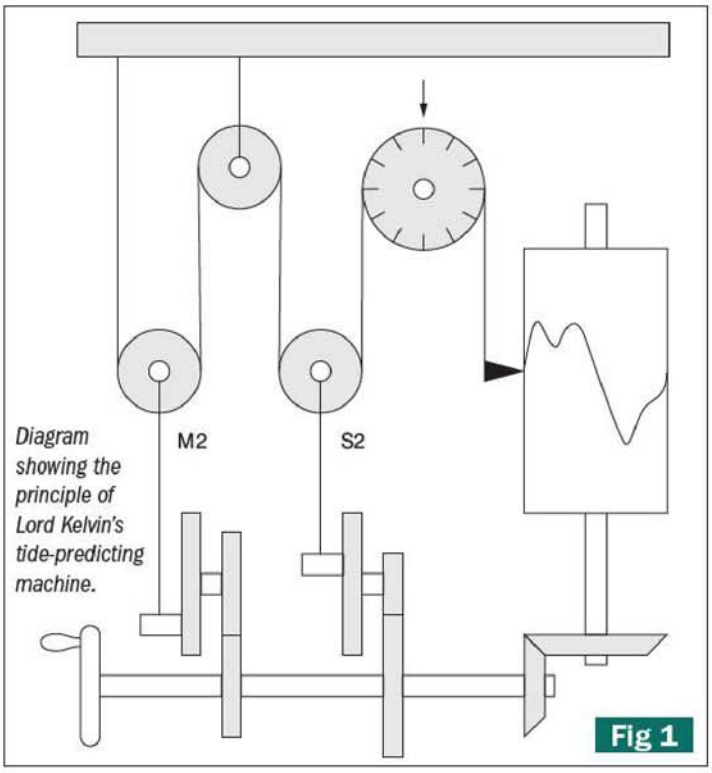


Diagram showing the principle of Lord Kelvin's tide-predicting machine.

ports. Older readers may remember the Hoover *Keymatic* washing machine which had programming notches cut into each edge on both sides of a thick square plate, thus giving a total of eight wash programmes. In my scheme a notch depth could perhaps encode amplitude, another one phase and a final one, frequency.

Displaying the information

The tide clock needs a means of displaying tidal information over the last 24-hour period. Having ruled out any form of electronic display, it occurred to me that an approximate curve could be shown with an elastic cord, or flexible band, stretched across the tops of say 24 pins whose vertical positions correspond to the tide height at half hourly intervals. But how I would implement such an arrangement, which would involve a mechanical memory, has yet to reach the back-of-the-envelope stage! I would like to avoid a plotter, as shown in fig 1, as this involves replacing expendables, which might not be available in years to come. A mechanical plotting solution would also be more interesting. It has been suggested to me that it might be nice to have a small tank of blue water, with variable depth, and a boat floating on it to indicate the current tide height!

I also intend to incorporate a moon phase ball, which is not difficult to implement, to show how far the tidal cycle is between Springs and Neaps, and also an indicator to show the time to the next high or low water.

Timekeeping

Finally, a clock-controlled input is needed to drive the tide indicating mechanism. I initially toyed with the idea of incorporating one of Harrison's famous timekeepers, H1 or H2, but I quickly realised that with such complexity, it would be unlikely to be completed before my personal end date! So, as the clock is associated with the sea, I favour a chronometer style balance with a spring-detent escapement, which would be simple to implement in a large size. The balance, some 5in. diameter, would oscillate slowly allowing the action of the escapement to be seen clearly. I am anxious to make the design aesthetically pleasing and mechanically interesting.

The above are my initial thoughts. However, some may prove too grandiose to implement. I would welcome readers' comments and suggestions before I begin the detailed design work.

I would like to thank Dr John Amson (ref. 2), for helping me to understand various tidal matters and for reviewing this article.

References

1. Castle-Smith R., *Finishing a Gold Medal Clock*, *M.E.* 4325, 9 May 2008.

2. Amson J. and McQuater A., *Tide Clocks* (three part series), *Horological Journal*, May, June and July, 2006. **ME**

DIARY

MARCH

13 **Colchester SMEE.** Members' DVDs. Contact Jon Mottershaw: 01206 383456.

13 **Hereford SME.** Derek Goddard: William Armstrong. Contact Nigel Linwood: 01432 880649.

13 **Polegate & District MEC.** John Blackwell: Railways Around Newhaven. Contact D. F. Pratt: 01323 645872.

14 **Glasgow & S.W. Rly Ass'n.** AGM. Contact Bruce Steven: 0141 810 3871.

14 **Sunderland (City of) MES.** Peter Russell: Computers. Contact Albert Stephenson: 01429 299649.

15 **Bedford MES.** Boiler Testing Traction Engines. Contact Ted Jolliffe: 01234 327791.

15 **Leyland SME.** Big Shaun's Traction Attraction. Contact A. P. Bibby: 01254 812049.

15 **Model Steam Road Vehicle Soc. Boiler Tests.** Contact John Bagwell: 01452 304876.

15 **Otago MES.** Club Running Day. Contact James Woods: 476 1369.

15 **York City & DSME.** Running Day. Contact Pat Martindale: 01262 676291.

16 **Lancaster & Morecambe MES.** Canon Bill Greetham: The Settle & Carlisle Railway. Contact Mike Glegg: 01995 606767.

16 **Model Steam Road Vehicle Soc.** Bring & Buy Sale. Contact John Bagwell: 01452 304876.

16 **Peterborough SME.** S. Ross: Restoring a Steam Road Roller. Contact R A Meek: 01778 345142.

17 **Chesterfield & District MES.** AGM. Contact Mike Rhodes: 01623 648676.

17 **Nottingham SMEE.** AGM. Contact Graham Davenport: 0115 8496703.

17 **Romney Marsh MES.** AGM. Contact John Wimble: 01797 362295.

18 **Birmingham SME.** AGM. Contact Mike Page: 01564 784006.

18 **Bristol SMEE.** Geoff Sheppard: On the Table Evening. Contact Trevor Chambers: 0145 441 5085.

18 **Hull DSME.** Members' Current Projects. Contact Tony Finn: 01482 898434.

18 **Leeds SMEE.** Paul Tracey: Drawing in 3D. Contact Geoff Shackleton: 01977 798138.

18 **MELSA.** Meeting. Contact Graham Chadbone: 07 4121 4341.

19 **Cardiff MES.** Club Chat. Contact Don Norman: 01656 784530.

19 **East Somerset SMEE.** On the Table. Contact Roger Davis: 01749 677195.

19 **Leyland SME.** Cock-up Night. Contact A. P. Bibby: 01254 812049.

19 **Sutton MEC.** Quiz Night. Contact Bob Wood: 020 8641 6258.

20 **Brighton & Hove SMLE.** Pete Groves & Derek Green: Around Mt. Etna by Train. Contact Mick Funnell: 01323 892042.

20 **Colchester SMEE.** Models Night. Contact Jon Mottershaw: 01206 383456.

21 **Chesterfield & District MES.** Public Running. Contact Mike Rhodes: 01623 648676.

21 **SM&EE.** Polly course training day 4. Contact Maurice Fagg: 020 8669 1480.

21 **York City & DSME.** David Pinniger: Garden Railways. Contact Pat Martindale: 01262 676291.

22 **Cardiff MES.** Open Day. Contact Don Norman: 01656 784530.

22 **MELSA.** Bracken Ridge. Contact Graham Chadbone: 07 4121 4341.

22 **Westland & Yeovil DMES.** Track Running Day. Contact Gerald Martyn: 01935 434126.

22 **West Riding SLS.** Public Running. Contact David Batty: 01924 363908.

23 **Reading SME.** Public Running. Contact Ian Fothergill: 0118 9421679.

24 **Romney Marsh MES.** Track Meeting. Contact John Wimble: 01797 362295.

25 **Birmingham SME.** Bits & Pieces. Contact Mike Page: 01564 784006.

26 **Cardiff MES.** Bits & Pieces. Contact Don Norman: 01656 784530.

26 **Sutton MEC.** Guest speaker. Contact Bob Wood: 020 8641 6258.

26 **Westland & Yeovil DMES.** AGM. Contact Gerald Martyn: 01935 434126.

27 **Colchester SMEE.** Working the Main Line. Contact Jon Mottershaw: 01206 383456.

27 **Hereford SME.** Nigel Jeffries: The Brunels, Father & Son. Contact Nigel Linwood: 01432 880649.

27 **Newton Abbot & District MES.** Meeting. Contact Graham Day: 01626 772739.

28 **Leyland SME.** Boiler Testing Day. Contact A. P. Bibby: 01254 812049.

28 **Romney Marsh MES.** Boiler Testing. Contact John Wimble: 01797 362295.

28 **SM&EE.** Gauge 1 informal meeting. Contact Maurice Fagg: 020 8669 1480.

29 **Bedford MES.** Boiler Testing Locomotives. Contact Ted Jolliffe: 01234 327791.

29 **Bristol SMEE.** Steam-Up & Boiler Test Day. Contact Trevor Chambers: 0145 441 5085.

29 **Harrow & Wembley SME.** Sunday Running. Contact Roy Goddard: **E. RSGwatford@aol.com**

MIKE FREEMAN

A beginner's approach to making a brass and aluminum chess set

Mike Freeman concludes with the machining details for the king and queen.

PART 3

Continued from page 275 (M.E. 4346, 27 February 2009)

The queen is 2.45in. (62.25mm) tall and is all lathe work to make, the dimensions being shown in **fig 7**. Start by mounting a 1in. (25.4mm) dia. bar of brass or aluminium in a 3-jaw chuck. There should be a minimum of 3in. (76.2mm) bar clear of the chuck. After facing the end of the bar, take a skimming cut for 2.5in. (63.5mm) towards the chuck. Scribe a mark 0.250in. (6.35mm) from the faced end and centre the contour tool over the mark. Then take light cuts until the contour is 0.875in. (22.3mm) diameter. Now scribe a further mark at 0.850in. (21.6mm) from the faced end of the bar and make small cuts with the contour tool until a finished diameter of 0.817in. (20.75mm) is achieved. Now replace the contour tool with a boring bar and set the top slide over to 60 degrees. Take small cuts until the top of the queen comes to a point. I made use of the Myford ML10's reverse feature to carry out this top taper. Still using the boring bar, make a slight cut 0.3in. (7.6mm) from the centre point of the newly turned top, to a depth of 0.050in. (1.27mm). This cuts the ring that can just be seen at the right-hand end in **photo 16**.

Remove the boring tool and replace it with a cutting tool. The remaining two tapers are next so set the top slide over to 5deg. and make the first taper cut between the top contour and the middle contour. Continue taking light cuts until the taper matches the two contours. When satisfied set the top slide over to 8deg. and make the last taper which runs between the middle contour and the base of the queen.

Finally return top slide to zero and change to a parting tool to part off to a length of 2.45in. (62.25mm). **Photograph 17** shows the finished queen. >>

Queen in the lathe after polishing.

The finished queen.

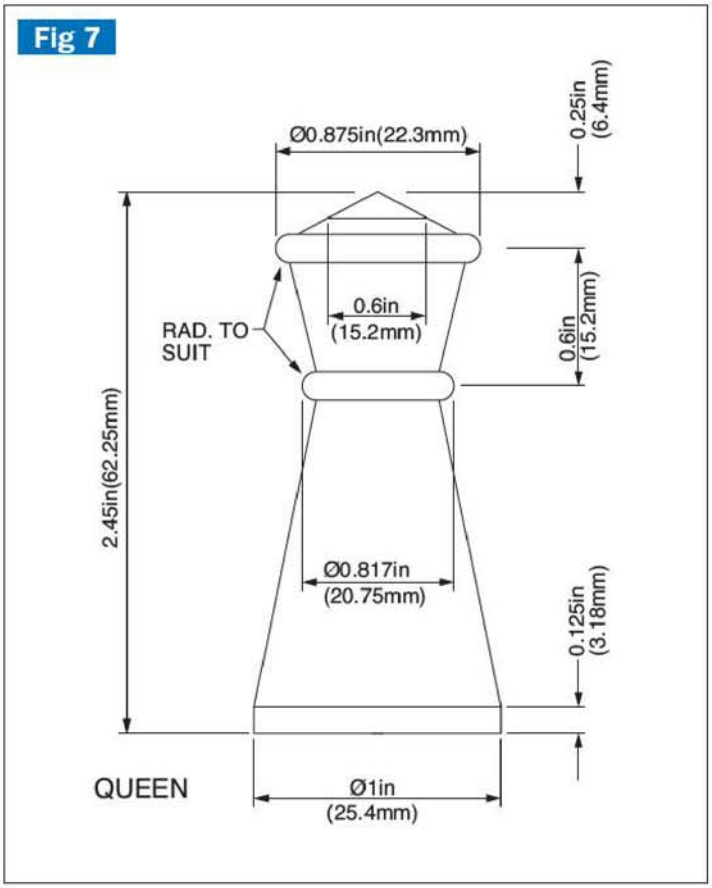


Table 4

Queen 2.45in. (62.2mm) tall

1. Using a 3-jaw chuck mount a 1in. (25.4mm) dia. bar of brass or aluminum with a minimum of 3in. (76.2mm) long clear of the chuck.
2. Face the end off and take a skimming cut for 2.5in. (63.5mm).
3. Centre the contour tool with the faced off end; measure back 0.25in. (6.35mm) and then make small cuts until the contour is 0.875in. (22.3mm) in diameter.
4. Move the tool towards the chuck by 0.6in. (15.2mm) a total of 0.85in. (21.6mm) from the faced end.
5. Make small cuts with the contour tool until a finished diameter of 0.817in. (20.75mm).
6. Replace the contour tool with a boring bar and set the top slide over to 60deg.
7. Take small cuts until the top of the queen comes to a point. I ran mine in reverse to achieve this task. *(Only do this if your back plates are bolted on; don't run in reverse if using a threaded mandrel, Ed.)*
8. Make a slight cut 0.3in. (7.6mm) from the centre and make the ring as per photo to a depth of 0.05in. (1.27mm).
9. Remove the boring tool and replace with the cutting tool.
10. Set the top slide over to 5deg. and make the taper cut between the top contour and the middle contour. Continue until the depth matches the two contours.
11. Set the top slide over to 8deg. and make the last taper between the middle contour and the base of the piece.
12. Return the top slide to zero. Use this opportunity to polish the queen.
13. Part off to a length of 2.45in. (62.2mm).

King

The king is 2.5in. (63.5mm) tall and is very similar to the queen except that his body is a little fatter and he has a cross at the centre of his head (**photo 18** and **fig 8**). Start by chucking a section of 1in. (25.4mm) diameter bar, take a light cleaning cut for 2¾in. (69.8mm). Now face the end of the bar before using a centre drill, followed by drilling and tapping an M3 hole (or any equivalent i.e. ME or BA).

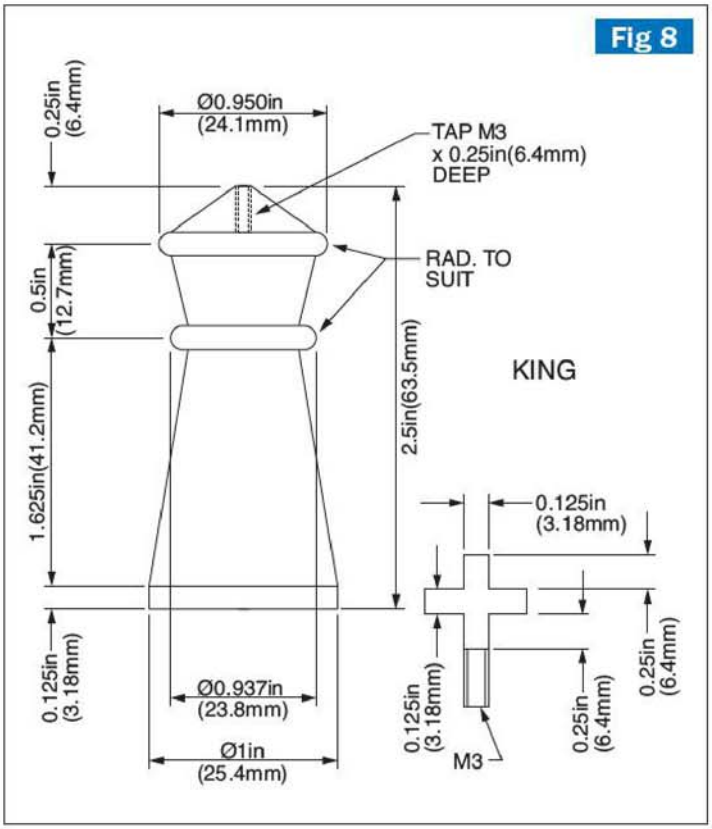
Measure 0.25in. (6.4mm) from the faced end and scribe a mark. Measure another 0.5in., i.e. .750in. (19.05mm) from the faced end and scribe a second mark. Use the contour tool and centre it at the 0.25in. (6.4mm) mark and form the first contour, until it just completes its shape and no deeper. Re-position the contour tool centre to the 0.75in. (19.05mm) scribed mark and using light cuts, take the tool in until you have a finished diameter over the contour of 0.937in. (23.8mm).

Change to a boring bar and with the top slide set over to 60deg. turn the top, as you did with the queen, between the first contour and the centre hole. Reset the top slide to 10deg. and change the tool so the first taper can be cut between the two contours, to a depth that matches the contours. Re-position the top slide to 6deg. and cut the last taper for the main body until it blends in with the contour and the base. Polish the king and then part off to length.

The last item to make is the cross for the king's head. The dimensions for the cross are all 0.125in. (3.18mm) wide and thick and you can either mill or file to shape. The base of the cross is rounded so that it can be threaded M3. Polish, and then screw the cross into the top of the king. I used a little Loctite to ensure it doesn't go missing in the future.

That concludes the build, and hopefully you now have a nice chess set to create a stir, which hopefully will put off your opponent when playing. It really is nice to feel the difference in weight and the set is certainly tactile.

The finished king.



Afterthoughts

After polishing I did use a lacquer to protect the polish but I must admit I didn't get on with it to well. Whether I used the right product or not I don't know, but there may be better ways to protect your work.

Another variation I have thought of since making the first set is to make both sides from aluminium with one side anodised and the other side plain (or anodised a different colour). But then you loose the weight differential, which is one of the nice outcomes of Brass and Aluminium. You can of course drill out the bases and put a plug of brass or some other heavy metal inside. Some finished chessmen can be seen in **photo 19**.

If you wish to view more photos they can be seen on http://www.mikes-models.com ME

A view of some of the different pieces.

Table 5

King 2.5in. (63.5mm) tall

1. Chuck a section of 1in. (25.4mm) diameter bar and take a light cleaning up cut.
2. Face, centre drill, then drill and tap an M3 hole (or any equivalent i.e. ME or BA).
3. Use the contour tool and centre it at the faced end edge. Measure towards the chuck 0.25in. (6.4mm) and form the first contour so that it just completes its shape and no deeper.
4. Re-position the contour tool centre to 1in. (25.4mm) from the faced end and using light cuts take the tool in until you have a finished diameter over the contour of 0.937in. (23.8mm).
5. Re-position centre of contour tool 0.75in. (19.05mm) from the faced end and advance it into the work for 0.15in. (3.8mm).
6. Change to an ordinary turning tool and set the top slide over 10deg. Turn a taper between the two contours.
7. Re-position the top slide to 60deg. and turn between the first contour and the centre hole forming the topmost taper of the king.
8. Re-position the top slide to 6deg. and cut the main body taper until it blends in with the contour base.
9. Polish the king and then part off to length.
10. Make the cross so the body parts are 0.125in. (3.18mm) wide and thick.
11. The bottom of cross is 1/4in. long and rounded so that it can be threaded to match the hole (M3 in my case).
12. Polish and screw the cross into the top of the king. I also used a little Loctite to ensure it doesn't go missing.

Ascot Locomotive Society

The society has now rebuilt most of its railway on the new racecourse site, having been relocated from the previous one when the racing straight mile was realigned in 2004 to make more room for the new grandstand opened in 2006. The society is unable to use the following items recovered from the previous railway buildings, but hopes some other society or enthusiast can recycle them in their own developments. If not, they will have to be destroyed later on in the spring.

The following items are going for a song:

- Four pairs of locomotive shed doors, approximately 4ft. wide and 4ft. high.
- A 10ft. wide by 6ft. high steel framed lean to carriage-shed end with two doors taking four tracks at 20in. centres.
- Two 8ft. wide by 6ft. 6in. high pairs of external doors and frames.

All are exceptionally strong and fitted with custom made hinges and bolts. Contact Derek Alford, the secretary on 01344 482485 for a viewing.

The Model Steam Road Vehicle Society

The MSRVS has just released news of its all new website and a new logo launch in time for the 24th Annual Rally in Tewkesbury on the weekend of June 27/28. The new website address is **www.msrvs.co.uk** and the site has a brighter look to it, with new features planned over the coming weeks.

One significant change in image is the launch of a new club logo. This is actually a rendered image taken of a 3D Computer Aided Design model of one of the club member's traction engine wheels. This gives it the full 3D effect without being a specific photo of any one type of engine, while hopefully being instantly recognisable as a traction engine wheel. The society hopes to use this in all their stationery and publicity for the future, so keep a look out for this distinctive image.

Preparations are well under way for their rally, with engine and model invitations sent out with the February newsletter. So fine weather permitting, and the normal great support for the society, all should be set for a great event. With a Silver Anniversary coming along in 2010 the society is looking forward to good times ahead. Why not book the dates in your diary and check out the website to see what the group is all about.

Littlebrook Club - track for sale

The club occupied the Littlebrook Power Station grounds for 27 years but were given notice to quit in 2006. The club then purchased a secure container to store the entire track with the intention of using the container as a clubhouse and machine shop on a new site.

The track is of raised dual gauge 5in. and 3½in. by 970ft. long, with two access points and steaming bays, two traversers and access line. The club managed to move the now extremely heavy container to the Glentworth Club in Dartford, Kent.

Since then they have tried extremely hard to find a new site but without success, so have now decided to dispose of the container and its entire contents hoping that, somewhere in the British Isles, there are a group of model engineers who would like to take advantage of their misfortune.

Peterborough Society of Model Engineers Ltd

Dale seemed to be enjoying himself at the very wet Nene Valley Railway Vintage Weekend on 12 July 2008. (Photo: by Peter Jackson).

Norwich and District Society of Model Engineers

The club owns a 7¼in. gauge *Warship* battery-electric locomotive and would like to contact any individual or club who also owns one with a view to exchanging information regarding any modifications or replacements they have had to make and also to discuss the possibility of forming a 'user group'.

Welling and District MES

Due to the owners requiring the land for other purposes, the society will have to move from their present site in the near future. It may be a year or so before this happens so a provisional programme of public running has been planned for the following dates between 2pm and 5pm. They are: April 19; May 3, 17, & 31; June 14 & 28; July 12 & 26; August 9 & 23; September 6 & 20; October 4. Open days have been planned for May and October for visiting clubs and Gauge One Association members and will be announced in *Club Diary* nearer the time.

In Memoriam

It is with the deepest regret that we record the passing of the following members of model engineering societies. The sympathy of staff at *Model Engineer* is extended to the family and friends they leave behind.

Stephen Atkinson	*Model Engineer's Society (NI)*
John Whybrow	*Canvey Railway and Model Engineering Club*

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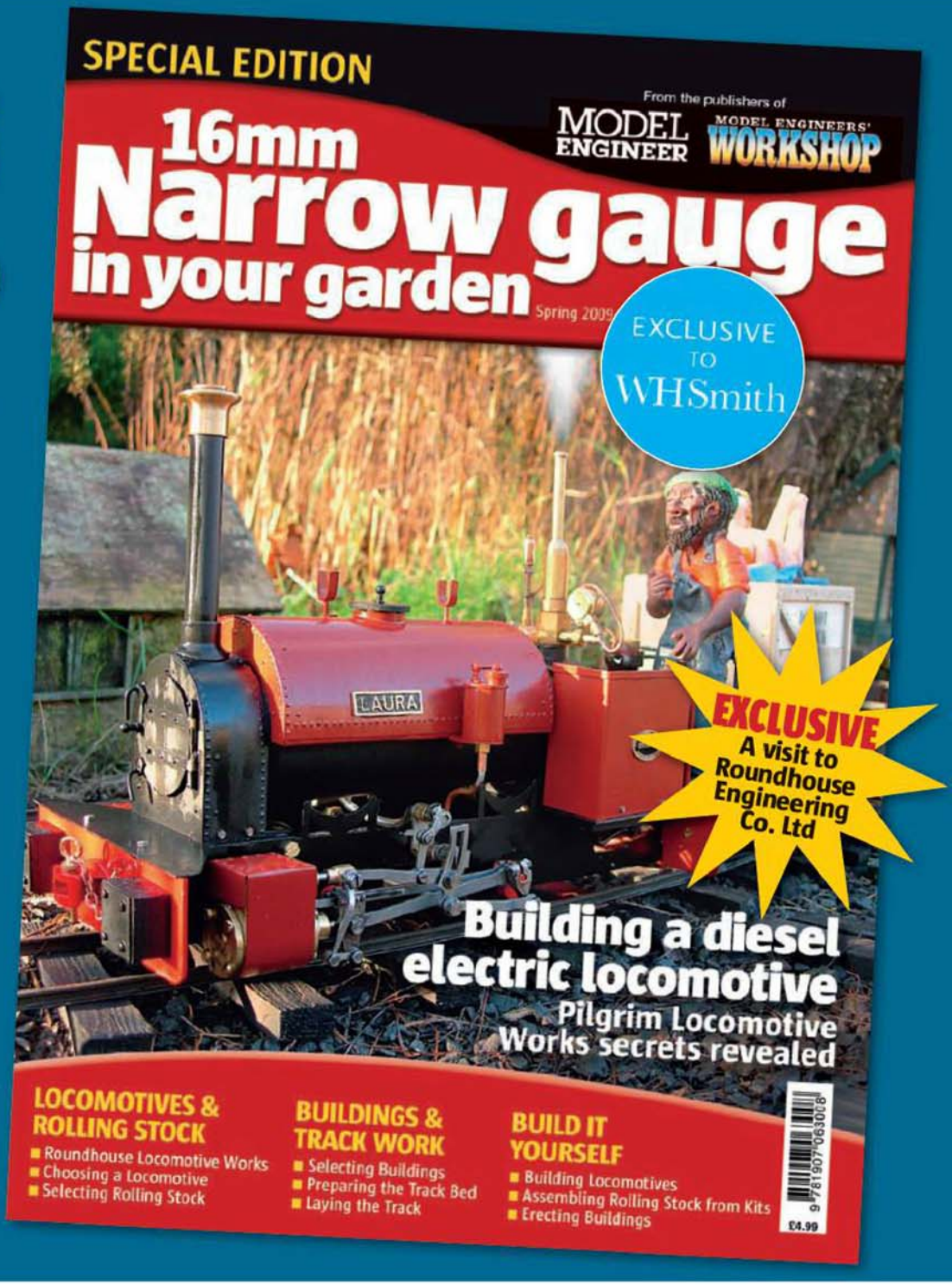

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JUST IN! Fobco, Startrite, Ajax & Meddings 240 volt bench drills

Elliot '00' Omnimill. ***One of the BEST ones yet!!*** Vertical and horizontal

Boxford 1130 lathe (not finished)

Boxford 5" + CLUTCH / IMP gearbox almost immaculate RARE!

Taylor spinning lathe + tooling

Harrison M250 5" x 30" lathe

Q and S 6" Sawmaster hacksaw

Startrite 147S steel cutting vertical bandsaw in excellent condition

Myford ML7 lathe

Crompton/ Tyco NEW motor for ML7/ Super 7 <

£164.50

< Eagle surface grinder + mag table

Harrison M300 fixed steady HARD TO GET!

Myford vertical slides £100 - £245
Micrometers (various) £5 - £40 each
J&S arbor press *(large)* £225
Harrison / Colchester D14 faceplates 12" / 18"
Taylor spinning lathes £1250 - £1650
Gear cutters small each £12
Swage block 12" square £125
Crompton NEW 2HP motor each £120
Myford MA99E collets each £20
Kasenit furnace £175
Archer tapping heads £75 - £125

20 assorted 1" bore horizontal milling cutters for £59*
**inclusive of post and VAT. UK mainland only.*

SIP NEW mill, Twain, Grade A factory

Limited stock/special price

Myford ML10 lathe (greased)

Guyson sandblaster

Boxford Mk111 lathe + stand

Boxford 250STS (rare 240 volts model)

Colchester Chipmaster lathe

Presses / arbor / selection

RJH bench grinder / buffer - 240 volts

Harrison M300 6" x 24"

Waltons 50" 16g guillotine + stops

Milling/Drilling ground X-Y table

Harrison vertical mill + vice & chuck

Harrison 140 lathe + gearbox & power cross feed

Harrison L5 lathe

Flame fast DS300 brazing hearth

Myford ML7R lathe + stand

Immaculate/one owner!

PLEASE PHONE 0208 300 9070 TO CHECK AVAILABILITY OR TO OBTAIN OUR LIST

DISTANCE NO PROBLEM! DEFINITELY WORTH A VISIT ALL PRICES EXCLUSIVE OF VAT

Just a small selection of our current stock photographed!

We have wood lathes, saw benches, bandsaws, morticers and Record vices etc - large selection!

HME ceramic chip kiln

Bridgeport slotting head

Myford capstan attachments


Harrison / Colchester D14 face, catch & 4 jaw chucks

Tom Senior milling vice (swivel)

Harrison Graduate 42" lathe

Taylor Hobson engraver

Boxford STS 1020 lathe

Q and S 6" power hacksaw + coolant

Raglan 5" x 24" lathe

Myford vertical slides and accessories

Viceroy drill grinding machine (240 volts)

Flamefast hearth DS120F

Denford Viceroy buffer's

Archer tapping heads

Harrison L5 travelling steady (L5A, L6, Student, Master also)

Crompton Parkinson Foot Mounted 2HP 240V / single phase 1400 revs as new.

'L00' face plate + we have loads more from Myford to Colchester Mascot

Keyway broaches 7/16" 18mm

Myford coolant tank (240 volts)

Startrite TA1250 12" full sliding table saw bench (240 volts)

Eclipse angle plates

Disc sander (heavy duty)

Engineers flat PVE (cased)

Pollard sensitive drilling machine

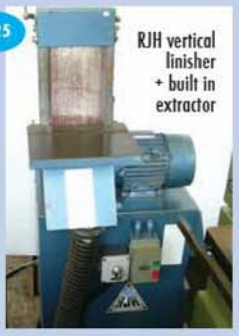
Burnerd 'L0', D13 & D14 collet chucks

EME (Elliot Small Tools) precision universal vice

Cowells miniature milling machine

Dickson toolposts to suit Colchester Mascot (others available)

Harrison taper turning attachment only

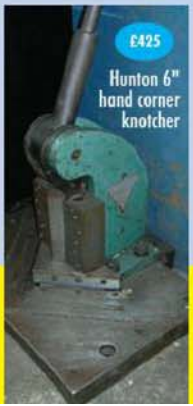


Clarkson 40INT collet chuck + collets (we have 2MT-5MT and 30INT to 50INT in stock!!)

Colchester Triumph fixed steady

Jones and Shipman large arbor press

Steinel tapping machine



We are still **OPEN SATURDAY MORNINGS** dedicated to the model engineer

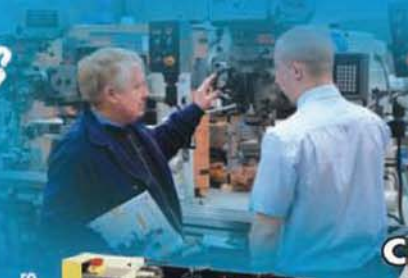
THESE ARE ALL NEW MACHINES AT PRICES COMPARABLE WITH RE-CONDITIONED OR 'SECOND-HAND EQUIPMENT

MACHINE & TOOLING SPECIALISTS


Mills


Drills


Bandsaws



Lathes

CHESTER U.K. LIMITED
MACHINE AND TOOLING SPECIALISTS
www.chesteruk.net

All machines come with relevant safety features, standard accessories, manual and parts list

CRUSADER LATHE

Max Swing	300mm
Max Distance Between Centres	810mm
Motor	1.5hp
Net Weight	450kgs

STANDARD ACCESSORIES
- 3-Jaw Chuck
- 4-Jaw Chuck
- 2 Axis Digital Readout
- Face Plate
- Fixed Steady
- Travelling Steady
- Splash Guard
- Machine Stand
- Quick Change Toolpost
- Toolholders
- Machine Lamp
- Coolant System

FEATURES
- D1-4 Camlock Spindle
- 2 Axis Digital Readout
- Hardened & Ground Bedways
- Indeperdent Leadscrew and Feed Rod
- Gap Bed
- Taper Roller Bearings
- Cast Iron Bed

Includes Digital Readout

H80 BANDSAW

Max Cutting Capacity @ 90°	Round 90mm Square 90x 120mm
Max Cutting cpacity @45°	Round 65mm Square 70 x 120mm
Blade Speed	20,29,50m/min
Motor	420w
Power	240volt
Blade Size	1300 x 0.63 x 12.5mm
Packing Size	760 x 295 465mm

FEATURES
- Cast Iron Base and Arm • Canbe used with stand supplied or bench mounted
- Roller Bearing Blade Guides • Angled Cutting • Auto Switch off when cutting finished
- Ideal machine for the Home Workshop providing large capacity cutting in a small space.

DB11VS

Centre Distance	700mm
Swing over Bed	280mm
Spindle Bore	26mm
Motor	1200w
Spindle Speeds	125-2500rpm
Net Weight	180kgs

FEATURES
Digital Speed Readout • T Slotted Crosslide • Variable Spindle Speed • Metric & Imperial Thread Cutting • Longitudinal Power Feed

STANDARD ACCESSORIES
3-Jaw Chuck • 4-Jaw Chuck • Face Plate • Coolant Tray • Rear Splash Guard • Lathe Tool Set • Chip Guardd

CENTURY MILL

FEATURES
- Variable Speed Spindle
- Digital Depth Readout
- Fine Feed Quill
- Heavy Duty Cast Iron Construction
- Strong 1.5hp Motor
- Angled Milling Head
- Wide Speed Range

Max Drilling Capacity	20mm
Max End Mill Capacity	22mm
Max Face Mill Capacity	70mm
Table Size	600x180mm
Cross Travel	200mm
Long Travel	350mm
Taper	MT3
Speeds	50-3000rpm
Size	720x565x1020mm
Weight	135kgs

'T' MILLING MACHINE "HORIZONTAL & VERTICAL MILLING

Delivery by Quotation

FEATURES
- Variable Speed Spindles
- Separate Motors
- Longitudinal Power Feed
- Halogen Work Lamp
- Inbuilt Coolant System
- Heavy Duty Cast Iron Construction

Table	880x240mm
Long Travel	435mm
Cross Travel	230mm
Vertical Travel	860mm
Spindle Tapers	ISO30
Herizontal Motor	1.5hp
Vertical Motor	2hp
Speeds Horizontal	20-2500rpm
Speeds Vertical	50-3000rpm
Net Weight	850kgs

All prices include VAT. Delivery Free to UK mainland – excluding certain Scottish postcodes. Prices valid for duration of this issue only.

WHY CHOOSE CHESTER?

- **ONE YEAR WARRANTY** – All machines come supplied with a 12 month manufacturers parts warranty from date of receipt of delivery
- **MADE TO LAST** – Chester Machines are built to high standards. All machines are made from cast iron and quality checked throughout production.
- **WE KNOW MACHINE TOOLS** – A good understand of machine tools and there environment is essential to provide you the customer with the right machine.
- **LATEST TECHNOLOGY** – Chester continue to expand their range of machine tools and accessories, enabling us to offer the widest range of machines and tooling in the UK.
- **SERVICE AND SUPPORT** – Chester offer parts and after sales service from both our Chester HQ and Midlands Showroom alongwith local agents here in the UK and Overseas.
- **EXPERIENCE** – Chester have been distributing and installing machine tools all over the UK and Overseas, for many years , including private individuals, training establishments, schools and industrial customers.

For full details on these and other machine tools please contact

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email: sales@chestermachinetools.com
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email: machines@tpmachines.co.uk
Opening Times: 9am-5pm, Mon-Fri.
Sat 9am-12pm

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