

MODEL ENGINEER

Vol. 197 No. 4278

21 July - 3 August 2006

HARRISON CLOCKS

BRAZED BOILER CAUTION

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TO
VOL 196



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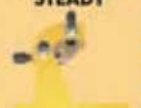
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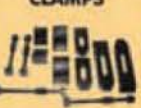
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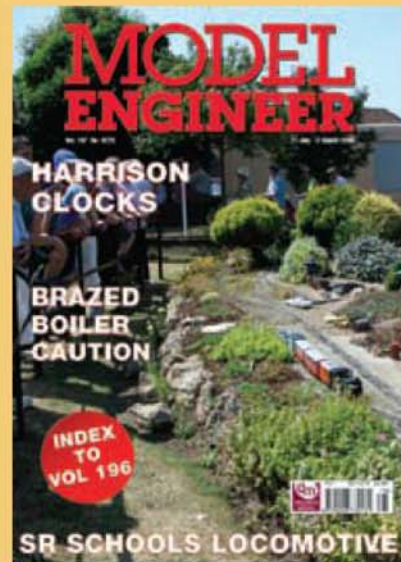
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(Photograph by David
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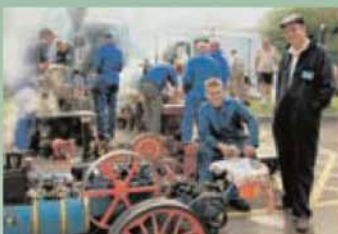
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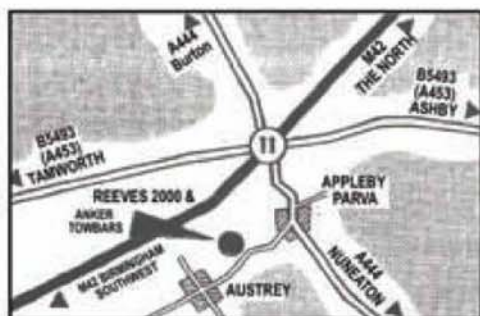
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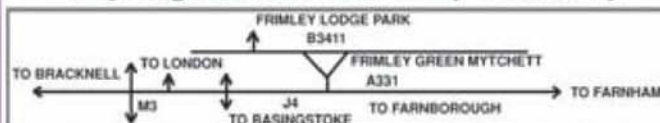
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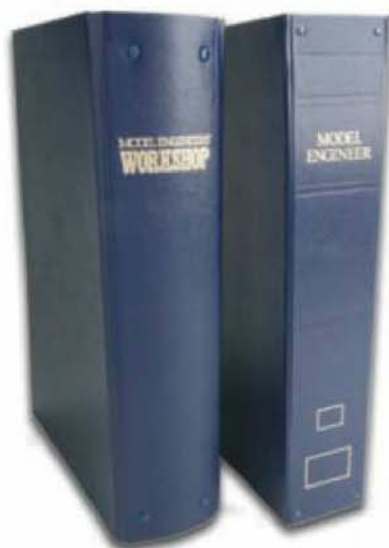
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SMOKE RINGS

With the Editors

Steam 'spectaculars' will be held on July 22, 23, 26, 29, and 30.

Chris also tells us that new members are always welcome. Contact 07711 717470 or chris@cjenglish.demon.co.uk

South Downs plus

Visitors to the Model Engineer Exhibition at Sandown Park last year were greeted by a large narrow gauge locomotive from the South Downs Light Railway. Chris English has written to let us know that an extension has just been opened.

It was celebrated by a special train carrying invited guests taking the first run. Youngest member of the South Downs Light Railway Society, Thomas Cowlin, aged just three, cut the ribbon to clear the way for the first circuit over the complete line.

Society members built the extension over two years. The process involved removing some 500 tons of soil to create a 14-foot deep cutting. The mile-long extension used five tons of rail, 2000 sleepers, 4000 rail bases, and 8000 screws.

The society took over the track about five years ago, and relaid it to 10¹/₄in. gauge. Since then it has refurbished the carriage shed, installed a full signalling system, and acquired the brand new locomotive *Pulborough* which was the one displayed at our exhibition.

The railway can be found at the Wyvale Garden Centre, Stopham Road, Pulborough, West Sussex.



South Downs Railway's new cutting.

Curly Bowl

A quick reminder that the LBSC Memorial Bowl competition will be hosted by the City of Sunderland Model Engineering Society on Sunday September 3. To enter this super, friendly event, contact Albert Stephenson on 01429 299649.

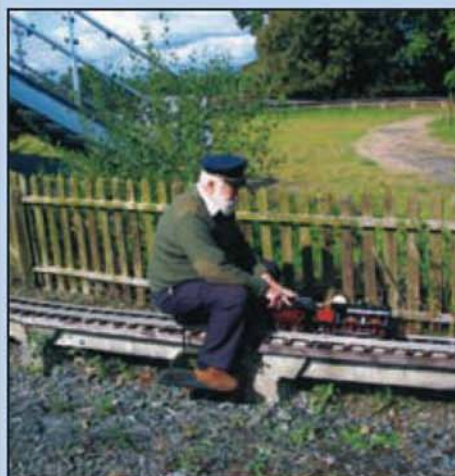
All LBSC designed and derived locomotives will be welcome at the Roker Park track. So will any other items devised by the great man.

In addition to the usual prizes, the Sunderland Society will have a special memento for all entrants.



John Harrison

Winner of the great prize to measure longitude at sea using his chronometer. Harrison's earlier clocks used in the longitude quest are the inspiration for the clocks by A. J. S. Pratt, the second of which is described in this issue.



Ulster visit

Our recent profile of the Ulster Folk and Transport Museum at Cultra near Belfast, has ruffled a few feathers. Problem is that it really only covered the museum, while a few yards way is the home of the Model Engineering Society of Northern Ireland for more than 30 years.

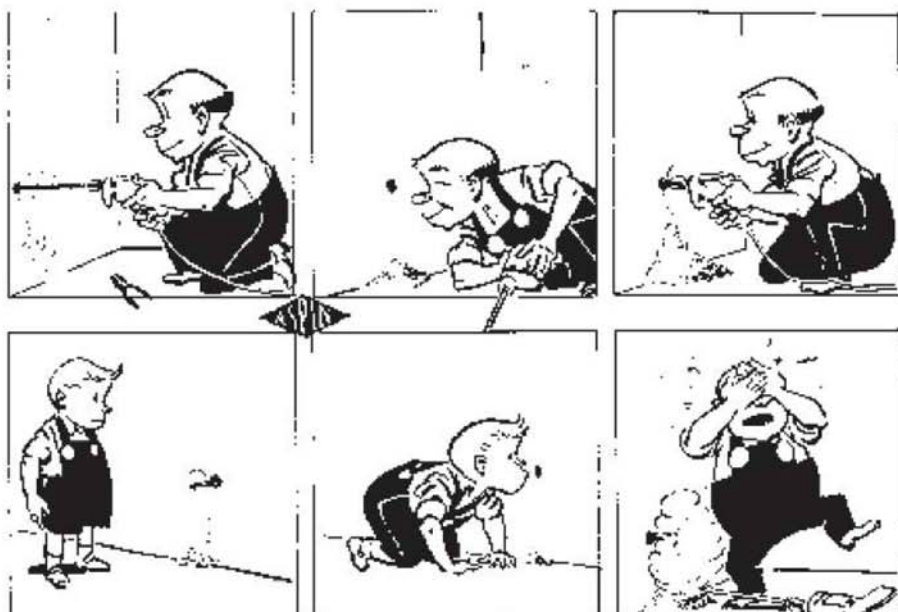
Several readers have let us know that visitors to the museum in Cultra cannot fail to notice the superb setup of the MESNI. So we are happy to pass that on, and to give you a taste, publish a photo of Bob Symes driving a 'Lion' at Cultra recently.

MESNI is an active club with super facilities. To see more visit www.mesni.co.uk

Bob Symes with Cultra Lion.

CHUCK, the MUDDLE ENGINEER

by B. TERRY ASPIN



POST BAG

Colour reproduction

Drilling digital scales

SIRS, - You published a very (for me) timely article on digitising a milling machine which was most helpful as I have just purchased a Warco WM16, this being the largest and heaviest mill that I can accommodate. BUT! There is always a but!

How on earth do you drill the hardened stainless steel scales? I have only succeeded in making an impression despite using new Dormer drills.

Due to the restricted clearances on my machine I have had to modify the method of mounting the DROs and drilling each end of the 'Y' axis scale is the obvious choice.

Hope that you can help.
Peter Gain, by e-mail.

Malcolm Stride replies:

I have replied to Peter directly but others may find themselves in a similar situation. The scales may vary, but mine drilled reasonably easily by drilling from the front face. I suspect that the back and outside edges are hardened but the drill will break through once started from the front. Shortening the scales is hard work with a hacksaw and I averaged one blade per two cuts. An abrasive disc might be easier.

Boxes to identify

SIRS, - I am writing in the hope that one of your knowledgeable readers may be able to help me. My father, (a long time engineer at Laycocks) died a short while ago and I am now in possession of some tools but also two boxes. My question is, what went into them? I enclose two photographs. I am hoping one of your readers may help by possibly pointing me in the direction of an old catalogue.

Brian Cutler, Lancashire.



Brian Cutler is trying to find out what went into these two boxes that have come into his possession. Above; A Chesterman Protractor Box - No. 96 with rule No. 80. Right; - Moore & Wright Precision Tools Box - No. 130.



SIRS, - Either my eyes are going funny, or people are painting their locomotives some odd colours these days. In M.E. 4269, 17 March 2006 the locomotive on the cover has a buffer beam in tasteful shades of orange and custard, as does the nice L1 on page 315. The Midland 4-2-2 on page 314 has a tender in a delicate pink. On reflection, I suppose this is appropriate for a Tender Behind! (Sorry).

Otherwise, congratulations on the overall standard of illustration in 'Ours' these days.

Alan Atkinson, Yorkshire.

Save the planet?

SIRS, - I am writing to you fully aware that my subject may be contentious and provocative. As I read your pages, issue after issue, I am awed by the talent, skill and innovation shown by your many contributors in the matter of energy conversion. Their ingenuity and inventiveness knows no bounds in this field.

But I am haunted by a conversation many years ago with my 'old boss' (a practical scientist and engineer second-to-none) when I told him of my aspiration to "build models when I retire". He replied "All very well, but one should really concentrate on inventing things that are useful". OUCH!

So is it beyond the wit of your specialist contributors that their talent should not occasionally focus on practical apparatus to encourage the average garden-shed enthusiast to build viable devices that would help to alleviate the increasing threat of power starvation both in this and in the developing world?

The appliance-of-science in this experimental area could well spark a major breakthrough one day. To quote Professor E. R. Laithwaite in his book *How to Invent* (Thring &

Laithwaite, Macmillan Press, ISBN 0-333-220269) "There is an inventive streak in all of us to a greater or lesser extent, but it must be developed to be useful...!"

Not exactly what he meant in the context of his book, but sufficient for my request in this letter!

M. R. Clay, Kent.

A thank you and some information

SIRS, - I would like to thank Mr. Ian Abbott (M.E. 4268, 3 March 2006) for replying to my query on the subject of printing photographs and engravings etc. I was hoping to find some dates of when these processes were invented to enable engineering researchers to give a date for illustrations and therefore when the machine was invented. His reply was, nonetheless, interesting.

Ref. *Smoke Rings* in the same issue, Mr. Taylor is looking for information on the Mann Wagon. A new book by John Pease on the history of the Mann's Patent Steam Cart and Wagon Company is available from the Road Locomotive Society sales officer: Peter Smith, 2 Ocean View, Polruan, Fowey, Cornwall PL23 1QJ, price £24.99 plus postage.

The Museum of English Rural Life at Reading University does not appear to have anything from Mann's but does have drawings and sales ledgers from: Burrell; Fowler; Ransomes, Sims & Jefferies; and Wallis & Steevens. Hope this helps.
Tony Webster, by e-mail.

Cutter safety

SIRS, - May I be so bold as to add to the safety advice given by Mr. Spenlove-Spenlove in his article on *Spindle Mounted Milling Cutters*, M.E. 4270, 31 March 2006, If milling cutters are sent out for professional sharpening they are likely to be returned with the business end coated in a sort of

rubbery dip, which one is tempted to remove by twisting off for re-use later. The very act of grasping the covering with sufficient grip to remove it will probably cause the very sharp edges to slice through said covering and one's flesh as well. I found this out the hard way; luckily my workshop first-aid cabinet was close by.

The moral is that one should wear thick leather gloves when handling newly sharpened cutters.

David Bennett, Bucks.

April fool?

SIRS, - Whilst quite happy that I found the 'April Fool' entries on the pages of M.E. 4270, 31 March 2006, I am somewhat bemused at what looks to me to be an apparent tongue-in-cheek description of a machine called a 'Printing lathe' as described in *Post Bag* of that issue.

Having been employed in many disciplines during my career, but not including printing, I cannot bring myself to believe that such a machine existed. The first thing that worried me was the requirement for a 'Hi-Fi' valve amplifier unless the operator wanted *Music While You Work* prior to the introduction of Walkmans, iPods, etc.

Then I got to wondering how such a system with a built in process time lag could produce engravings such as those luckily shown on pages 393 to 396 of the same issue. Absolutely impossible I believe.

Another give away is the lack of a light proof cover for the scanning head. It would be very difficult for the head to read accurately in ambient lighting.

I shall be watching, with interest, further editions of *Post Bag* for similar comments.

Colin Long, Essex.

Coil winding machine

SIRS, - I am in possession of a Macadie automatic coil winder Model T.D.S.M manufactured by The Automatic Coil Winder & Electrical Equipment Co. Ltd., Winder house, Douglas St., London SW1. It carries a patent number 199417.

I am enclosing a photocopy of a page from a catalogue showing the same machine. After a clean up the machine appears to be in good condition and I have already managed to wind a coil.

Any information in the form of memories, write-ups, pictures or perhaps a copy of a manual for this machine from your readers would be greatly appreciated.

Most importantly I would like information about the mechanism which switches over the direction of the winding, as my machine appears to have some parts missing in this area.

Anton Vella, Birmingham.

A4 Locomotive streamlining

SIRS, - With reference to the LNER Class A4 Pacific in 3 1/2 in. gauge with the 'cut-away' type streamlining that I am building.

Do any of our readers, by any chance, know of someone who has recently (or not so recently come to that!) built an A4 with streamlining?

If so then I would be pleased to receive their details so I can hopefully pick their brains.

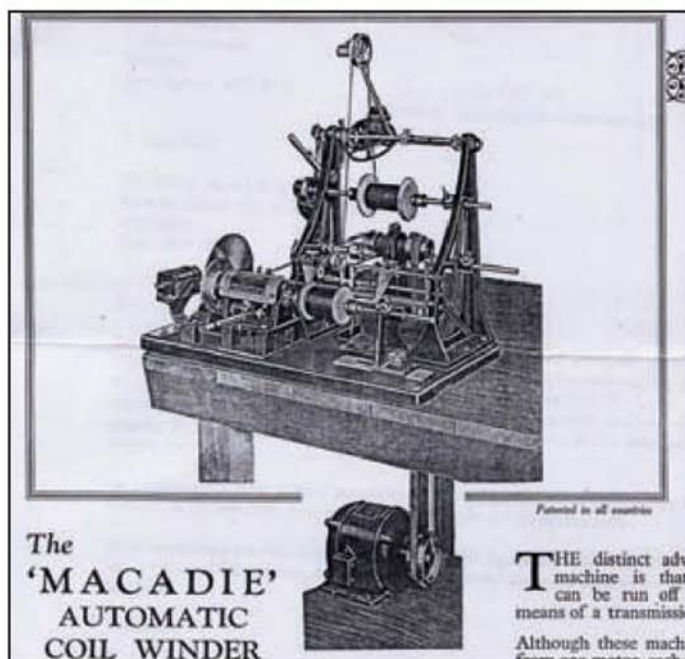
Steven Marshall, Cambs.

More on Juneero

SIRS, - I too was very interested in Peter Spenlove-Spenlove's letter (M.E. 4255, 2 September 2005) with regard to the Juneero tool. By coincidence, I have made reference to the same equipment in an article, on a completely different subject, that I have prepared in readiness for submission to the Editor in due course.

My own Juneero tool was a Christmas present from my parents, I think shortly after World War Two and a decade or so after Mr. Preston's purchase, when I must have been 11 or 12 years-old at the time. I clearly recall how proud I was when I constructed a stand for my father's shaving kit and a toast rack for my mother, who was even gracious enough to actually use it for a while!

My photo 1 shows the tool,



The coil winding machine for which Mr. Vella seeks information.

unlike Mr. Preston's sample, resplendent in its factory finish and the storage box showing a purchase price of 25/-, the small bending tool being available as an optional extra.

The included literature describes the equipment as "Six practical tools in one" and lists a considerable number of design sheets that could be purchased at 2d each. Nearly 60 years on, reading down the list, the following offers caught my attention: - bicycle propeller, slide gauge, pantograph, buffer stop, photo frame, porter's barrow, signal box, footbridge, signals, engine shed, water tank and a selection that perhaps reflected the troubled times of recent years, battleship, Spitfire, Hurricane, Blenheim bomber, Lysander, aircraft detector, ARP rack, searchlight and a blackout lampshade.

I can also confirm that a variety of materials were available for use as the list included nuts and bolts;

metal - plain and coloured red, green, blue, orange, black and assorted colours; corrugated metal - available as above; metal discs of various diameters; steel strips, steel rods and angle iron, all supplied in 15 in. lengths; glass substitute in various colours; springs and transfers for brick, slate and stone - supplied in 1/- packets.

A further piece of publicity (photo 2) also raised a smile. The company invited builders to submit entries to a "Designer's Contest in Junior or Senior Sections" when cash prizes could be won if the submission was considered to be suitable for inclusion in the manufacturer's Series of Design Sheets. The invitation continued with the promise that the entry "would be published under the designer's name, with 10s 6d being awarded for a Junior and £1 1s for a senior entry accepted". In addition, six complimentary copies

of the Design Sheet will be supplied so that "the contributor can present them to friends and the contributor will also be presented with the Fellowship of the Juneero Club".

The company must have thought that this was a great idea as the publicity leaflet stated that "This is a fine opportunity of gaining recognition of your skill and ability and we hope that you will send in your ideas for consideration. There is no entry fee or expense of any kind and models not accepted will be promptly returned if postage is included. You should become a member of the Juneero Club by writing to the Club Secretary, Juneero Ltd., Stirling Corner, Borehamwood, Herts."

How times have changed, or have they? Is the spirit of the Juneero enterprise still current or has the message never been away and has it been reflected in the columns of this excellent magazine and other associated publications since the era of LBSC and his contemporaries?

With an obviously well organised manufacturing and marketing organisation, I am left wondering whatever could have happened to cause the demise of such an established company. How long did it last after the mid-1940s and what happens now at Stirling Corner? No doubt many within the readership will know the answer to my queries.

Geoff Dowden, Oldham.

Portass lathes

SIRS, - In reply to the letter of T. W. Bridgeland (M.E. 4270, 31 March 2006), many thanks for giving me the idea of going in a different direction of research. I now have a better idea of the origin of this lathe.



In reply to B. F. Atkins (same *Post Bag*) who also sent a picture of his lathe. I now think it to be a 'Portass' made machine and badged as Zyto of around 1938/39, as this fits in very nicely with the previous owners comments.

He bought the lathe new, complete with cast iron stand and tray and kept it all his working life, it being totally refurbished around 1990.

I think these lathes are the 'Super Zyto', its bed and headstock are cast as one piece and the rest of the specs seem to be such a very close match.

If anybody out there has any other information I would be grateful if this could be passed on **Mick Johnson, North Yorkshire.**

Variable speed control problems

SIRS, - Having owned a Clark CL 300M lathe for approximately one year I had no cause to find fault with it.

But just recently I found that the speed control potentiometer was behaving erratically. At first, I thought it was the cold weather, but as the weather warmed up it was still not right.

So having decided that it was the switch at fault I removed the plastic knob (two grub screws) and sprayed the shaft base of the potentiometer with Servisol switch cleaner working the switch backward and forward whilst spraying. This has done the trick it now performs as new. I thought some of the owners of this lathe might try this before replacing the switch.

Please remember to disconnect from the supply before spraying.
Mike Day, Guernsey.

I/C exhaust design

SIRS, - I have a mathematical formula for designing exhaust systems using 'Standing-Wave Scavenge'.

The formula is:

$$BSD^2/1400d$$

Where B is the bore of one cylinder in inches, S is the stroke in inches, and D is the dwell - the time that the exhaust valve is open - in crankshaft degrees. d is the diameter of the exhaust port, not the exhaust valve.

The resulting equation should give you a length in inches.

You should double, or more, this length to enable the pipe to clear the engine.

An expansion chamber with a diameter of three times that of the pipe and with a capacity equal to one cylinder should be attached to its end.

If you are building a manifold of

two, three, or four pipes they should be of equal length and open into a common expansion chamber.

If you are building a manifold for a three-port 4-cylinder engine, i.e. a Mini, you should use the LCB - Long Centre Branch - method. The outer pipes should Siamese, then be extended to match the double - length of the centre branch before joining into the common expansion chamber.

Are there formulae for:

Valve overlap,

The periods around tdc (top-dead-centre),

Inlet valve opening lead/exhaust valve closing lag,

And bdc (bottom-dead-centre),

Exhaust valve opening lead/inlet valve closing lag,

These, I believe, affect the ability of an engine to 'idle'. Is any of this relevant to 'small scale' engines?

Peter Brown, Nottingham.

Boiler stress calculations

SIRS, - I was very confused by Mr. Collyer's letter (*M.E.* 4264, 6 January 2006) regarding stresses in small copper boilers. Was my 55 year-old strength of materials education that much out of date? Had I better hang up my calculator?

However, after a while I took comfort that someone more competent than me would write and put us right with some good theory and a clear explanation.

This has now happened and we

should be grateful for the informative letter from Mr. Martyn, (*M.E.* 4271, 13 April 2006).

However, now the technical side has been put right I must express my dismay at Mr. Collyer's statement - "*This is HND stress theory, which is way outside the scope of the M.E.*" This, with respect, is nonsense.

Heaven forbid that the *M.E.* should print pages of mathematical acrobatics every fortnight, but if it will lead to safer and better boilers, or whatever, when something useful is offered, then I believe you should publish at the appropriate level, and not be limited by some supposed intellectual barrier. The *M.E.* must encourage the novice but equally it should assist the expert because the skills of the expert filter down to the benefit of us all.

Derek Lampard, Somerset.

Clock making on small lathes

SIRS, - Your correspondent, D. M. Ricketts, queries the lack of constructional projects for the small lathes (*M.E.* 4272, 28 April 2006). I have described the construction of several clocks using such lathes: -

My English Regulator was built on the Cowell lathe.

I made at least four clocks using the Unimat 3 and 4 lathes.

My weight driven brass alarm clock was made on the Toyo 210 lathe.

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In the interests of security, correspondents' details are not published unless specific instructions to do so are given.

Responses to published letters are forwarded as appropriate.



The lathe for which Mr. Abbotts seeks further information.

The $\frac{3}{4}$ second pendulum clock was constructed on the Peatol lathe. In each case all the wheel cutting was carried out on these tools. A free catalogue listing all these clocks can be obtained from RiteTime Publishing, tel: 01420-474747.

John Wilding FBHI, Sussex.

Another mystery lathe

SIRS, - I was given an old centre lathe 20 years ago. Lee & Hunt of Nottingham manufactured the machine and I am advised the year of manufacture was between 1890 and 1910.

Would any of our readers know where I can find relevant information regarding the past history of the Lee & Hunt company and any manuals or drawings detailing this particular machine?

I enclose an image of the machine to help.

Phillip Abbotts, Notts.

Sifbronze in boilers

SIRS, - It is extremely unfortunate that Peter Rich tells us in print that he uses Sifbronze for the major joints in his boilers (*M.E.* 4272, 28 April 2006).

Sifbronze must not be used for boiler joints. It is a cupro-zinc alloy that can be subject to a process known as dezincification - the progressive leaching out of zinc, leaving porous, weak copper.

The process occurs in conditions of high water temperature and is the result of reaction with water treatment chemicals, put in by the water supply company. It can certainly occur in the Derby area and I understand it also extends to Birmingham.

Experience on British Standard and British Rail specification drafting committees showed that important items require specific reference and as a member of the British Model Engineering Liaison Group, I asked for such a reference to be made in the new Boiler Test Code, but it was considered that the general statement in the first paragraph in Appendix A would be sufficient. But of course this only refers to silver-soldering, not brazing.

I still feel strongly that reference to de-zincification be made in the Test Code, particularly as the hydraulic test periodicity has been put out to four years.

I am sure that anyone who has witnessed first hand the effects of dezincification, as I have when a blow-down plug blew out, would support me in this.

Dennis Monk, Derbyshire.

TWO SKELETON CLOCKS IN THE STYLE OF JOHN HARRISON

A. J. S. Pratt
describes why, and how, he made a
second clock

● *Part II continued from M.E. 4276*

When I gave away the first clock my wife confessed she wished I had kept it. So I decided to make another, smaller version, to replace it.

The first clock was not very compact because the pendulums had to swing over the base pillars, and the spring barrel and fusee were above each other which added to the height. In the second clock I decided to have two spring barrels on either side of a single fusee, a smaller (144 tooth) great wheel and pendulums overhanging at the front.

There would also be a sweep second hand and a remontoire.

The plates would be strips of 1/8in. engraving brass built up like the first clock, and there would be ball races on all pivots.

I retained the grasshopper escapement, but used the pallet/composer arrangement designed by W. R. Smith in his grasshopper clock featured in the *M.E.* some years ago.

The synchroniser arrangement was the same as the first clock.

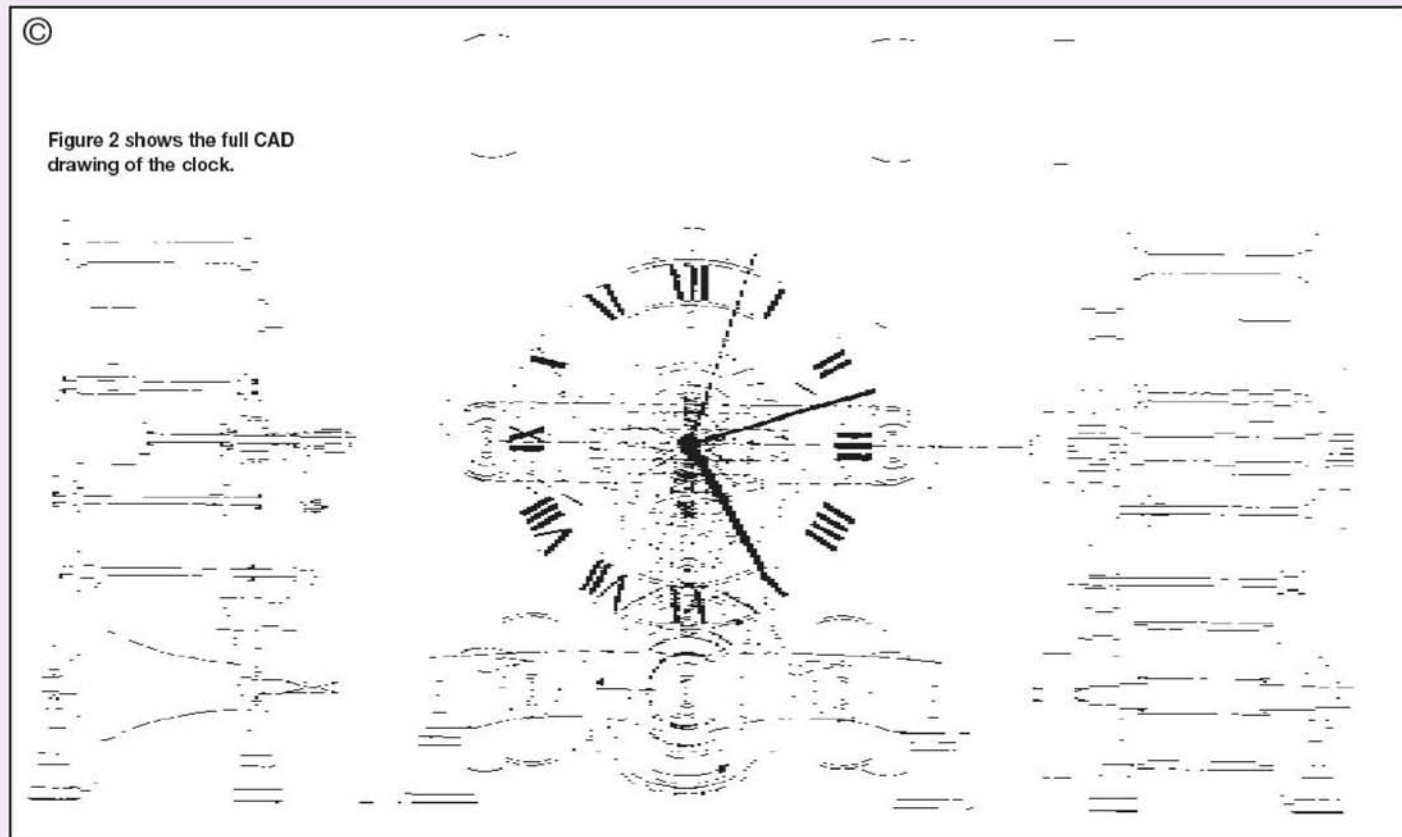
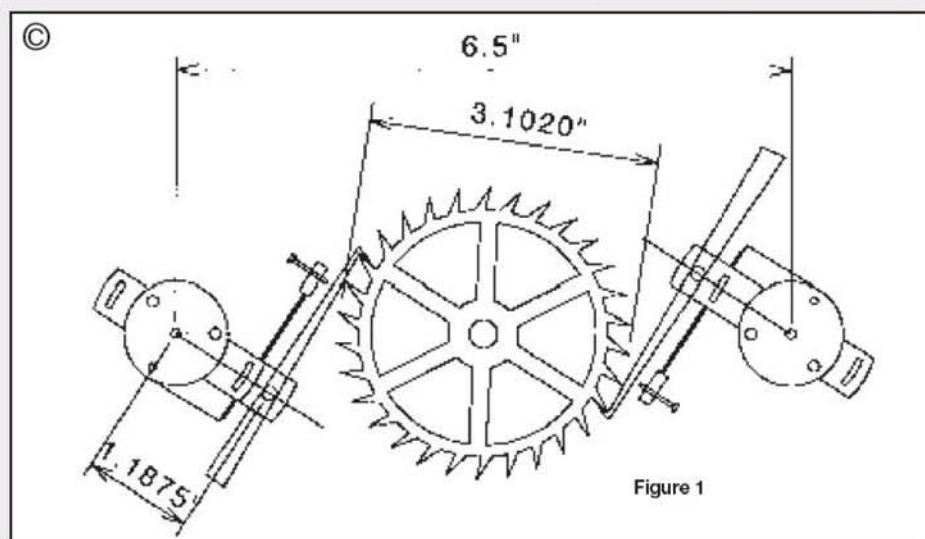
Figure 1 is the layout of the escapement, the starting point of the design. Note that the composer springs now carry the adjusting screws which control the depth of engagement of the pallets. These screws have lignum vitae pads on

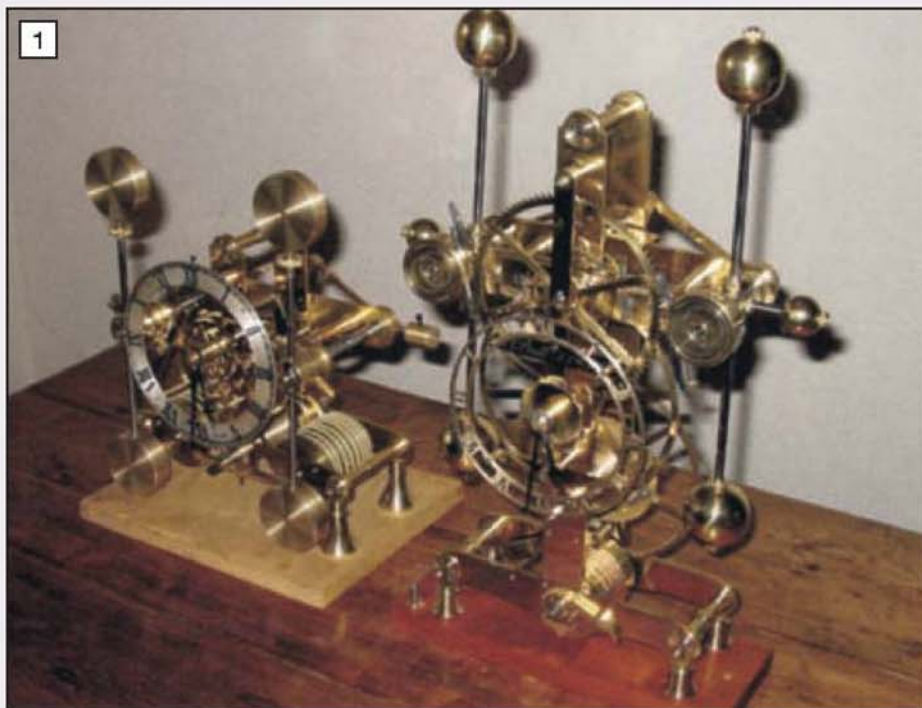
their tips, as there is relative movement between the pad and the back of the pallet when the nib is fully engaged. The angular position of the pallet pivot is adjusted with the curved slots and clamping screws. The centre distance of the pendulum pivots is now 6.5in. compared with 7.25in. for the first clock.

The escape wheel has 30 teeth, cut with a deadbeat cutter with 5 degrees of undercut, and the pallets have inner nib surfaces that are radial to the escape wheel centre.

In practice I found it necessary to relieve the inner surface of the pallet to clear the tooth behind the engaged tooth. At one stage I considered adding a second nib so that as the escape wheel rotates, the following tooth engages and prolongs the impulse, rather like a rack and pinion. This has been done on grasshopper escapements. Being lazy, I just filed a relief in the pallet face.

Unlike the first clock, which was a development project, I completed the design before cutting any





metal and made it virtually to drawing. The only commercial parts, apart from bearings, springs and screws were the dial and hands.

Photo 1 compares the two, showing how much more compact the second is compared with the first. Also, note that the compound pendulum is slightly shorter, yet still has the same period as the larger one. The disc weights are the same diameter, but the upper are thinner. The period is adjusted roughly by sliding the whole pendulum rod through the pallet carrier, and fine adjustment is by a small jockey weight threaded onto the upper part of the rod below the upper weight.

Train

Because this clock has an escape wheel which rotates once per minute, the train really needs a third wheel, and as I had made a regulator with 0.6 module wheel teeth, I decided to use the same wheel sizes:

Great wheel 144 teeth
Centre wheel 96 teeth
Third wheel 90 teeth
All pinions 12 leaf lantern pinions.

The provision of a sweep second hand added some complication because the centre arbor has to drive the hands which are coaxial with the escape arbor!

This is achieved by fixing the position of these two arbors such that a train of three identical gears can transfer to rotation of the centre arbor to the minute hand cannon tube. The centre one of these wheels also carries the pinion that drives the hour hand cannon tube. Rather neat, but I can't claim any originality in this feature, as there are many clocks with this arrangement. The wheels have 45 teeth, 0.6 DP, so the centre distance for the arbors was fixed at 2.125in. This required the third wheel arbor to be offset and its position fixed by the traditional depthing method.



Photo 2 shows the wheels that transfer the centre arbor rotation to the escape arbor. Note the spring slip washer on the lower wheel that enables the hands to be adjusted

The fusee required a double groove to accommodate two fusee lines from the spring barrels on either side. The shape was calculated for the characteristics of one spring, but with a pitch of 7t.p.i., not 14. Two grooves were cut at this pitch, but starting 180deg. apart, in effect a two-start thread. This meant that the fusee was nearly twice as long as for the first clock, and consequently the whole clock is deeper, front to back. The double fusee was not really necessary, but it made the whole arrangement symmetrical. A single stop iron was used, and purlin fusee line.

Normally the winding ratchet for a fusee clock is inside the fusee cone which enables the whole surface to be used for the line or chain. I decided to use an external ratchet on both clocks because letting down the spring is so much easier and quicker.

Remontoire

A spiral spring remontoire similar to the first clock was made, together with the fly and its wheel and pinion, star wheel and detents.

However, I was anxious to see how the clock performed, so as soon as the main train was made, I set the clock going. It worked so well from the start and I was dubious about a remontoire that resets every 10 seconds, so I have never fitted it (**photo 3**).

Manufacturing techniques

Rather than give a blow-by-blow account of the making of the clock, here are a few wheezes and dodges I have acquired on the way.

Wheel cutting

One of the first tools I made, when I set up my workshop, was a dividing head, to work with the lathe. I have an elderly 7B, sans gearbox, but with a dial leadscrew handle. Such luxury!

I can't remember where I got the kit for it from, but the spindle housing is a lump of cast iron which I bored by mounting it on the lathe cross-slide. The spindle has a 2 Morse Taper and is threaded to take Myford accessories. The head was designed to take Myford change wheels both for simple direct indexing and with a compound set up.

The latter caused an early downfall when a cumulative pitch error in the gear train left me with half a tooth on the last cut. I threw away the compound bit and made a worm and index plate, which I still use.



The remontoire that never was.

For my first two clocks, the index head was mounted on a vertical slide and the wheel cutter in the lathe spindle.

I then borrowed some drawings of the Quorn grinder and made just the spindle, which I now mount on the vertical slide with the wheel cutter. Two Chronos index plates make up the wheel cutting department.

The Chronos plates go up to 120 teeth, so for higher counts it is back to the home made dividing head and the lathe, or the milling machine for the 240 tooth wheels.

I have made a set of mandrels to suit most wheel sizes and bores, all 0.5in. shank to fit in a Myford collet, either in the lathe or dividing head.

Lantern pinions

Having turned these in a collet, I drill them using the home made dividing head. Because this was bored on the lathe's cross-slide it is dead on centre height. I can never get another lathe because the dividing head wouldn't fit!

I set the head spindle between centres, zero the cross-slide thimble, clamp the head down and it is then lined up precisely with the lathe spindle. The pitch circle radius of the pinion is then set on the cross slide and the trundle holes spotted with a centre drill.

One trick I have learnt is not to remove all the material between the end walls of the pinion. I plunge in with a thin parting tool and make two or three grooves depending on the length of the pinion. This prevents the drill from wandering before it touches the far wall of the pinion. The intermediate material left in place steadies and supports the drill and ensures that the trundles are on the true radius at each end and are not drunk. Removing the extra material is another operation, but it is worth it.

I glue the trundles in the pinion and cut off the surplus material with an abrasive disc in a Dremel held by hand against the tool post on the lathe! No H and S police here.

Drilling and tapping

Before I had a workshop I attended evening classes and made a sensitive drill to G Thomas's design. This is an indispensable piece of kit for precise drilling of clock parts. I tap holes from 12 to 4 BA, pulling the drill over with the round belt drive.

I try and avoid hand held tapping.

Crossing out wheels

Accurate marking out is the key to clean, even spokes in a wheel. I use a black felt tip marker rather than layout blue, and scribe the rim and boss of a wheel while it is still in the lathe. The spokes are also scribed either in the lathe using the division plate and a surface gauge on the cross-slide, or in the dividing head on a small surface plate. The surface gauge is set to half the spoke thickness above the centre line and all lines are then scribed at one setting.

For the very large and thick (0.1875in.) wheels, I made a wooden fixture to hold the rim of the wheel while I sawed them with an Abro file in a 12in. hacksaw frame. For the rest I used a piecing saw. I always sit down to use the piecing saw, and I now need a head band magnifier!



Setting up the second clock

There is very little to say. I made a jig to hold the pendulum rods vertical while the synchronisers were connected. I used two fine piecing saw blades to connect them, and they are still there. One of the pallets needed some metal off the tail to make it release properly and I had some trouble getting the No.67 drill to run true in the lignum vitae bush in the pallet. The pallets are quite long and any small error in the bush causes the pallets to be off line with the escape wheel.

The clock ran immediately and seemed much easier to set up than the first. Perhaps this is because it is grossly over powered. Although I reduced the strength of the springs, two of them still deliver much more torque to the train. The spring drums are much longer than the actual springs because they have to match the length of

the fusee. Even so, it takes a strong wrist to wind up the clock.

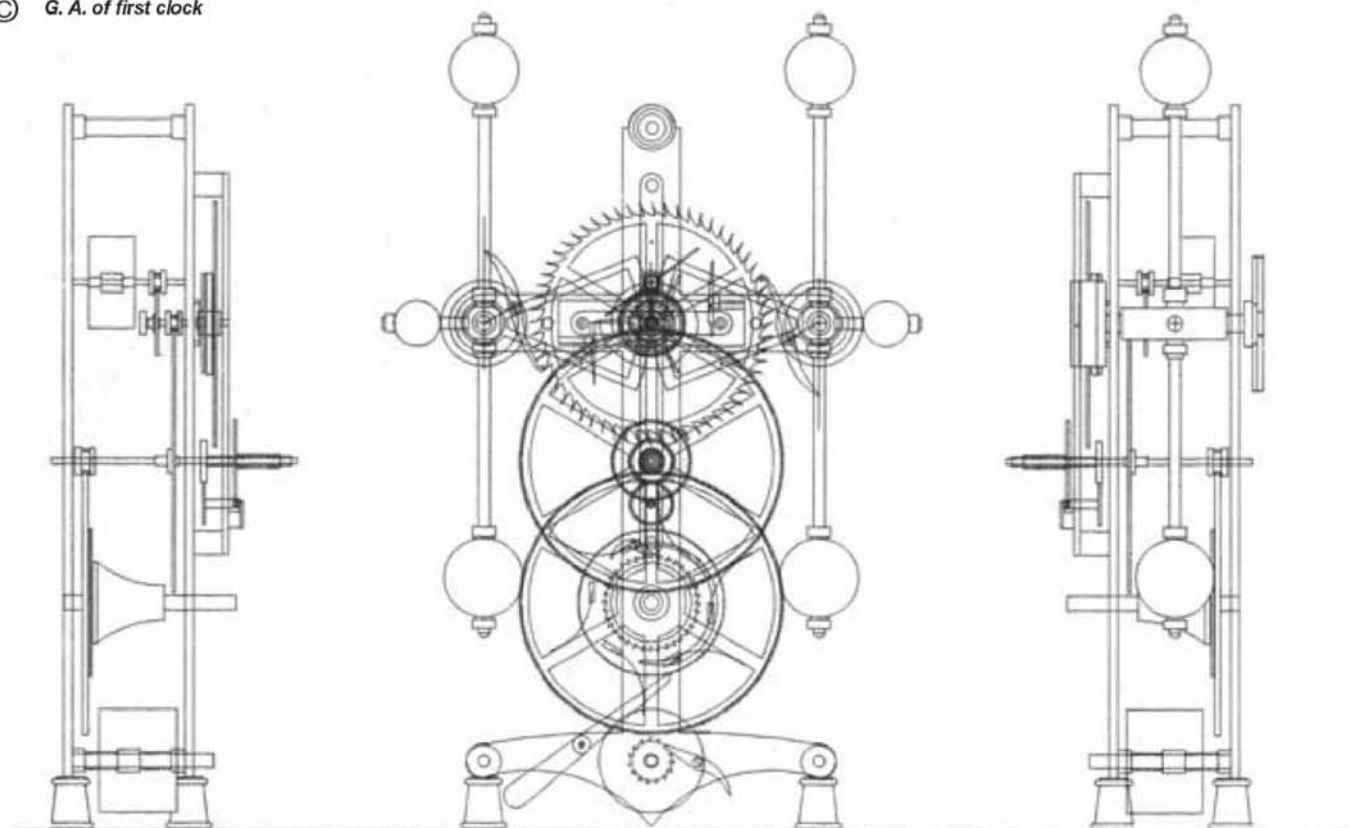
The time keeping of this clock is quite good considering the pendulum rods are carbon steel and it is subject to significant changes in temperature during a week.

The case

I used the same method of assembly for the case (photo 4) as with the first clock. However, because the case is smaller, an opening door would have looked too heavy, so I opted for a lift off case. However, to wind the clock, I devised a couple of spring supports at the side of the base, on which the case rests when lifted up, so that the clock can be wound and the hands set.

Acknowledgements

Although I tend to work alone I would like to



acknowledge the help I have received from local suppliers such as Gratton Engineering in Derby who let me rummage through their material stocks and who machined the spherical pendulum bobs for the first clock. Also Ian Cobb

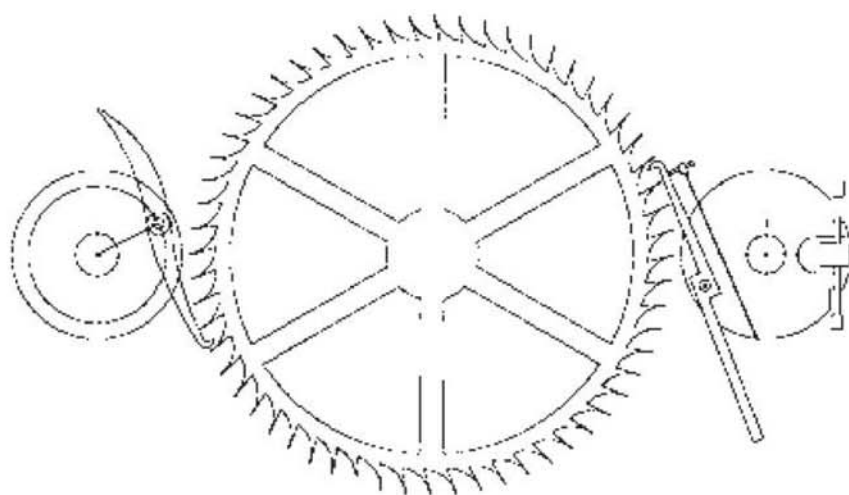
who supplies wheel blanks by return of post.

I also find articles on clock making in the *Model Engineer* often helped me solve some of the more difficult aspects of making one-off experimental time pieces.

I hope my contribution will encourage others to start with a clean sheet of paper (or PC screen) and design a unique clock which may well puzzle some clock maker in a future age. Why on earth did they do that?



Modifications to first clock



Modified Pallet for First Clock Shown on Right Hand Side

After running for eight years, the first clock (G.A. drawing is shown at top of this page) became very unreliable and I decided to modify it in the light of the

experience of building the second clock.

Although the remontoire was working correctly, the amplitude of the pendulum swing was only about 4 cm.

When I removed the pallets I was surprised to find that the lignum vitae pads on the adjusting screws had worn depressions in the 0.008in. thick composer springs. They were not quite worn through, but would have done so soon.

Another fault was the escape wheel had too much end float on its arbor. I suspected that I had omitted a spacing sleeve when I cleaned the clock about four years ago. The escape wheel 'floats' on its arbor because the ID of its two bearings is 0.125in. and they slide on the 0.125in. arbor. The only item fixed on the arbor is the star wheel and pinion, the escape wheel is located with spacing sleeves.

The main modification was to redesign the pallets with the adjusting screws on the ends of the composer springs as in the second clock. The pads will now have to wear through 0.125in. of steel!



An engineer's square and a turned roller being used as an improvised sine bar.



Milling the steam ports in the cylinder. Note the improvised clamping arrangements.



The set up used for drilling the steam passages from one of the end faces of a cylinder casting.

DRILLING STEAM PASSAGES

Duncan Webster

puts a new slant on the problem of drilling steam passages in Sweet Pea cylinders.

On my current project, a Sweet Pea, the drawing shows the steam passages between the ports and the cylinder bores at an angle to everything, as can be seen in fig 1. I am sure that this could be resolved by three-dimensional geometry, but holding the cylinder block at the required angle without an adjustable angle plate would be difficult.

It looked to me as though the passages could be made parallel to the mounting face, and only then need to be angled in one plane, see fig 2. That only left setting them at the correct angle to worry about. Attempts to line things up by eye on previous projects have been successful. However, on one it was a close run thing and I nearly had a drill poking out of the port face. My angle protractor is not at all accurate, and it would have been difficult to get in place anyway.

Whilst sitting in a tedious meeting at work, I got to musing on the problem. "If only I had a sine bar and a set of Jo blocks", thought I, then it dawned on me. Using a roller turned to the correct diameter and my engineer's square, I could make a sort of sine bar in situ (fig 3). It would have been possible to calculate the required diameter for the roller, but it is a lot

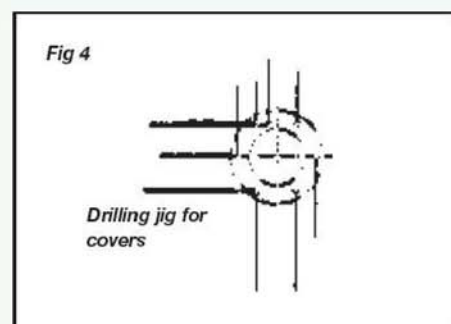
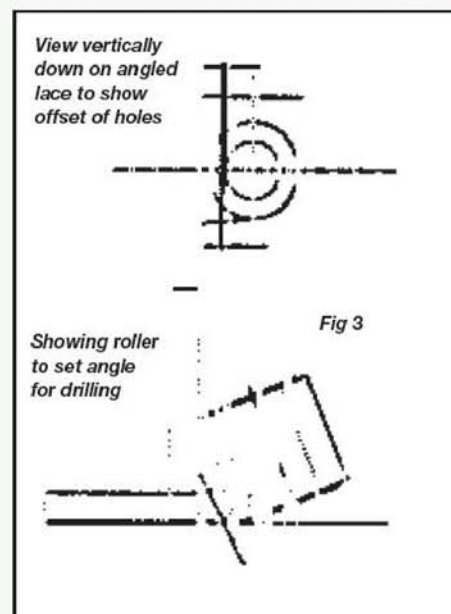
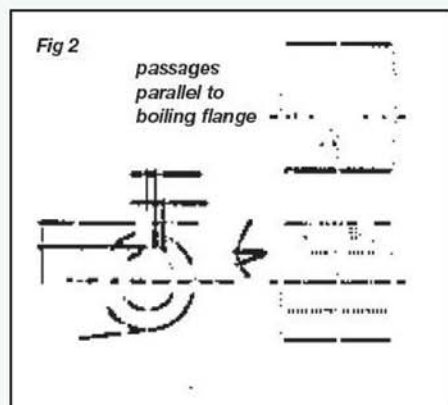
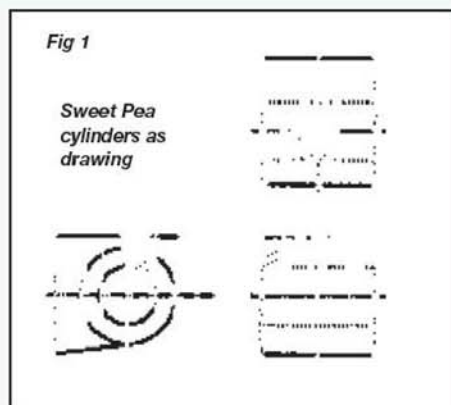
easier using CAD. I saw no reason why the ports had to be all in one plane, so I worked out where the other two holes should be (again on CAD) and, after locating the first one using a sticky pin, moved to the next two by dead reckoning and twiddling the handles on the miller. All four sets of ports turned out identical, unfortunately my photographic skills cannot manage a close up.

As each passage is in the same plane as its neighbour, they came out at different depths in the ports. This did not matter in this case, but had this not been acceptable, it would not have been much more difficult to work out an angle and make a setting roller for each port.

The photographs show the various set-ups used for milling the ports and drilling the passages. I do not believe in pretty clamps, using whatever is to hand means I have no compunction in drilling extra holes, welding bits on or sawing bits off to get exactly what I want. The green coloured square tube was part of a garden gate in a previous existence. It is now back in the scrap box waiting another incarnation. If a particular piece of scrap keeps on being used, I might make a pretty version, but not often.

Rather than marking out the holes in the cylinder covers, I made a drilling jig, again by dead reckoning. This had one hole to reference the passages, so when drilling the cylinders, I could position the jig relative to the passages, then mark one of the stud holes with a fine felt

tip pen, then put the cover on aligned with the mark by eye and use the cover to spot through for the tapped holes in the cylinder. The spigot ensures concentricity. No fantastic accuracy required here, just making sure the stud holes are not too close to the passages. As they turned out, all the covers are interchangeable as far as stud holes go, and can be turned over and put back on, showing that the drilling is pretty accurate.





Tony Griffiths

concludes his description of lathes from this successful company. No. 3

To complete our rundown of Harrison lathes, we look at three designed for heavier work in the toolroom and maintenance shops.

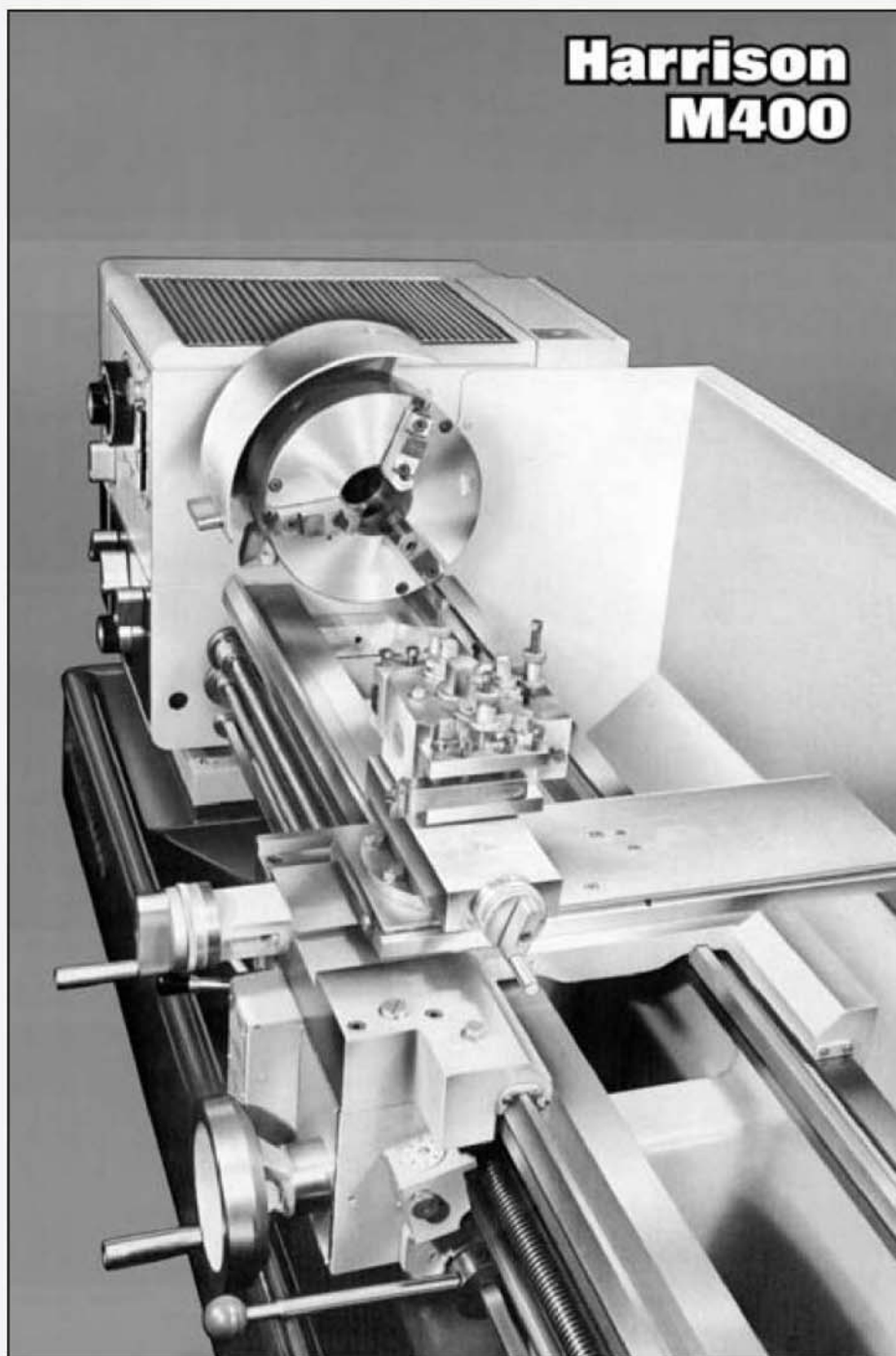
Harrison M400 lathe

The M400 was a heavily built if conventionally designed industrial-quality lathe with an exceptionally strong, deep (380mm - 15in.) and wide (360mm - 14.125in.) bed. Although it was intended as a medium-duty production lathe, it was also claimed by the makers to be capable of handling, through its wide speed range and great strength, both toolroom and general repair-shop work. It had a swing of 450mm (17.75in.) and a capacity of either 1000mm, 1500mm or 2000mm (40in., 60in., and 80in.) between centres. The induction hardened bed could be ordered either straight, or with a detachable gap able to accept up to 480mm (19in.) in diameter and 115mm (4.5in.) thick.

All models had 18 speeds progressing in a ratio of 1.46 from either 40 to 2000rpm, or 31 to 1600rpm, powered by a 7.5kW (10hp) 3-phase 1500rpm motor mounted on an adjustable plate bolted to the back of the bed immediately below the headstock. Four V-belts transmitted the power to the geared headstock - the input shaft of which carried individual clutches (made by Matrix) for forward and reverse drive. On the outboard end of the main spindle was a powerful self-compensating electromagnetic spindle brake manufactured by Warner. Spindle speeds were selected by a pair of neat, concentrically mounted dials that allowed both rapid, positive selection with the minimum of confusion for the new operator.

The 65mm (2.5in.) bore spindle was fitted with a hardened and ground No. 8 D-1 Camlock nose, carried a reduction sleeve to hold a 5 Morse taper centre and ran in expensive Gamet pre-loaded Super-precision bearings. The headstock gears and bearings (for this was a machine of considerable strength and capacity) were pump lubricated from a separate oil tank held in the base of the machine.

The cross-slide was of the full-length type and both it and the top-slide (which could be swivelled through 360 degrees), were fitted with taper gib strips. The handwheels were of the typical Colchester/Harrison 'semi-lever' type with the micrometer dials (dual-reading metric/English units were an optional extra) finished in non-glare satin chrome; the cross feed nut could be adjusted to eliminate backlash. When an M400 is encountered with dual English/metric dials it is worth knowing the cross feed screw and nuts can be either of English or metric pitch - to tell which is fitted look at the micrometer dials: that fitted to the outside position (nearer the operator) indicates the pitch of the screw e.g. if the outside dial is metric so is the feed screw and nut.



Harrison M400 catalogue

HARRISON LATHES

The tailstock was robustly built and fitted with a 73mm diameter (2.875in.) spindle with 155mm (6.125in.) of travel and a No. 5 Morse taper. The spindle was engraved with ruler marks in either inch or metric graduations (or sometimes both) with a rotary micrometer dial fitted as standard.

A variety of electrical-safety installations was offered, but usually consisted of a long, foot-operated bar fitted between the cabinet legs that controlled the action of a combined motor switch and spindle brake. Unfortunately the stand, through heavily constructed and complete with a

splash-back, was fitted with neither a slide-out chip tray nor any sort of storage.

An M400 weighed 1753kg (3857lb) in 1000mm between-centres form; 1956kg (4304lb) as a 1500mm capacity machine - and 2159kg (4760lb) as a long-bed, 2000mm model.

Overall lengths were approximately: 2215, 2690 and 3240mm (88, 106, and 127in.) respectively.

The screwcutting gearbox was able to generate both English and metric threads: 51 inch pitches from 2 to 84tpi and 54 Metric pitches from 0.2 to 14millimeters. By the use of additional changewheels 18 Module pitches from 0.2 to 3.5MOD and 27 Diametral pitches from 8 to 72DP could also be produced. The 27 power sliding feeds varied from 0.04mm to 2.84mm per revolution of the spindle in metric mode and from 0.0016in. to 0.112in. in English. The power cross feed rate was arranged to be half the sliding rate. The gearbox was provided with an oil supply, circulated by the lower gears splashing into the lubricant.

The double-wall, oil-sump apron was of a completely new design and was fitted with twin-bevel gear drive (with dog clutches) to the power sliding and surfacing feeds. This feature allowed the operator to instantly reverse either without having to stop the headstock spindle. A single lever selected and engaged the power feeds; returning the lever to its central position to stop the cut could be done without effort, no matter how hard the lathe was working. Electrical control of the spindle was primarily from a lever attached to the right-hand face of the apron, where it fell conveniently to hand and, of course, moved with the carriage as a cut was taken. An emergency-stop button and 'power-on' light on the headstock was provided and both the electrical isolator and coolant pump switch were mounted on the left-hand face of the stand.

Harrison M450 lathe

The M450, developed directly from the M400 but fitted out for more arduous work, was designed to ISO standards R1708, DIN 8608 and BS4656 as a general-purpose machine suitable for both production use and in maintenance and repair shops - and, optionally, as a toolroom lathe to BS4656, DIN 8605 and ANSI-B5-16. The practical outcome of the various tests meant that a length of free cutting mild steel 250 mm long and approximately 56 mm in diameter was guaranteed to turn within 0.01mm - though tests on a large batch of machines showed that this figure was always bettered and had an average value of 0.0025millimeters.

Although of the same capacity, the early production machines were rather different to the later ones, having a different design of apron and a more restricted threading range; the swing was 450mm (17.7in.) with three bed lengths that admitted 1000mm, 1500mm and 2000mm (40in., 60in. and 80in.) between centres. A detachable gap was optional and, when fitted, allowed the lathe to turn a piece of metal 642mm (25.25in.) in diameter and up to 206mm (8.125in.) deep.

The bed (dimensionally identical to that used on the M400) had induction hardened V and flat ways and was formed from a box section of high-quality cast iron with a maximum depth of 380

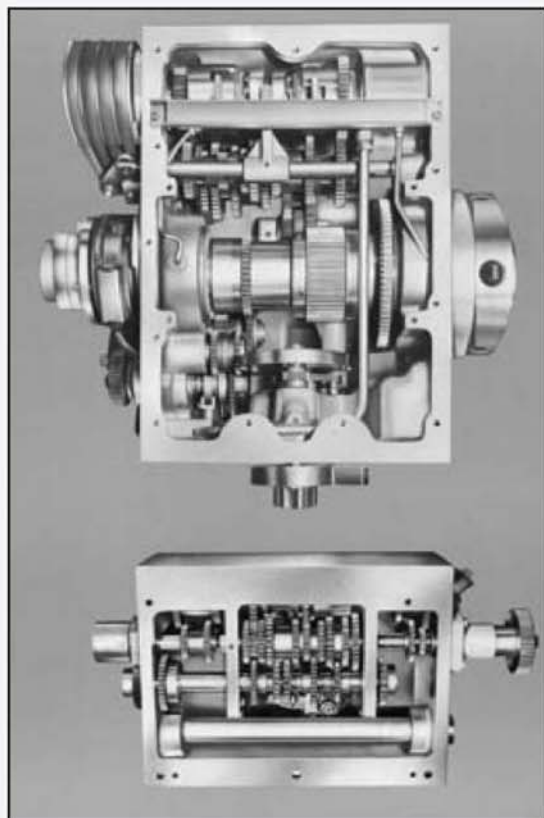
mm (beneath the headstock) and a width of 360 mm; heavy cross ribs braced the front and back faces and left clear spaces for swarf to fall through. The stand, while adequately strong and well made, had neither any form of storage, nor a slide out chip tray - both cost-cutting measures that would have been certain to annoy the unfortunate operator - if not the purchasing company's bean counters.

The headstock held hardened and 'Reishauer' ground gears fitted to shafts rotating in Gamet precision bearings - a double row at the front and a single row at the rear; the gears and bearings were supplied with oil from a belt-driven pump attached to a separate tank held within the cabinet base. The spindle was bored to pass 65mm (2.5in.) and was fitted with a hardened No. 8 D1 Camlock nose and a reduction sleeve to accept a No. 5 Morse taper. 18 spindle speeds were provided from either 40 to 2000rpm or, optionally, 31 to 1600rpm from an easily-changed 7.5 W (10hp) motor fastened to an adjustable plate bolted to the back of the bed immediately below the headstock. Separate Matrix-manufactured clutches for forward and reverse operation were fitted to the headstock input shaft but, unlike the M400, an electro-magnetic spindle brake (an essential feature on a modern, high-speed lathe) was only supplied against an extra charge. Two concentrically mounted, rotary selectors with unambiguous markings, and positive indents, selected the spindle speeds.

The oil-splash lubricated screwcutting and feeds gearbox (with induction-hardened gears) was controlled by three smooth levers - difficult to operate with oily hands - and a single rotary selector. On early machines with the push/pull button on the apron 38 English threads from 2 to 72tpi were listed together with 40 metric from 0.4 to 14mm, 18 metric module from 0.3 to 3.5MOD and 27 Diametral from 8 to 60DP.

Later machines, with the improved apron and single-lever control of the power feeds listed 78 metric pitches from 0.2 to 14mm pitch, 79 English threads from 2 to 84tpi, 47 Module pitches from 0.2 to 3.5MOD and 47 Diametral from 8 to 64DP. The feed to the leadscrew incorporated a torque-limiting mechanism and the gear train was fitted with a shear pin. On early lathes power feeds ranged from 0.002in. to 0.032in. (0.0508mm to 0.8128mm) sliding - and exactly half those for the surfacing rates. The power feeds on later machines (which were identical to those on the M400) ranged from 0.0016in. to 0.112in. (0.04mm to 2.84mm) with the power cross feed set, again, to be one half of the longitudinal rate.

The double-walled apron was formed to hold a quantity of oil within its base from where it could be pumped by hand to the various spindles and gears - and also to the bed and cross-slide ways. On gap-bed machines the carriage-traverse handle (which could be disengaged when using power feeds) was positioned on the right-hand side of the apron, while on straight-bed models it



The 65mm (2.5in.) bore spindle on the M400 was fitted with a hardened and ground No. 8 D-1 Camlock nose, and ran in Gamet pre-loaded super-precision bearings. The headstock gears and bearings were pump lubricated from a separate oil tank.

was on the left. On early M450 lathes the selection of power sliding or surfacing was by the usual kind of push/pull button (pull out for sliding operation, push in for surfacing, with a neutral position in the middle) with the engagement by moving the longer and lower of two levers on the face of the apron to the left. The feed could be set for left or right sliding (or 'in' or 'out' surfacing) by a separate button below and to the right of the selector button.

Later machines were fitted with a much improved apron (also used on the M400 and M500) with both selection and engagement by a single lever mounted in the middle of the apron and pointing forwards. A separate rotary control was used to set the point at which the power-feeds would be automatically disengaged if overloaded. The makers described the leadscrew nut as being of the 'floating' type, used to ensure 'maximum threading accuracy'. On the right-hand side of the apron, immediately below the standard-fit dial-thread indicator was a gated spindle-control lever that provided electrical stop/start and forward/reverse functions; in addition, an emergency-stop button with a 'power-on' light was fitted to the headstock while both the electrical isolator and coolant pump switch were mounted on the left-hand face of the stand.

The cross-slide was of the full-length type, and both it and the top-slide (which could be swivelled through 360deg.) were fitted with taper gib strips. The handwheels were of the typical Colchester/Harrison semi-lever type with the micrometer dials (dual-reading metric/English units were an optional extra) finished in non-glare satin chrome; the cross feed screw could be adjusted to eliminate backlash. When a machine

is fitted with dual dials the cross feed screw and nuts (the nut was a 2-part affair with fixed and adjustable components) and be either English or metric. To tell which is fitted look at the micrometer dials: the engravings on the outside (nearer the operator) indicate which type is fitted. i.e. if the metric graduations are on the outside the lathe has been fitted with a metric screw and nut.

The tailstock was robustly built and fitted with a 73mm diameter (2.875in.) spindle with 155mm (6.125in.) of travel and a No. 5 Morse taper. The spindle was engraved with ruler marks in either inch or metric graduations (or sometimes both) with a rotary micrometer dial fitted as standard.

Unfortunately the stand, like all those fitted to the larger M Type lathes, was fitted with neither a slide-out chip tray nor any sort of storage for tools, accessories or work in progress - although a large splash back was included as standard.

A 1000 mm capacity machine weighed 1753kg (3857lb), the 1500mm version 1956 kg (4304 lb) and the long-bed 2000mm model 2159kg (4760lb). Overall lengths were approximately: 2215, 2690, and 3240mm (88, 106, and 127in.) respectively.

Harrison M500 lathe

When introduced the 500 was the largest machine to join the original line up of M250, M300 and M400/M450, and was designed to meet the international ISO standards R1708 and BS4656 for general-purpose lathes (suitable for both production use and in maintenance and repair shops). It was subjected to lengthy testing by the Machine Tool Industry Research Association.

The actual swing was 530mm with a choice of three between-centres capacities of 1000, 1500 and 2000mm (40in, 60in, and 80in.). A detachable gap in the induction-hardened bed was optional and when fitted allowed the lathe to turn a piece of metal 730mm (28.75in.) in diameter and up to 200mm (7.875in.) deep. The bed was identical in size and weight to that used on the M400 and M450 lathes with a maximum depth beneath the headstock of 380mm (15in.) and a width of 360mm (14.125in.); heavy cross ribs braced the front and back faces and left clear vertical spaces for swarf to fall through. The stand, while adequately strong and supplied with a splash-back had neither any form of storage, nor a slide out chip tray - both cost-cutting measures that would have been certain to annoy the unfortunate operator, if not the purchasing company's bean counters.

The massive headstock held hardened and 'Reishauer' ground gears fitted to shafts rotating in Gamet precision bearings - a double row at the front and a single row at the rear; the gears and bearings were supplied with oil from a belt-driven pump attached to a separate tank held within the cabinet base. The spindle was bored to pass 80mm (3.125in.) and was fitted with a hardened No. 8 D1 Camlock nose and a bush to sleeve it down to a No. 5 Morse taper.

Eighteen spindle speeds were provided from 31 to 1600rpm from (an easily-changed) 9.2kW (12.5hp) motor fastened to an adjustable plate

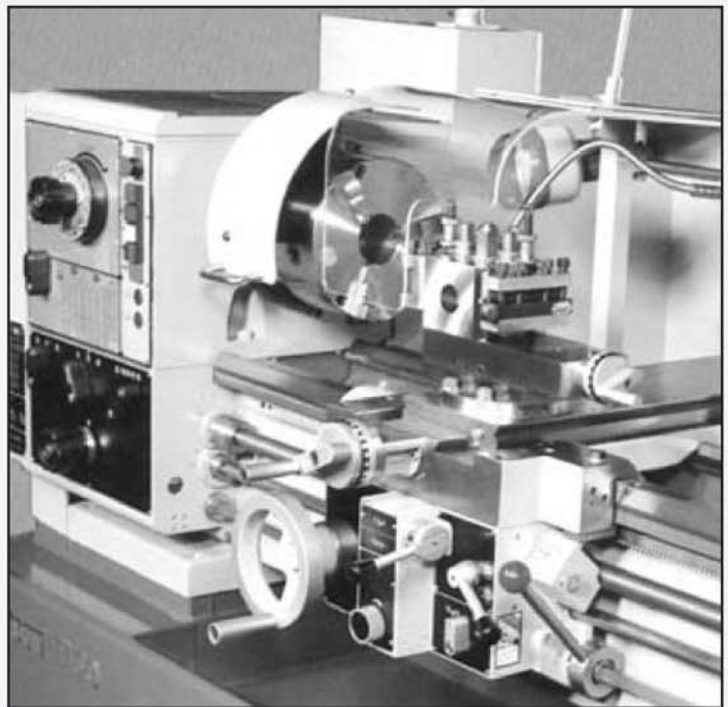
bolted to the back of the bed immediately below the headstock. Five V belts transmitted the power to the geared headstock - the input shaft was fitted with separate clutches, manufactured by the Matrix Company, for forward and reverse operation and the main spindle also carried (as standard) a powerful Warner electromagnetic brake mounted on its outer end.

Two concentrically mounted, rotary selectors that had unambiguous markings and positive indents selected the spindle speeds.

The oil-splash lubricated screwcutting and feeds gearbox (with induction-hardened gears) was controlled by three smooth levers and a single rotary selector. Without changing or rearranging any of the end gears (changewheels) 54 metric pitches from 0.2 to 14mm pitch, 51 English threads from 2 to 84tpi, 18 Module pitches from 0.2 to 3.5MOD and 27 Diametral from 8 to 72DP. The feed to the leadscrew (but not the powershaft) incorporated a torque-limiting mechanism and power feeds ranged from 0.04 to 2.84mm per revolution of the headstock spindle (0.0016in. to 0.112in.) with power cross feed one half the longitudinal rate.

The carriage included the double-wall, oil-sump apron of type newly developed in the 1980s where twin bevel gears, which incorporated dog clutches, powered the sliding and surfacing feeds; this feature enabled the operator to instantly reverse either without having to stop the headstock spindle. The engagement lever for the feeds worked through a simple safety gate and merely had to be lifted to selected power surfacing (cross feed) or lowered for sliding (longitudinal feed) - returning the lever to its central position, which could be done under load from the heaviest cut, stopped the feed. On gap-bed machines the carriage-traverse handle (which could be disengaged when using power feeds) was positioned on the right-hand side of the apron, and left on straight-bed models.

The makers described the leadscrew nut as being of the 'floating' type, used to ensure 'maximum threading accuracy'. On the right-hand side of the apron, immediately below the standard-fit dial thread indicator was a gated spindle-control lever that provided electrical stop/start and forward/reverse functions. In the



M450 saddle and headstock.

middle of the apron was a single gear (moving through a vertical gate in a manner first used on Kerry lathes of the early 1950s) that both selected and engaged power feeds; a separate rotary control was used to set the point at which the power-feeds would be automatically disengaged if overloaded.

The cross-slide was of the full-length type and both it and the top-slide (which could be swivelled through 360deg.) were fitted with taper gib strips. The handwheels were of the typical Colchester/Harrison semi-lever type with the micrometer dials (dual reading metric/English units were an optional extra) finished in non-glare satin chrome, the cross-feed screw could be adjusted to eliminate backlash.

When a machine is fitted with dual dials the cross feed screw and nuts (the nut was a 2-part affair with fixed and adjustable components) and be either English or metric. To tell which is fitted look at the micrometer dials: the engravings on the outside (nearer the operator) indicate that type is fitted. i.e. if the metric graduations are on the outside the lathe has been fitted with a metric screw and nut.

Apart from its height the tailstock was identical to that on the M400 and M450 machines; it had a 73mm diameter (2.875in.) spindle with 155mm (6.125in.) of travel and a No. 5 Morse taper. The spindle was engraved with ruler marks in either inch, metric (or both) graduations and a rotary micrometer dial was fitted as standard.

A 1000 mm capacity machine weighed 1871kg (4124lb), the 1500mm version 2074kg (4571lb) and the long-bed 2000mm model 2277kg (5027lb). Overall lengths were, approximately: 2215, 2690, and 3240mm (88, 106, and 127in.) respectively. 



HORIZONTAL SPINDLE MILLING ATTACHMENT

Jim Haslam

continues with item 8, the spacers.

●Part II continued from page 755
(M. E. 4276, 23 June 2006)

Face off the bar, machine the 6mm diameter and cut the thread. Part off the component and finish to length. Centre drill, drill 5mm dia. and tap M6.

Arbor support arm (item 9)

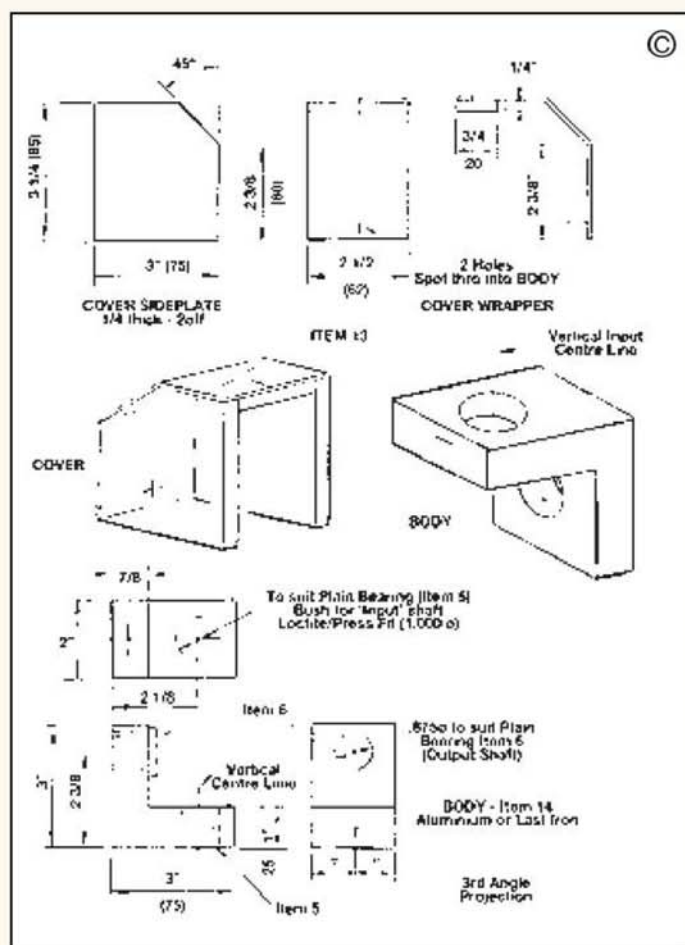
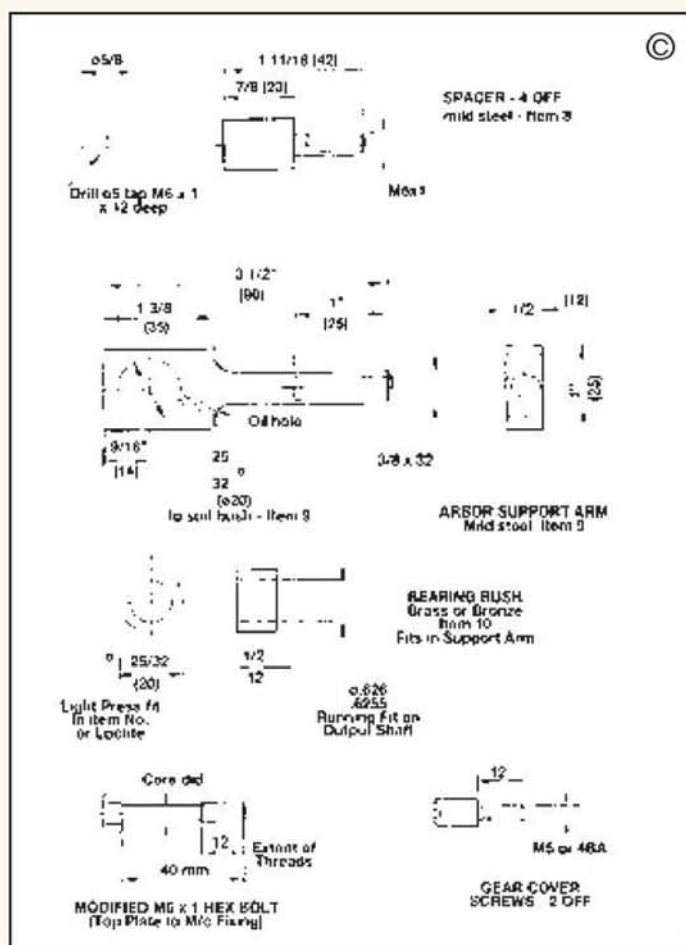
This was an afterthought. I considered additional support for the output shaft worthwhile and it fitted nicely in the available space. It can be machined from any piece of rectangular bar or fabricated from two pieces silver-soldered together.

1: Mark out the hole for the bush and the outline of the stem.

2: Set up in the 4-jaw chuck with the marked out circle running true. Centre drill, drill and ream or bore to size. The speed should be lowered for these operations to reduce the out of balance forces.

3: Reposition in the 4-jaw chuck, centre drill and machine the 8mm dia. with tailstock support.

4: Cut the thread, mark out and centre punch for the oil hole, transferring through the bush when fitted.





The main attachment body being bored in the 4-jaw chuck. The material chosen was Duralumin.



Trepanning the large hole in top plate in the lathe. It was subsequently bored to finished size.

Modified bolt (item 11)

The depth stop casting referred to above is bored to fit the machine quill. It is also split to provide a means of clamping the casting to the spindle. This slitting had allowed the casting to spring closed on my machine. If this has happened on your machine a broad nosed flat screwdriver inserted in the slot will assist in springing it open to facilitate adjustments.

The bolt (item 11) fits in the saw cut between the cross-clamping bolt and quill. The bolt is waisted to ease its fitting and removal.

Gearbox cover (item 13)

It is most essential that a suitable cover be fitted although it can be made from materials to hand and silver soldered or rivetted together. That shown comprises a brass or steel wrapper and two side plates made from 6mm thick Perspex. The Perspex was available and it gives me the satisfaction of seeing the gears revolve and allows me to check for adequate lubrication.

Body (item 14)

The design of this milling attachment was dictated by the recent acquisition of a length of 3in. square, Dural bar. Pure aluminium is rarely used in mechanical engineering because of difficulty in machining it and its low structural strength. However, the addition of 4% copper to aluminium plus some other trace elements gives the alloy Duralumin, which is a far more useful. It took me 30min to cut off a suitable billet with my hand-powered hacksaw and then I was able to machine the cut faces to length on the lathe. Had this bar not been available I would have made a suitable pattern and had a casting made - again in aluminium alloy.

The part was machined as under:

- 1: Mark out and machine the faces square and to size all over.
- 2: Mark out for the gearshaft positions, centre punch and, with dividers, mark the large diameter circles for the bearing bushes.
- 3: Set up the component in the lathe and drill and bore one of the bearing holes.
- 4: Set up the other hole and again drill and bore to size.

Lower turning speeds may be necessary on this component to avoid problems with out of balance forces.

Upper and lower mount plate (items 15 and 16)

These two items can be made from steel, brass or

aluminium alloy, whichever is available. They need to be $\frac{3}{32}$ or $\frac{1}{8}$ in. thick.

The top plate needs to be trepanned to obtain the larger hole, which is a clearance fit on the milling machine quill. I carried out the work as follows:

- 1: Cut out the plates to the specified size.
- 2: Apply laying out fluid and carefully mark out the four fixing holes and the large hole in the top plate.
- 3: Clamp both plates together and pilot drill the four spacer fixing holes, having ensured that the plate edges line up. Mark the two plates so that their orientation to one another can be repeated and then separate.

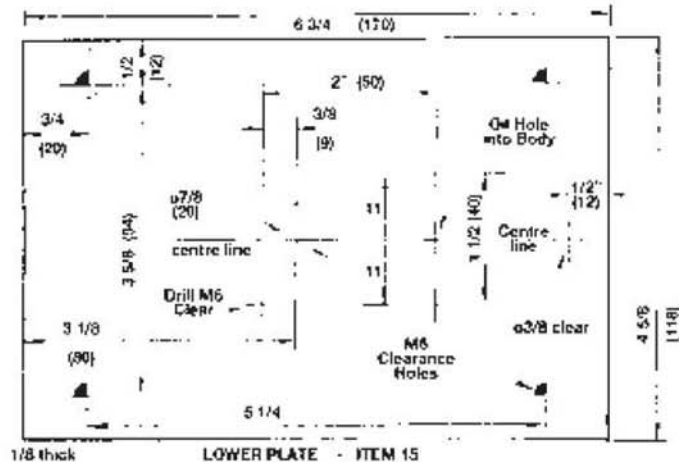
- 4: Mount the top plate in the 4-jaw chuck and trepan the large hole, boring it to the finished size.

- 5: Drill the two additional holes in the top plate for the machine to plate fixing bolts.

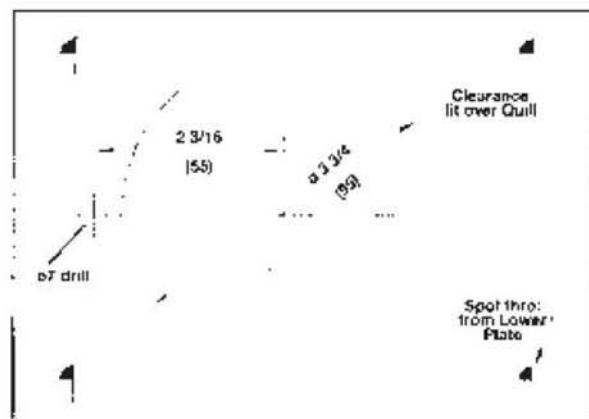
- 6: On the lower plate mark out for the body (item 14) fixing holes taking care to place them correctly with respect to the position of input shaft.

- 7: Mark out the support hole position and drill. Open up all the pilot holes drilled in the plates to finished size and deburr.

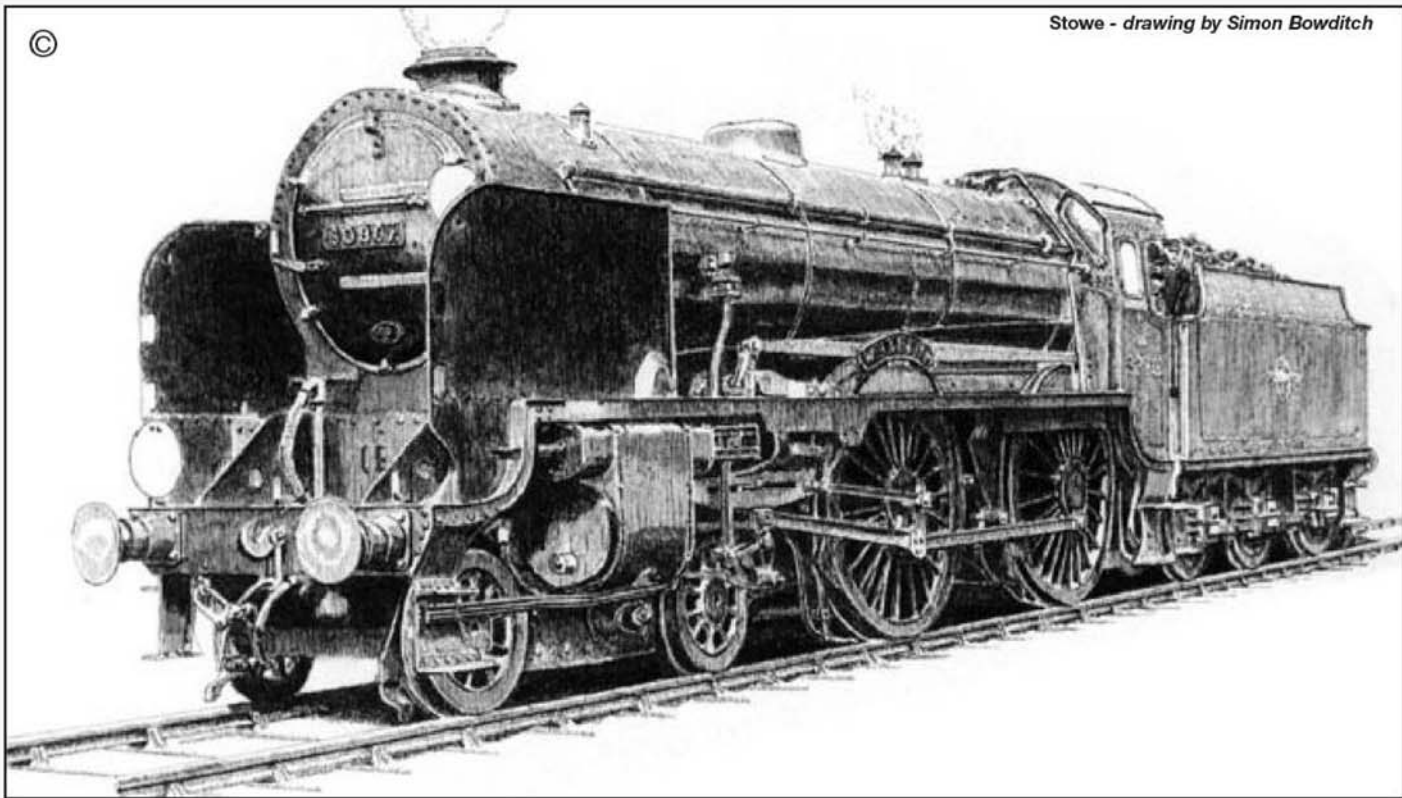
●To be continued.



1/8 thick LOWER PLATE - ITEM 15



TOP PLATE
ITEM 16
1/8 thick
Steel or Aluminium



STOWE SOUTHERN RAILWAY 'SCHOOLS' CLASS LOCOMOTIVE

Neville Evans

continues his description of this handsome class of Southern Railway locomotive.

● *Part II continued from page 32*
(M.E. 4264, 6 January 2006)

Our model of the Southern Railway 'Schools' class locomotive, or rather the 'V' class as we really should call

it, is designed to be as close to scale as I can reasonably make it. Having said that, I feel that I must point out that it is impossible to build an exact scale working model of any engine that I know of, simply because of the fact that the flanges must be enlarged to keep said engine on the track. On the GWR for instance the tyres were 5.75in. wide with flanges 1.3125in. deep. The treads were coned at 1 in 20 with the outer $\frac{7}{8}$ in. that overhangs the rail backed off underneath by $\frac{3}{8}$ inch. In 5in. gauge at

1.0625in. to 1ft. scale, this equates to 0.465in. wide with a flange depth of about 0.116 inch. A little too small for comfort. The modelling fraternity have resolved upon a tyre width of 0.531in. together with a flange depth of 0.157 inch. It must be apparent that it is impossible to increase the diameter of such things as wheel splashers to accommodate an oversized wheel flange, as this discrepancy would become immediately apparent to the practised eye. My practice has always been to take the



Full size slide bar stay. Note how the flush rivet heads are formed (photo: Dr. Peter Thomas).

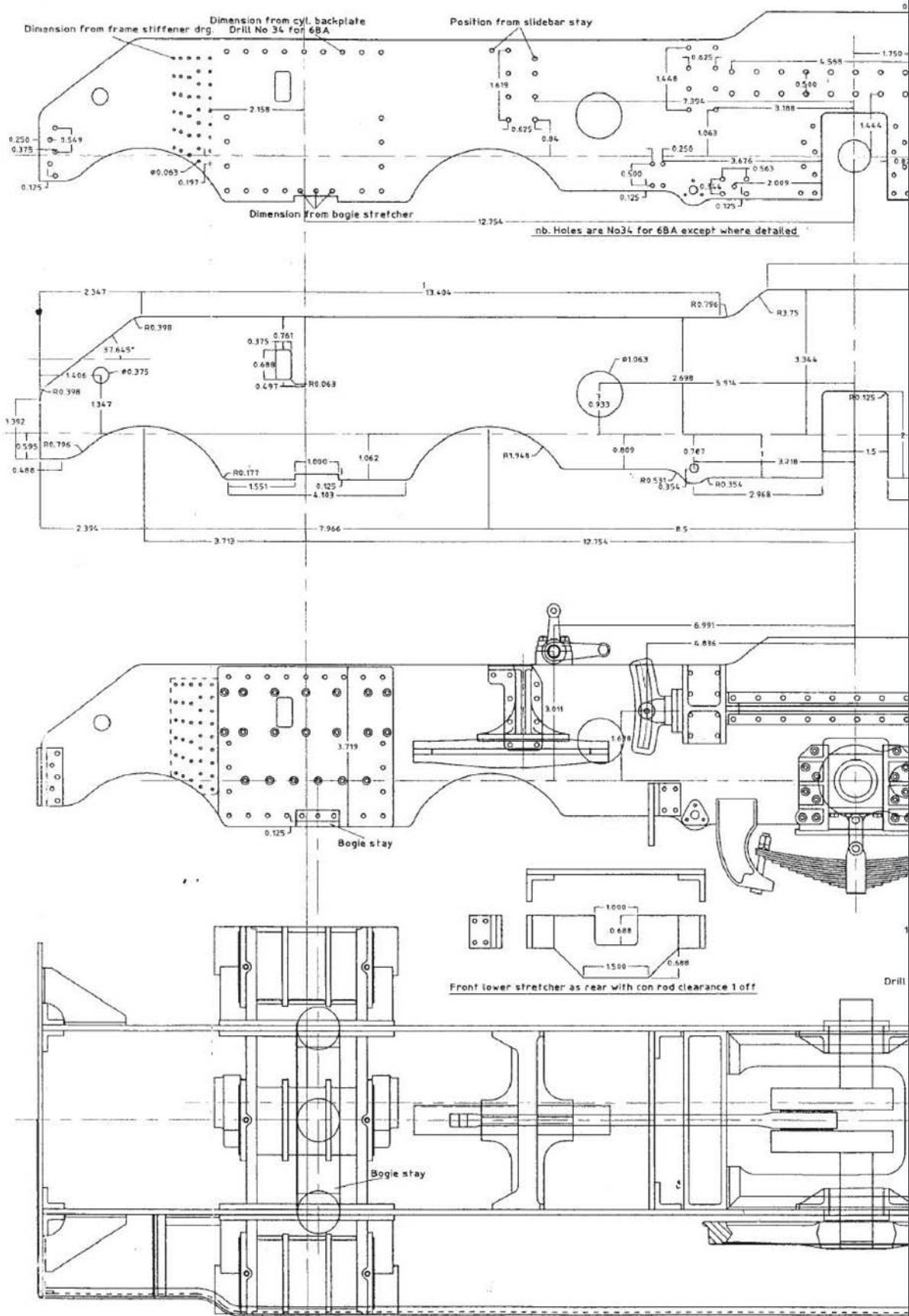


Expansion link stay and slide bar stay (photo: Dr. Peter Thomas).

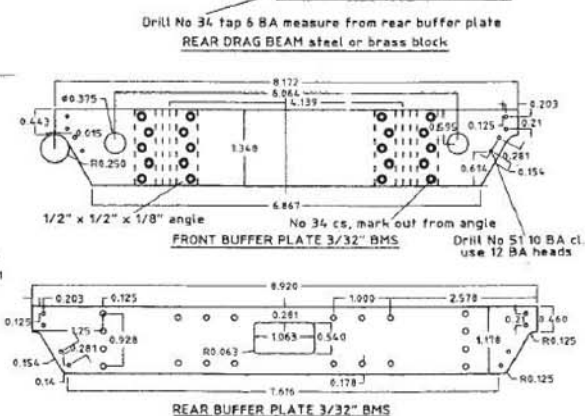
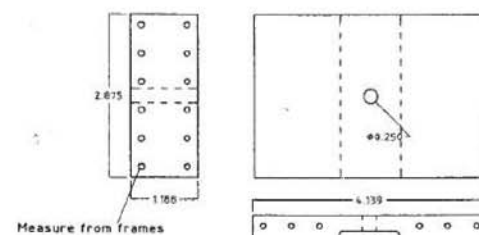
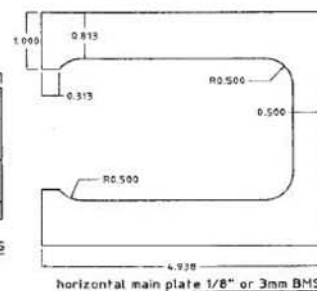
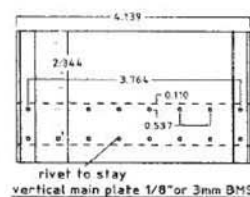
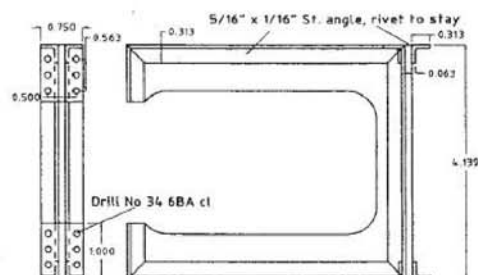
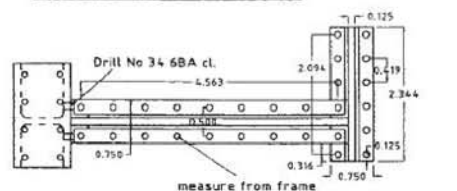
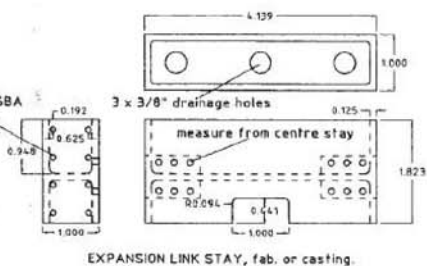
overall measurement of the wheel, that is the diameter over the flange, and to work back down reducing the actual diameter over the tyre so as to allow for the model flange. This departure from scale has the effect of lowering the total height of the engine by an insignificant amount, but as this is extremely small when compared to the overall height of the locomotive, it is quite unnoticeable.

The frames of the little 4-4-0 are in fact nearly as long as a smallish 4-6-0, as the 'Schools' is one of the largest four-coupled engines ever built in Europe. Happily we are not bedevilled with thousands of extraneous rivets around the place, although come to think of it, when they were taken into shops for work on smokeboxes and the like they seem to have had snap heads liberally scattered where neat, flush rivets grew before. One exception is the group of four bolt heads to be seen at the extreme corners of the front and rear buffer plates, as well as the 36 or so rivets that hold on the two strengthening plates that are found just in front of the cylinders; these excrescences were present on the new locomotives as built.

A significant feature of the 'Schools' is the large and very obvious bracing structure that finds itself at the rear end of the locomotive, underneath the footplate and presumably supports the rather large cab, as well as the back of the footplate. We may be able to turn this bit of trellis work to our advantage however, as I am most anxious to move the centre of gravity back until it is at the very least behind the driving axle. In an effort to reduce weight at the sharp end as much as possible, I have dispensed with the usual solid block which



Drg No 2 SCHOOLS CLASS. "ST



"TOWE" FRAMES & STRETCHERS



A fine set of Stowe frames totally fabricated by Derek Tulley - the cast components are not yet available (photo: Derek Tulley).



Full size expansion link bracket (photo: Dr. Peter Thomas).



Inside motion and slide bar stay (photo: Dr. Peter Thomas).



Right hand outside motion and slide bar stay (photo: Dr. Peter Thomas).

formed the foundation for the front buffer plate on most of my preceding engines. In fact the large and extremely stiff inside cylinder block more than makes up for any slight lack of rigidity in this area. The cylinder blocks have, of course, been lightened as far as possible by the addition of lots of air among the rather weighty metal. I have been toying with the idea of making a set from heat-treated aluminium L.M.25 alloy. Lovely stuff this, it machines like butter, and is very strong and rigid. I used it for many years to make Manx Norton cylinder heads and barrels, in conjunction with cast iron barrel liners. The cylinder heads were given cast iron or phosphor bronze valve seat liners but the combustion chambers were simply plain aluminium alloy straight from the machine. Needless to say they gave not a scrap of trouble from then 'til now.

Just in front of the cylinders there are a pair of 16 gauge stiffening plates. These rather obtrusive plates are rivetted onto the frames by no fewer than 36 rivets on each side. Please note that although I have detailed $\frac{1}{16}$ in. holes for snap headed rivets, these heads have been flattened out considerably by large men with big hammers until they are nearly $\frac{1}{8}$ in. in scale diameter. Possibly the most useful thing that you can buy at this stage of construction is *The Book of the Schools 4-4-0's* by Richard Derry, for the photographs alone. The picture of *Eton* in photographic grey, opposite page

No. 1, will tell you more in an hour of careful study using a magnifying glass, than I could in a year of writing. Borrow it from your local library if all else fails.

The centre stay is part fabrication and part casting although the front portion, which also carries the centre expansion link trunnions, can easily be built as a fabrication from $\frac{1}{8}$ in. or even $\frac{3}{16}$ in. steel plate, screwed together and silver soldered. As can perhaps be seen from the appended photo, Derek Tulley has had to go the built up route, because he is ahead of the pattern-making schedule. The complete stay when rivetted up is immensely strong and rigid. It could in fact be built as heavily as possible even to the extent of carrying extra ballast on the inside. I appreciate that it resides a short distance ahead of the driving axle, but it can easily be balanced by a much smaller weight at a greater distance aft of the centre of gravity. In fact, with a locomotive of this power, we should spare no effort in adding as much weight aft of the front axle as possible.

The bogie is rather similar to the large plate framed device that Mr. Hawkesworth used under the front end of the 'Modified Hall' and the 'County'. The springing however is quite different as the 'Schools' has coil springs as opposed to the leaf springs on the GWR locomotives. One point to note is that the downward slope on the lower edges of the bogie frame to be seen in

the earlier photos of these engines, had to be modified because of fracturing of the plates. The bogie was of course the same as that of the 'Nelsons' but carried 3.5 tons more weight. New frames of greater depth were substituted as can be seen in the G.A. drawing of the later version of the locomotive, that is the one with the le Maitre chimney. The change over seems to have occurred about half way through the building of the class, and all the early ones had been dealt with by the mid thirties, which suggests a degree of urgency.

Smoke deflectors were fitted to the engines as standard after the first batch of ten, and the earlier ones were soon brought up to suit, much to the disgust of such luminaries as Curly Lawrence, or LBSC as he was better known, and my Father. The G.A. drawings inevitably show that sanding was provided to the leading driving wheels only on the first ten engines, but Nos. 900 to 909 were very speedily equipped with rear sanders also, as were the three later batches. Steam operation replaced gravity at the same time. Snifting or anti-vacuum valves adorned the smokeboxes of Southern locomotives but from 1946 onward they were deemed not to warrant the extra maintenance required and they were removed as the engines came in for general repair. We can conveniently discuss the multiple blast pipe le Maitre exhaust when we come to the front end generally, in the not too distant.

●To be continued.

ROAD STEAM

Stan Nipper and Martin Wallis

continue the description of the engine but Martin begins with a few thoughts on foundries.

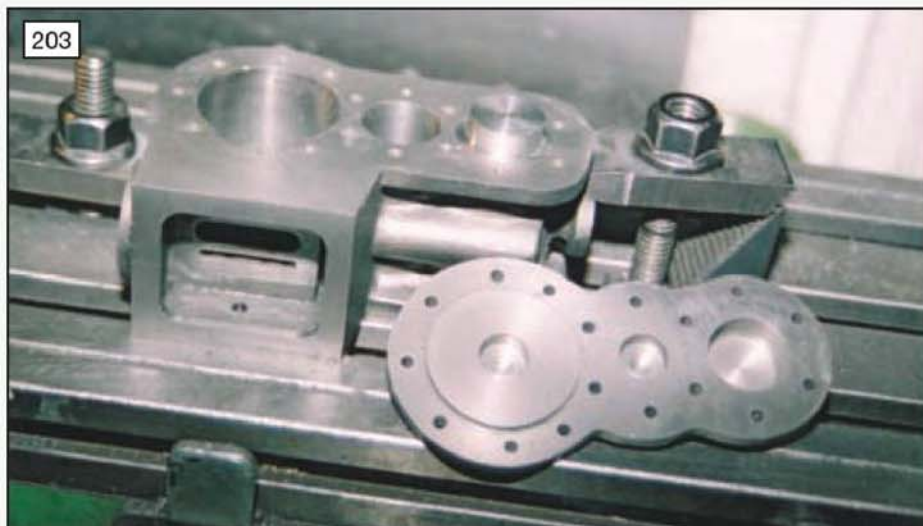
● *Part XXII continued from page 753 (M.E. 4276, 23 June 2006)*

Little Samson Models has a steady and ever increasing stream of requests for assistance in getting one-off castings poured from home made patterns. As an example, a gentleman is making a 3in. scale Fordson Model F tractor - for which he has already made the internals of the gearbox (including cutting his own gears) and various parts including the gear stick but has had no luck finding a willing foundry to cast the bell housing.

The reality is that Little Samson Models has enough trouble getting its own castings done. Here in the South East three foundries have closed in recent years, one of which sadly was the major supplier for another well-known purveyor of road steam castings. No new foundries have opened.

The main reason, I understand, is rising costs. Recent increases in the price of gas, oil, and electricity have hit foundries hard; likewise they have an ever-increasing number of expensive environmental and emissions hoops to jump through. Interestingly, the foundry folk I deal with are as environmentally informed as anyone. They do not simply want a license to pump out as much CO₂ as they fancy (and goodness knows what besides), their goal is a level playing field.

For example my main iron foundry uses large, electric induction furnaces. In their opinion these are about as near to 100% efficient as may be achieved. Certainly the insulation is so good that you can rest a plastic cup of coffee on top of the furnace in complete safety - I have done it! Their argument is that their efficiency is several orders of magnitude better than their competitors in China, who I am informed, burn inferior fuels such as lignite and have far fewer environmental controls/expectations. I understand the quantity of CO₂ produced per ton of cast iron poured in



The cylinder and front cover. Note the turned button simulating the piston valve liner in the piston valve bore (photo: Stan Nipper).

SAVAGE'S UNIVERSAL CARRIER

Great Britain is considerably less than the equivalent in China, so where is the environmental logic of British foundries shutting and China's flourishing?

A second reason for the closure of some of these foundries is conjecture on my part. Most such enterprises go back many years and, in consequence, own the land they trade from. As with so many companies the land is now worth very much more than the business, so close the business and welcome another housing estate, block of flats or shopping centre.

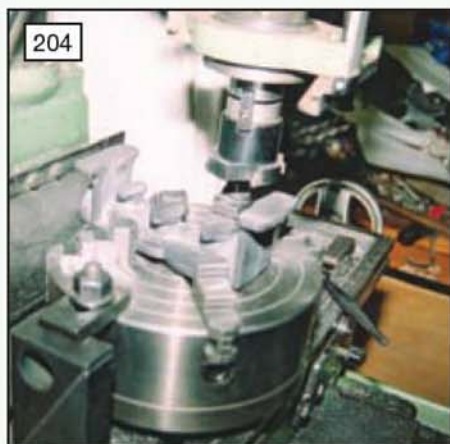
Cylinder covers

Returning to our *Universal Carrier* there are two cylinder covers specified on the model. One of very few departures from the prototype. On the full size wagon the cylinder was only open at the front end, the casting having 'blind' bores. The legs, which fixed the cylinder to the crankcase, were an integral part of the casting. The quickest way to appreciate this is to glance at **photo 211**. Here on the model there are two castings, the prototype was just one.

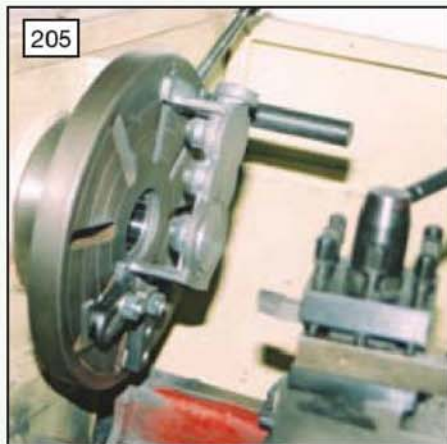
In model engineering terms not only does the substitution of two castings for the prototype's one make all the machining much more straightforward but the foundry work became considerably more manageable. In addition there were two other less obvious advantages. Firstly the piston valve liner, which is a medium press fit in the cylinder casting. If it were to be pressed into a blind hole what are the chances of getting it back out again? On the full size engine, presumably there were threaded holes to draw it back out (although not detailed on the work's drawing) or perhaps Savages never envisaged the need to withdraw it. Secondly, the transfer ports for the high pressure and low pressure cylinders would have to have been cast in. The thought of such narrow, cored passageways situated at the end of the blind bores did not appeal at all.

Locating of covers

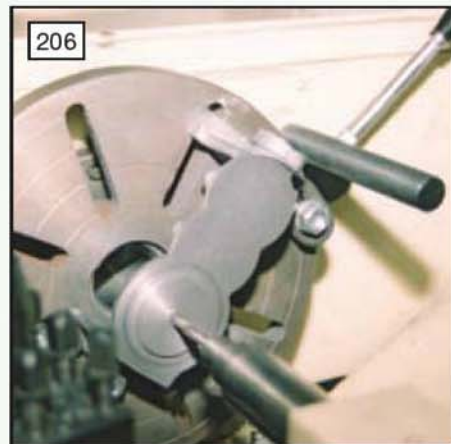
The same method used by Savages to locate their front covers was adopted to locate the back cover (**photo 203**). The piston valve liner at one end, which is noticeably longer than the



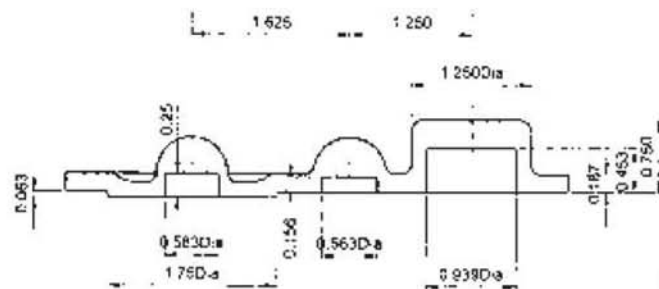
Machining across the feet on the back cover (photo: Stan Nipper).



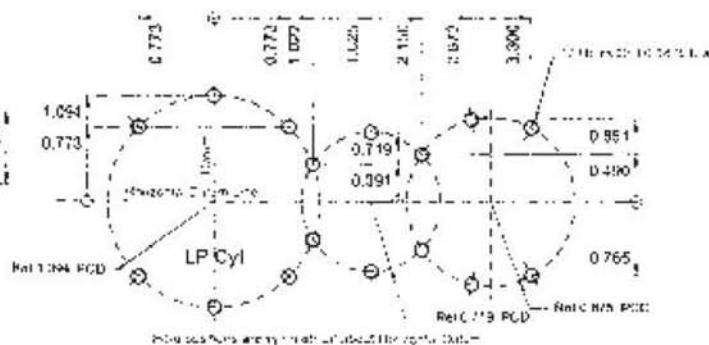
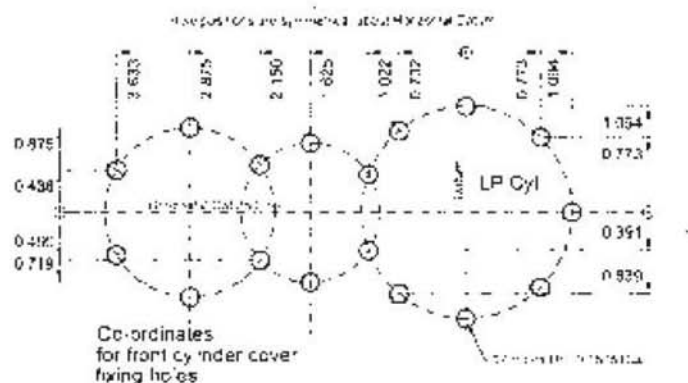
The casting was transferred to the lathe to be faced across (photo: Stan Nipper).



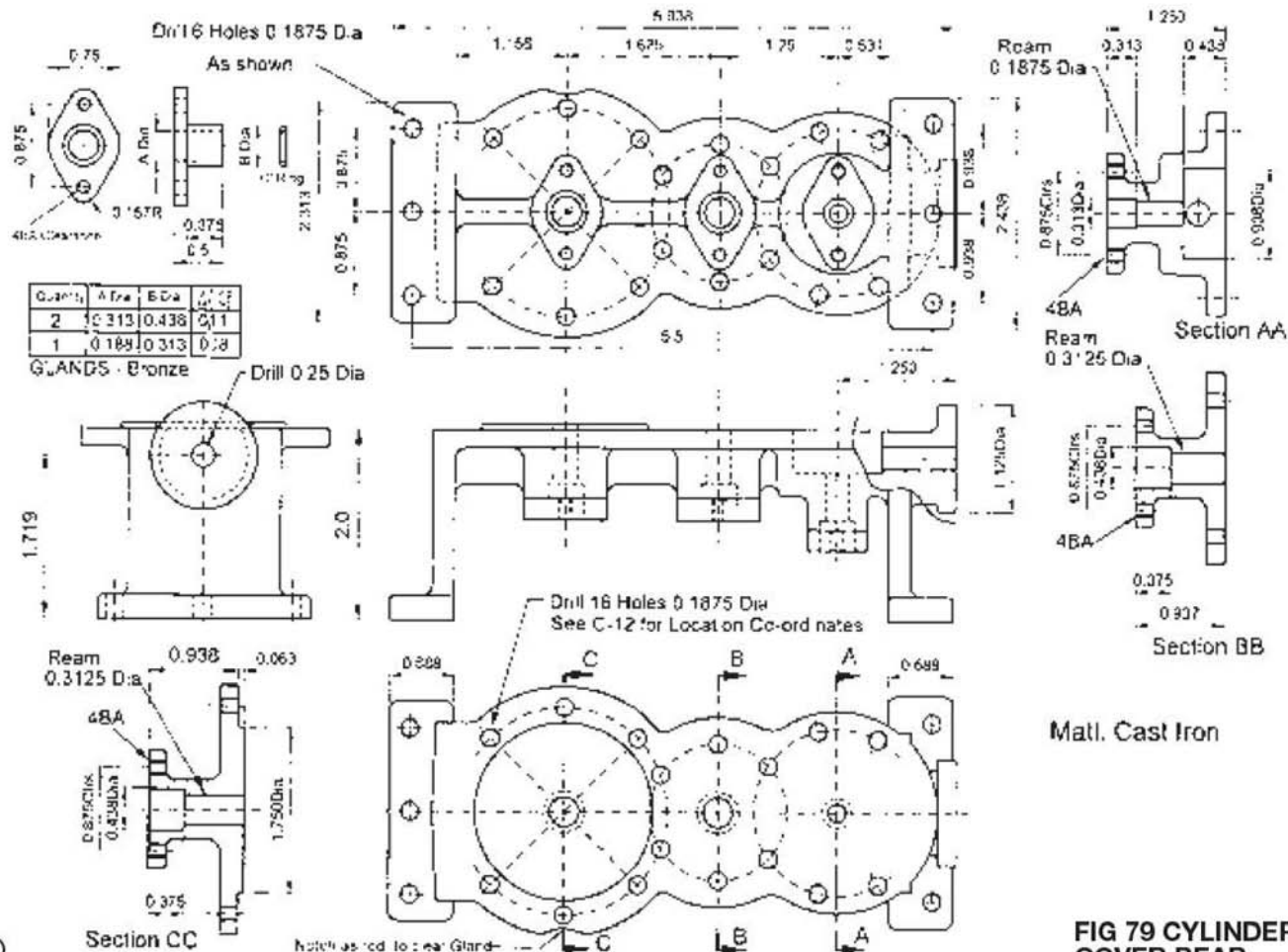
The low pressure piston rod hole being drilled and reamed (photo: Stan Nipper).



©



Co-ordinates
for rear cylinder cover
fixing holes



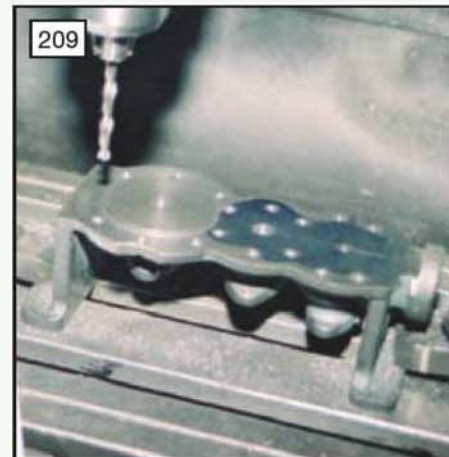
**FIG 79 CYLINDER
COVER REAR**



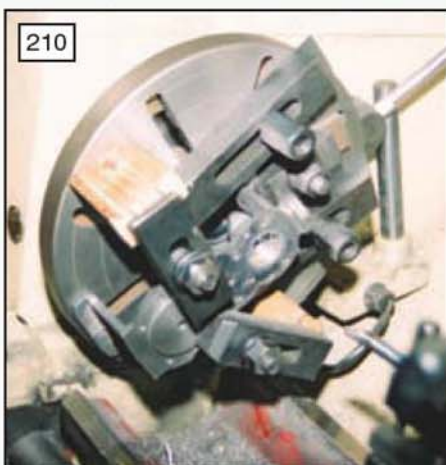
207
Facing across the front cover on the lathe (photo: Stan Nipper).



208
Co-ordinate drilling the holes for the front cover (photo: Stan Nipper).



209
The duplicate operation on the back cover (photo: Stan Nipper).



210
The casting is returned to the lathe to machine the piston valve liner recess (photo: Stan Nipper).

cylinder, is used as a location and at the other end a raised spigot on the cover locates in the low pressure bore.

A good place to start on the back cover is to machine across the two feet, and whilst so positioned the builder might as well lightly skim across the faces of the three glands at the same time. The casting may then be fixed to the faceplate, centred on the low pressure cylinder, to be faced right across and to machine the raised spigot for location purposes. At the same time the hole for the low pressure piston rod may then be drilled and reamed, a sliding but not loose fit

being sought, a piece of piston rod material being used to confirm the fit.

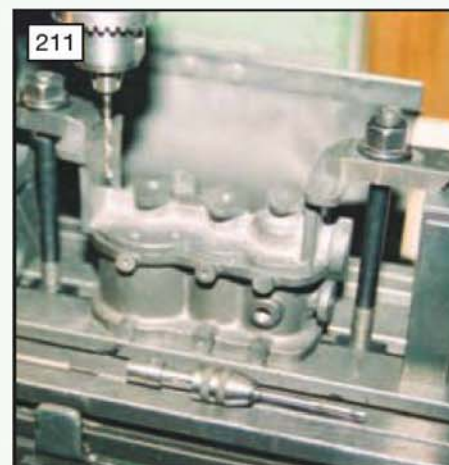
The operation may then be repeated for the front cylinder cover, this time a 4-jaw chuck doing the deed. However this time the drilled and reamed hole is only 0.25in. deep, a smaller size may be substituted as the hole is for location purposes only. Once finished do not, however, remove it from the chuck too quickly. Unscrew the chuck, with the work in it, and transfer it to the milling machine, see photo 208. Position the cover so the three circles are axial with the milling machine table and with a short piece of ground bar, chosen to match the hole in the cover, in a collet pick up the centre of the low pressure cylinder. Zero the digital readout or the table dials accordingly.

Co-ordinate drilling

It is now easy enough to move the table along the prescribed amounts to co-ordinate drill the centres of the high pressure cylinder and piston valve bores. With the co-ordinates to hand it is then just a few short steps to drill all the holes for the fixing studs as well, the drawings provided giving all the necessary dimensions.

Drilling the back cover is a duplicate operation with the casting fixed straight to the machine table. The two remaining piston and valve rod holes may be drilled and reamed, followed by the stud holes - but remember that the stud co-ordinates are different from the other cover.

Most builders would probably like to return the covers to the lathe to machine the larger recess in each cover that locates over the end of the piston valve liner, see photo 210. Sharp-



211
The holes in the covers being spotted through into the cylinder (photo: Stan Nipper).

eyed readers may have noticed that in the front cover this recess is dimensioned 0.939in. in diameter but on the back cover just 0.938in., for which there is an explanation. In both cases the liner needs to be a steam tight fit in the covers. For the back cover a light press fit is recommended for which the 0.938in. is specified. For the front cover an O-ring has been squeezed in (quite literally) so an easier fit is suggested, as the O-ring will make it steam tight. However, if the piston valve liner has yet to be machined it hardly matters, the correct fits may be sought later.



212
A CNC machine is shown being used to profile the gland bosses (photo: Stan Nipper).



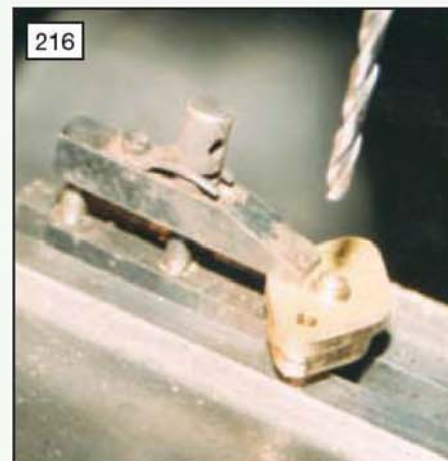
213
Larger flange on the back cover is the main steam inlet, smaller one on the cylinder is the steam inlet from the simpling valve (photo: Stan Nipper)



The back cover is fixed to the crankcase with six 2BA bolts (photo: Stan Nipper)



A CNC machine will make quick work of cutting out the valve rod guides (photo: Stan Nipper)



A simple jig is used to drill the holes in the valve guide (photo: Stan Nipper).



The fully machined set of valve and piston rod guides all ready to fit (photo: Stan Nipper).



A photograph showing the valve guides fitted in to the crankcase (photo: Stan Nipper).

The last few little tasks are the spotting through of the fixings holes in to the cylinder casting, tidying up and drilling for the stuffing boxes, and facing off the steam inlet flange.

Real progress

The time has now come when the builder is ready to fit the cylinder to the crankcase, not in itself too challenging a task but an occasion when the model takes another big step towards completion. The legs of the back cover are simply bolted to the front face of the crankcase using six 2BA studs and nuts, but first the exact location will need confirming.

Assemble the crankshaft in the crankcase and, with the crankcase upside down (to use the large flat surface) on the milling machine table, or on a surface plate, pick up the centres in the ends of the crankshaft with a height gauge. Then scribe a line at the same height across the front face of the crankcase. This will give the vertical height of the high pressure and low pressure rods. Then mark the distances across the front face according to the drawings, and check that they do indeed correspond to the middle of the big ends on the crankshaft. Leave the scribed lines just as they are, do not centre pop them.

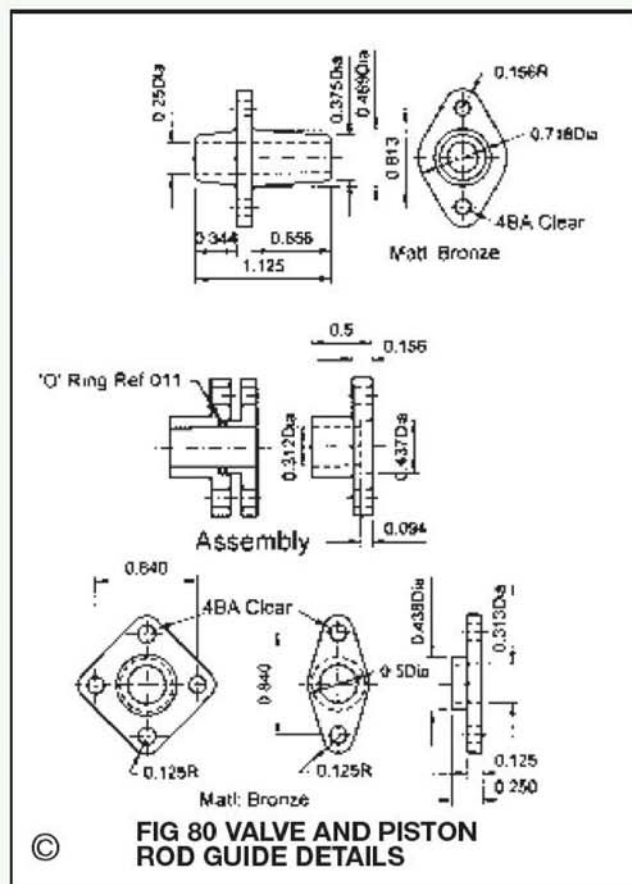
Cut off three suitable lengths of ground rod the same size as the high pressure valve rod, high and low pressure piston rods, and turn a point on each. The three pieces may then be dropped in their holes in the back cover and the whole offered up to the crankcase. The three points may be lined up with the scribed lines on the crankcase and each given a gentle tap to mark the spots.

Valve and piston rod guides

The crankcase may then be drilled for the high pressure valve and two piston rod guides. The guides are simple enough to machine, the piston rod guides incorporating an O-ring to both encourage the crankcase oil to stay inside and discourage the ingress of water or condensate from the cylinders. Since the valve rods have a much shorter travel the valve guides do not need an O-ring seal.

Once the guides are all fitted, the cover may be replaced and the dummy rods slid into place. The six 2BA holes may then be gently spotted through, drilled and then tapped for studs and nuts. Some builders may wish to add a single dowel pin in each leg for a more positive location. Once secured the cylinder may then be added. The position of the low pressure valve rod may then be transferred to the crankcase in just the same way and the hole drilled and the last valve guide fitted.

● To be continued.



Ted Wale

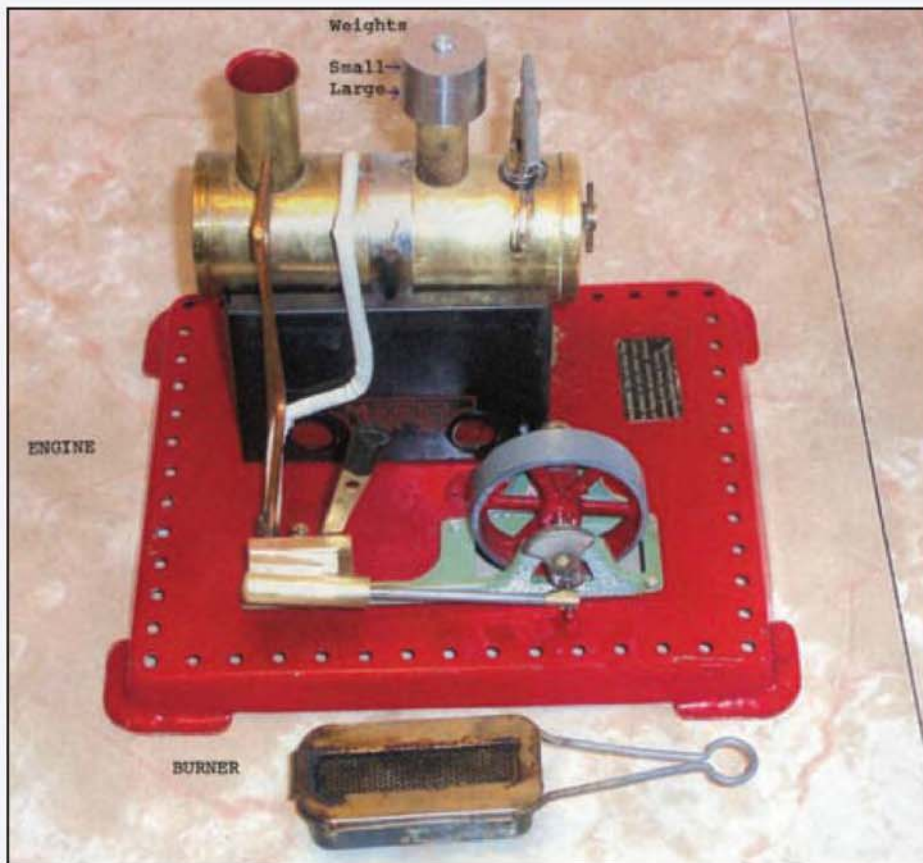
describes how he restored a Mamod stationary engine to its former glory.

Ken, a bridge friend of mine, one day mentioned between rubbers that he had a small model steam engine with which he had great fun with when young: unfortunately it now did not go. "As I played with models, could I fix it?" he asked. My usual safe answer was "Don't know, show it to me". So the next time we played at his house I was shown his youthful treasure, a Mamod model stationary engine. Those readers who are as old as myself will recognise this pre-war toy, one of a range of little simple steam models which gave us great joy and were the initiation into steam work.

Inspection in my workshop showed the model to have three faults: the spring that held the oscillating cylinder against the valve port block was missing; the boiler safety valve was non-operative and the burner was plugged.

Replacing the cylinder spring proved interesting; the first I tried was much too strong and the engine would not spin over. It took several progressively weaker springs before I had a spinning engine and I had grave doubts at that stage as to whether the cylinder would be held against the block adequately under pressure.

The safety valve problem was that the tiny rubber washer that was the seal had deteriorated into a hard brittle substance that would not seat properly but worse, the spring was broken and I found this also to be very brittle, it broke again when I tried to extend it. I decided to remake the safety valve on an entirely different principle. I copied the operation of a small pressure cooker. A good seat for a small ball bearing, a support tube for the pressure shaft and two weights to fit on top of it gave a reliable assembly that would be far less likely to fail for the foreseeable future. One weight was twice the other so that the smaller gave 5psi, and the others significantly larger. On air test they were found to be too large and a small reduction had to be made to each. The only thing against this was that the new safety valve assembly was much larger than the original and looked a bit clumsy on this little engine. However, it worked safely.



KEN'S ENGINE

The burner had been used with solid fuel pellets (I was told) and they plugged the grid. Disassembly, cleaning and a new piece of steel wool inside restored the burner to satisfactory operation with methylated spirits as originally intended. I can remember the use of this liquid material from my own boyhood engines.

A general clean up all round, new washers on the filling level set holes and it was ready for test. I didn't like the long thin steam pipe from the top of the boiler. I felt that it would cool the saturated steam from the top of the boiler resulting in the engine operating on a high percentage of water; so I insulated this pipe with some electrical wire sleeving, as can be seen in the photo, in the hope of mitigating this.

On test the water in the boiler made steam and the engine ran very well with the light weight alone. With the heavier weight it took off like a dingbat! I never tried it with both weights as shown in the photograph. It would need a load on the engine flywheel. My worry about the weakness of the cylinder spring proved groundless. There was virtually no steam leakage at the port block and the reversing lever worked as it should. The only possible performance failure was in the burner. It could not hold enough meths to boil the whole boiler full of water at one firing and had to be refilled half way through a full run. Maybe this wasn't so bad after all - built-in safety feature?

Altogether a very satisfactory nostalgic performance, and Ken was very pleased too! 

IN THE NEXT ISSUE

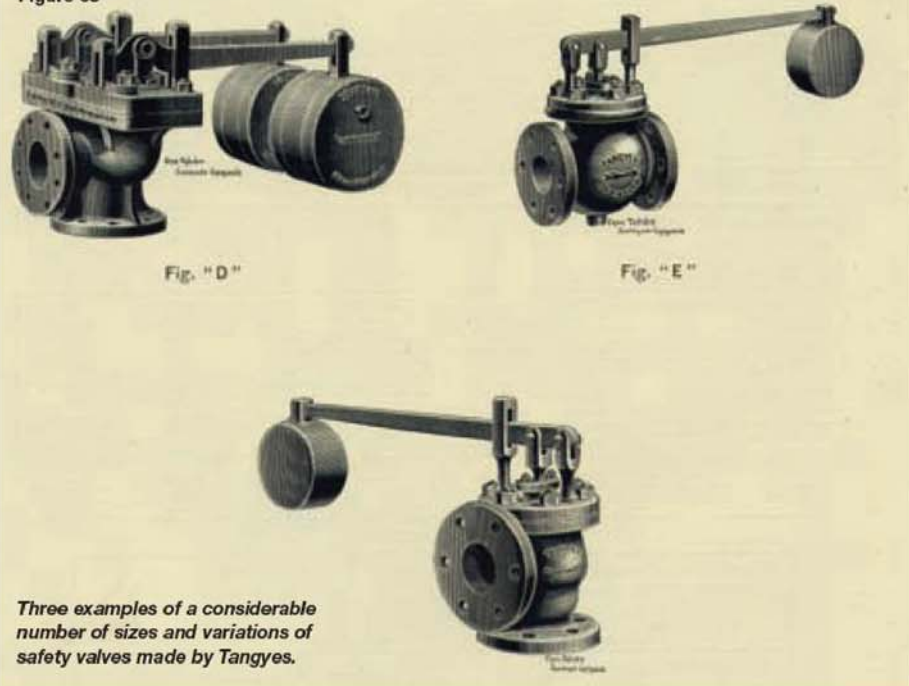
- New Epicyclic Engine
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Plus all your regular favourites

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contents subject to change

Figure 55



Three examples of a considerable number of sizes and variations of safety valves made by Tangyes.

THE PRODUCTS OF TANGYES OF BIRMINGHAM 1891

David Piddington

presents his penultimate look at the products of The Cornwall Works.

●Part V continued from page 760 (M.E. 4276, 23 June 2006)

The engine unit shown on top of the 'Colonial' (fig 54, M.E. 4276, 23 June 2006) is a good introduction to the world-renowned range of steam engines produced by Tangye. This one is the 'Soho' engine named after the surrounding Birmingham suburb. This particular view does not do justice to the attractive line of the unit bedplate which was, in

plan, likened to a banjo with the cylinder forming the finger board, the trunk and connecting rod the strings, and the main bearings set across a circular bed forming the sounding board. The crankshaft was so made that the flywheel would fit at either end, and with steam supply at top of the valve chest, could be either right or left-hand mounted. Though shown here in horizontal mode, it could be mounted vertically but only for 70lbs/sq.in boilers though the reason is not clear from the catalogues. Cylinder bore diameters and strokes range from 5 by 6 up to 12 by 14 inches. A boiler feed pump was fitted to all engines.

The 'Colonial' boiler was made for wood type fuel only, and any engine or boiler so called was made so that it could be dismantled into smaller

parts or assemblies for easier carrying overland by native porters, and where more sophisticated handling equipment was not available.

Boiler fittings, fig 55, were a major consideration to all customers and whilst safety in the majority of industry was a minor factor, the devastating consequences of boiler explosions were well-known and chronicled. Study of engineering journals of Victorian times give a large number of accounts of such calamities and investigate into fine detail just how and why these failures occurred. Tangyes, by 1891, had a range of safety valves which, in correct use, would give a good guide of boiler performance to an alert engineman. This illustration gives only a quick look into the huge range of such valves produced and, after a careful count, I can find no fewer than 245 possible variations on the themes of just six patterns of safety valve and of which three are shown here. All had cast iron bodies and weights, gunmetal valves and seats, forged steel levers and malleable iron fulcrum. As I said before, just how did one decide which was the ideal for the purpose intended?

In addition to the safety valves there was provision for various types of wheel valve, displacement and sight-feed lubrication systems, steam traps and separators, retaining valves and strainers, water gauges, pet cocks, etc.

I have deliberately omitted one item from that list, this being the 'Soho' safety governor fig 56. The principle of operation is well-known, the internal valve being of the equilibrium type, i.e. with steam pressure on each side of the valve giving quick action at the very short stroke necessary for adequate working. It was so designed that if the drive belt broke, or ran off, then the weights would fall by gravity assisted by a powerful spring and the engine would be brought to rest. As can be seen there was an optional speed adjuster to regulate engine speed when running. The unit was always supplied combined with a steam stop valve and available in 14 different sizes to suit maximum working pressures of 120 or 150lbs/sq.in. steam pipe diameters increasing across the range from 1 to 6 inches.

An alternative governor was the Tangye 'Improved Pattern Porter' of the traditional type with the ball flyweights mounted above a pantograph. This unit was totally separate from a steam stop valve but similarly bevel gear driven

Figure 56

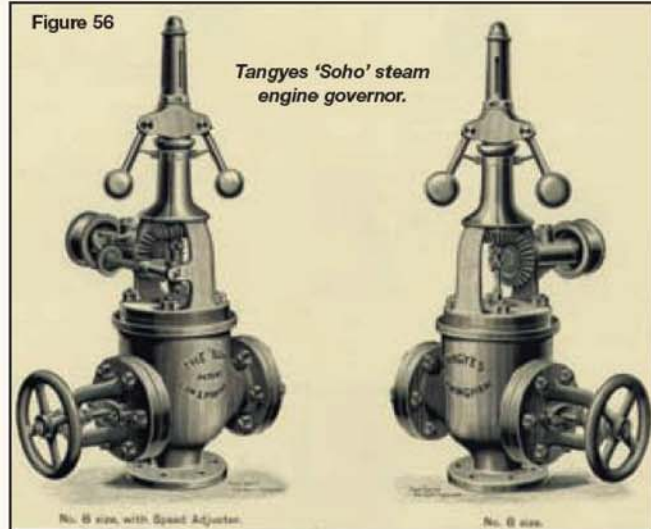
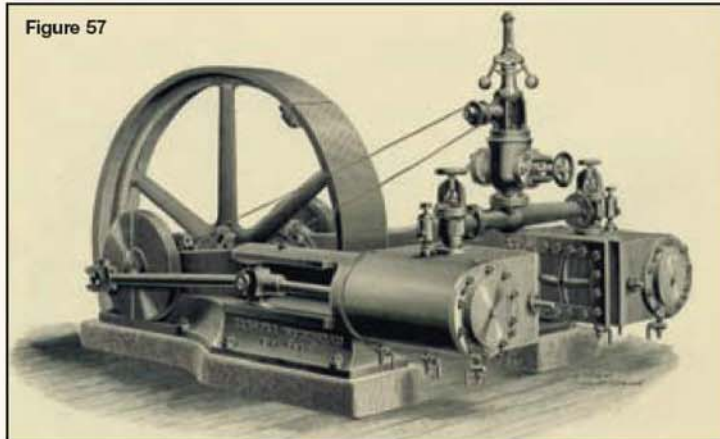


Figure 57



An original Tangye Coupled Horizontal Steam Engine on which the late Edgar T. Westbury based his ever-popular 'Double Tangye' design for model engineers to reproduce.

and available in seven sizes. A 'Soho' governor may be seen mounted upside down in fig 49 (see part IV, *M.E.* 4276, 23 June 2006).

The remaining parts of these descriptions are of the famous steam engines and the first one, fig 57, will be very familiar to *Model Engineer* readers being the type the late Edgar T. Westbury described construction of in *M.E.* volume 110 in 1954. Somewhere in Westbury's writings he mentioned his belief that the original Tangye records had been lost and he could only approximate on sizes. This was unfortunate for now that these catalogues have become better known and actual Tangye dimensions re-established I regret I am unable to co-relate any dimension of the model design with those now available to me. I believe that the catalogue may be relied on for, though dated 1891, I am sure that their patterns may have been in use for many years and would continue to be so. However, Westbury did achieve a creditable likeness to the originals and for that we should be ever grateful.

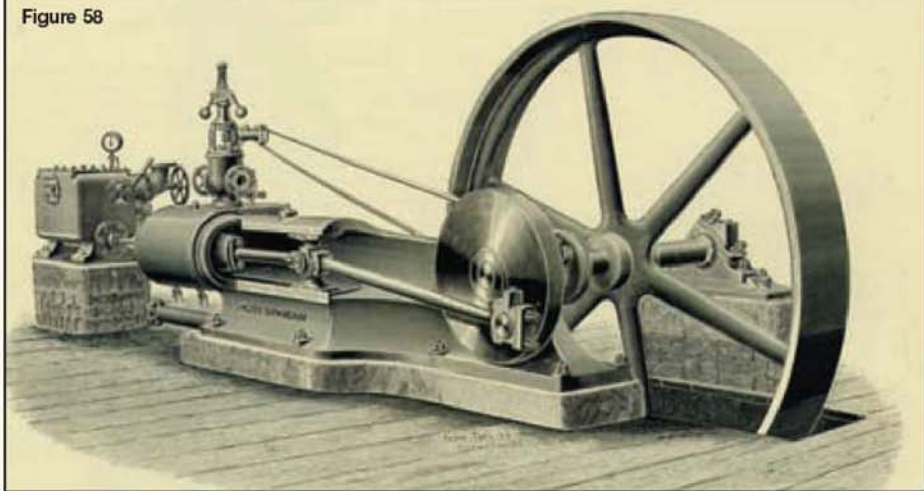
This engine was listed as the 'Coupled Horizontal Steam Engine' and we have already seen a single-cylinder unit a few illustrations ago (see fig 51, *M.E.* 4276, 23 June 2006). The basic twin engine was only for 100lbs/sq.in. but in seven separate sizes from 9in. bore by 20in. stroke up to 16 by 30 inches. Flywheel diameters ranged from 8 to 13ft. and were planed on the half joint faces, then turned and faced on the rim and edges, and then slightly rounded for belt driving. A 'Soho' governor was fitted to each cylinder with a separate stop valve. There was a central coupling on the crankshaft and gave the owner the choice of using one side only should some of his machinery be under repair enabling him to economise on fuel consumption.

A similar range of twin engines were fitted with condensers and pumps but for reasons I am unable to determine, were fitted with the 'Porter' governor instead of the 'Soho'.

The single-cylinder version of the horizontal engine, this time fitted with a condensing pump driven from an extension of the piston rod is shown in fig 58. This was made in a similar range of sizes to the twin-engine units and further information was given as to detail construction. The cylinders of both single and twin units were steam-jacketed formed by a separately forced-in liner. This was then lagged and losses from condensation were kept to an absolute minimum. If I may digress here again one André Chapelon, the world-renowned French designer of steam railway locomotives, used steam jacketed cylinders on an experimental machine in the late 1930s with considerable success. Here were Tangyes doing the same thing in standard production half a century earlier. Use of 'modern' materials is also noted with the application of 'India Rubber' for the valves in the condenser pump. The slide valves were operated from a single eccentric, though the Meyer simple expansion gear could be fitted as an optional extra.

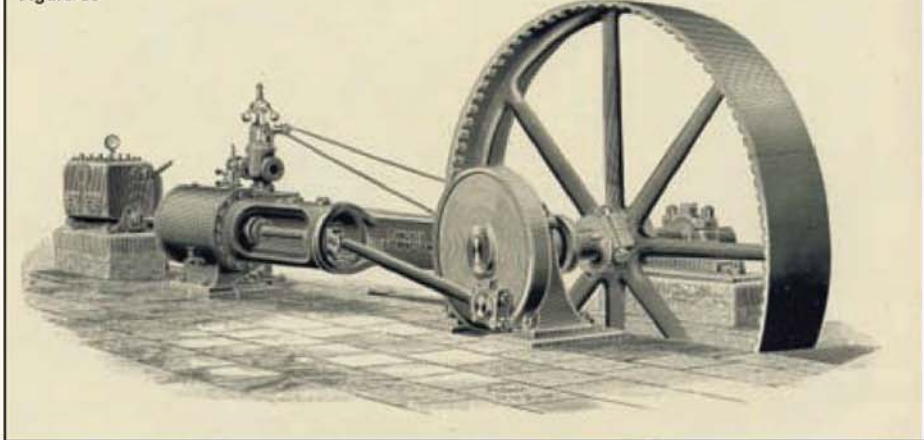
There was a second type of engine marketed by Tangye, much larger but in a reduced range of 100lbs/sq.in. whereas the 'trunk' engines described so far have had the crosshead sliding in a combined trunk and base casting, and could be ordered in the range from 60 to 100lbs/sq.inch. The single-cylinder engine in

Figure 58



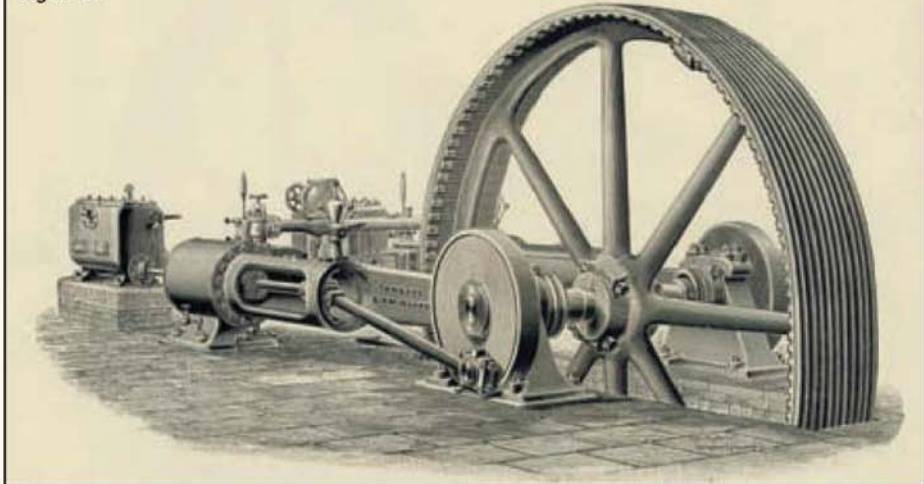
Tangyes Horizontal Condensing Steam Engine with trunk standard casting, and double acting air pump driven from the piston rod.

Figure 59



This is a larger machine. A Condensing 'Girder' Steam Engine with Air Pump. The trunk casting has been replaced with a substantial girder comprising the crankshaft pedestal, trunk guide and front cylinder cover.

Figure 60



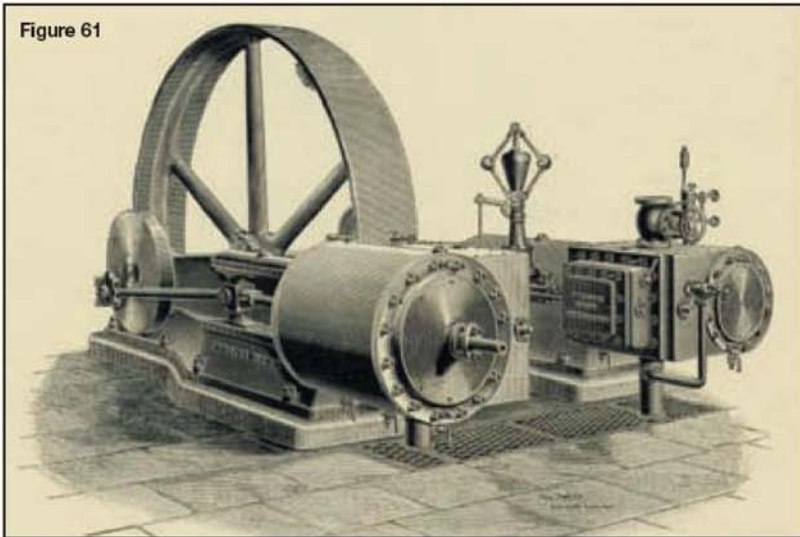
Larger still. The Coupled 'Girder' Condensing Steam Engine with two cylinders, two air pumps, and the Tangye-Johnson automatic cut-off gear. Note the 'split' flywheel which were easier to cast in halves to be machined on the faces and bolted together on such large diameters.

fig 59 was known as the 'Girder' engine and has the trunk slide and main crankshaft bearing connected by a substantial girder, the whole being in one casting. The smallest 'Girder' engine had a 14 1/4 in. bore by 28 in. stroke with a 10 ft. dia. flywheel up to a 22 1/2 x 44 in. stroke giant with a 15 ft. flywheel. This

latter machine weighed over 20 tons. As before these were available with choice of pumps and condensing gear, Meyer or Tangye's own expansion gear and with either type of governor previously illustrated.

The twin-cylinder variation of the 'Girder' engine is shown in fig 60 though this could,

Figure 61



A compound cylinder version of 'Double Tangye' was designed by John Bertinat, a revered contributor to M.E. pages. Drawings and patterns for the miniature are held by Reeves 2000.

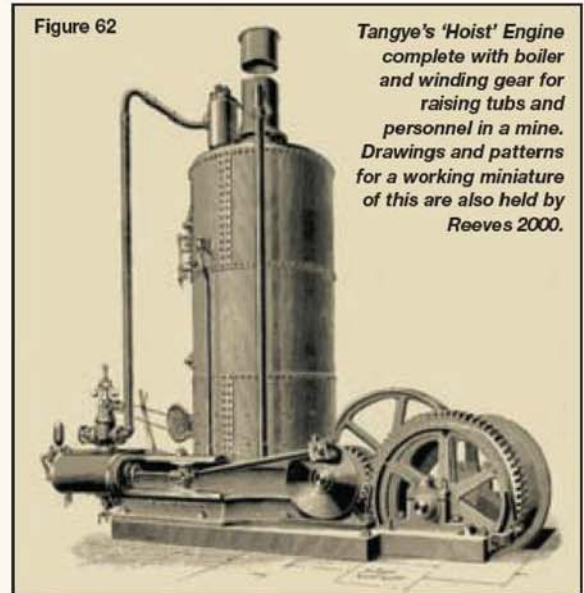
obviously, not have its crankshaft split to run on one side only. The major difference in specification related to the flywheels which were larger still in the range from 12 to 18ft. diameter. This particular flywheel is shown grooved for rope driving in a cotton mill.

All the foregoing engines have been of the simple expansion type but we must not overlook the compound expansion variety and where there were as many more possibilities in both single, twin, trunk and girder units. That shown in fig 61 is the compound version of Westbury's 'Double Tangye' having a much larger lower pressure cylinder on one side. It will be noted that the 'Porter' governor is used in this application and the engine could not be operated as a single unit.

One of the 'elder statesmen' of model engineering publications, John Bertinat, reproduced this marque by adapting a large Stuart Turner cylinder casting and offered the design to the model engineering suppliers I worked for who, at that time two decades ago, declined it. During the mid-1990s I resurrected the design, re-traced John's drawings and completed the manufacture of all the necessary new patterns.

At that same time I completed a design for a single-cylinder trunk engine, based on a Tangye 1891 catalogue illustration as seen in fig 62, complete with boiler, feed pump, reversing gear and hoist gear for demonstrating the working of

Figure 62



Tangye's 'Hoist' Engine complete with boiler and winding gear for raising tubs and personnel in a mine. Drawings and patterns for a working miniature of this are also held by Reeves 2000.

Figure 63

This is the Compound Coupled 'Girder' Engine version of 'Compound Tangye' shown in fig 61.

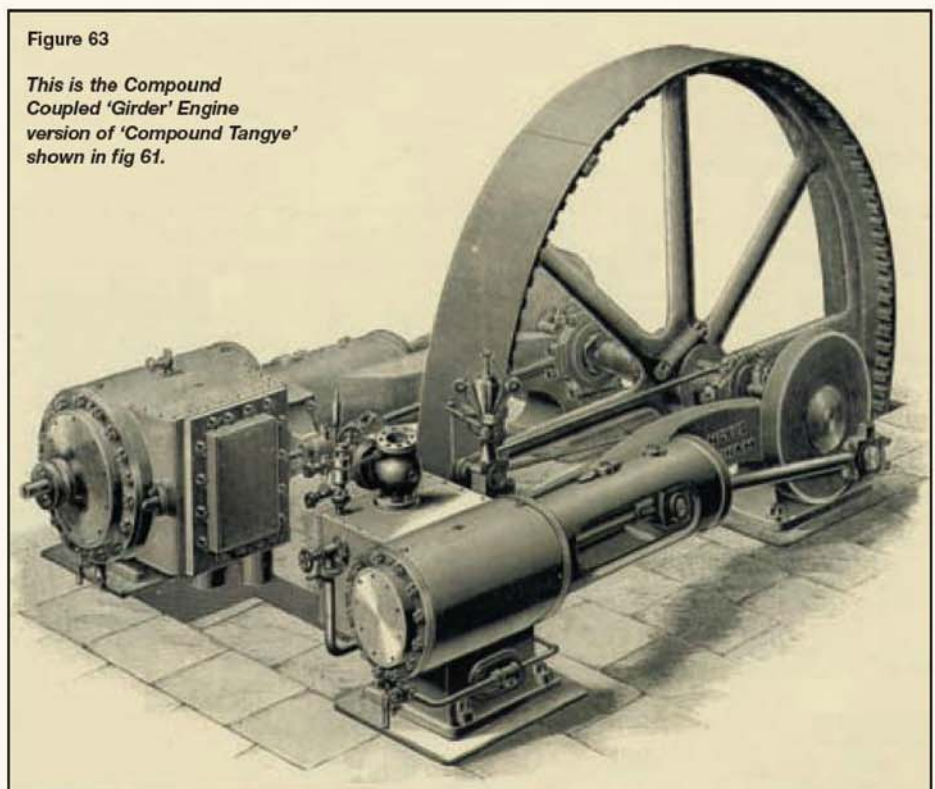
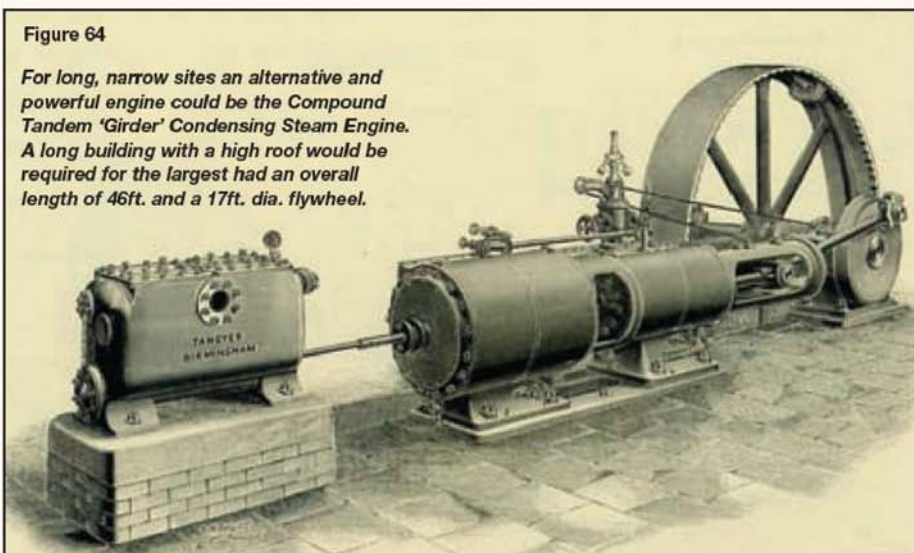


Figure 64

For long, narrow sites an alternative and powerful engine could be the Compound Tandem 'Girder' Condensing Steam Engine. A long building with a high roof would be required for the largest had an overall length of 46ft. and a 17ft. dia. flywheel.



a mine shaft. Again all the pattern work was completed before the Marston Green works in Birmingham closed. It remains to be seen if Reeves 2000 will ever put these two designs into production. I do hope so.

An impressive compound 'Girder' engine is shown in this engraving fig 63, and these could be ordered with a combination of cylinder to flywheel of 13 1/4 in. HP cylinder, 23 in. LP cylinder, 28 in. stroke and a 12 ft. dia. wheel up to a giant 21 in. HP, 36 in. LP, 44 in. stroke with an enormous 18 ft. dia. flywheel. There were five engines listed in the series but could be subdivided into three sections one without condensing, one with condensing operating between 90 and 120 lbs/sq. in., or with a lower pressure range from 70 to 90 lbs/sq. inch.

There was a further development of the compound engine and used particularly where space was limited or the engine house on a long, narrow site. Tangyes could provide a girder

Figure 65

Tangye's 'Archer' Steam Engine, open fronted and better suited to uni-directional rotation though could be reversed.

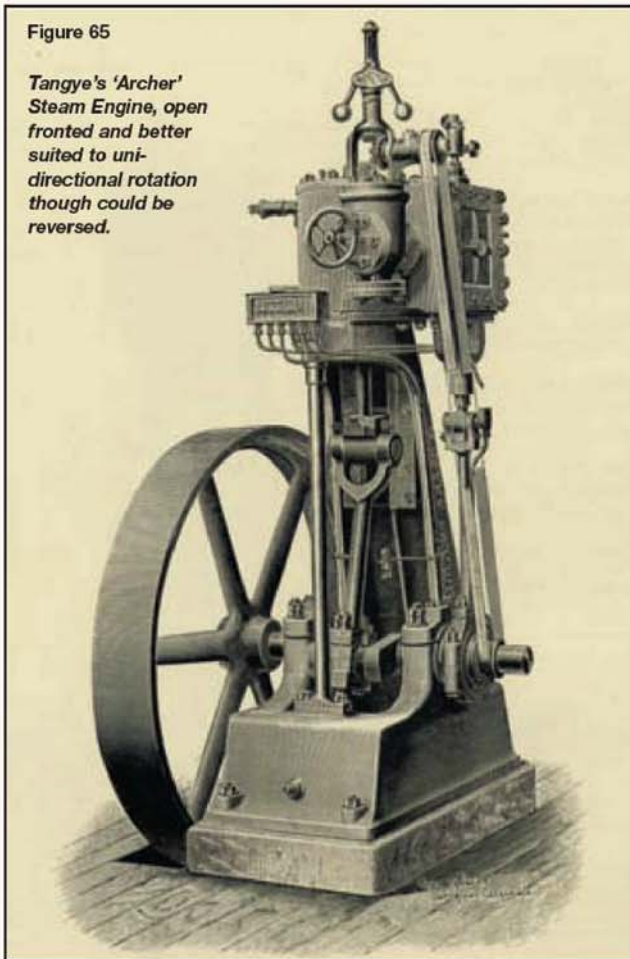
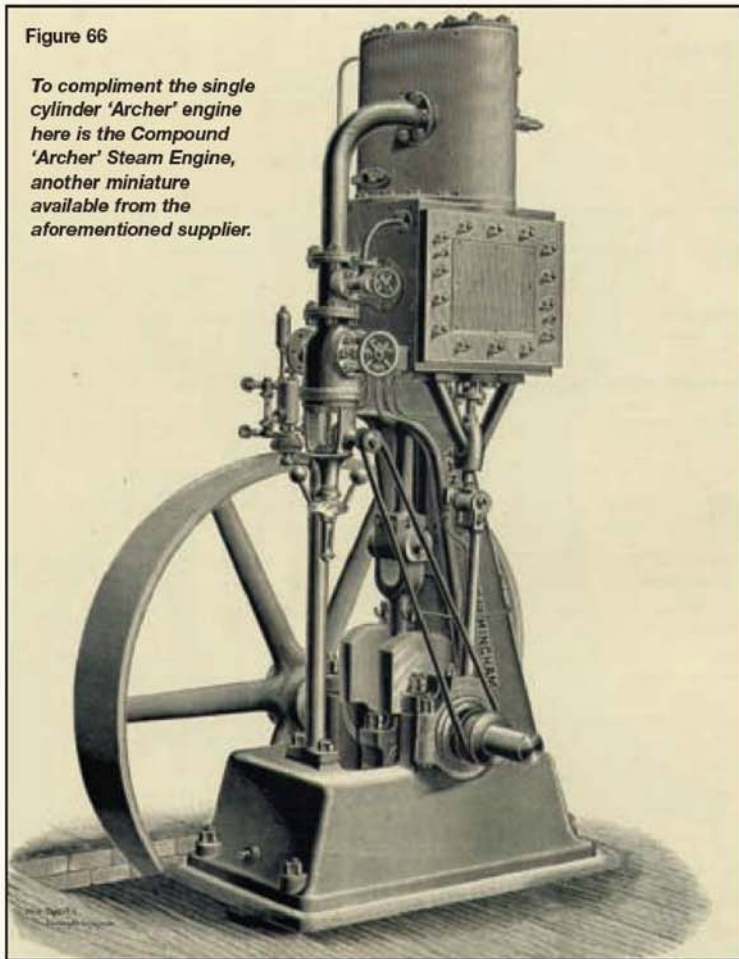


Figure 66

To compliment the single cylinder 'Archer' engine here is the Compound 'Archer' Steam Engine, another miniature available from the aforementioned supplier.



engine with tandem cylinders on the common piston rod and with condensing pump shown in fig 64. Both high and low-pressure cylinders were steam jacketed that on the low-pressure cylinder being part of the receiver between expansion stages. I am certain that this would make a fine model for the industrial enthusiast, though all engines have an appeal to someone, somewhere.

We can now consider vertical engines though, strictly speaking, these should be described as 'inverted vertical' engines. In the early days of steam propulsion of ships the engines were put into the bilges and drove a crankshaft above to the paddle wheels. This, I understand, was known as a vertical engine. Thus any engine which has a crankshaft below the cylinder would be 'inverted'. Tangye made two types; the 'A' frame which we have seen before and the 'Archer' of which the single cylinder engine for 160lbs/sq.in. is shown in fig 65. The name appears to have been derived from the sport of toxophily where the engine frame forms the bow and the front support column represents the string. If I may give the former Reeves company an historical mention their 'Monarch' engine, ably described as a construction series in *Engineering in Miniature* from 1981 to 1983 by contributor E. L. Yallup, is a similar 'Archer' engine. At the time I composed my lecture notes in the 1980s the Birmingham Science Museum was restoring a twin column archer engine with separate support columns for each cylinder. This fine machine additionally had Meyer expansion valve gear. I have yet to pay the entrance fee to visit the new exhibition at

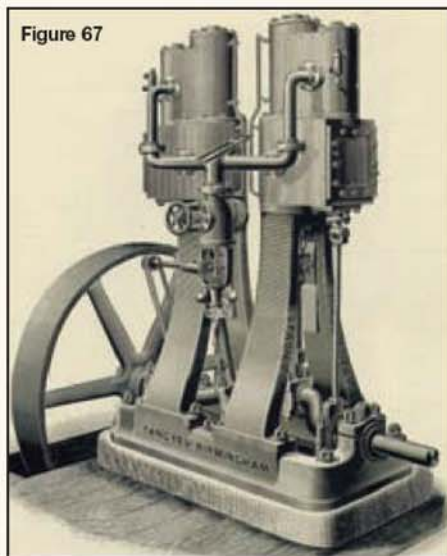
Birmingham's 'Millennium Point' so have no idea as to the present whereabouts of this fine Tangye exhibit.

With higher boiler pressures the vertical engines tended to be somewhat smaller, for example a 10in. bore and stroke machine only required a 5ft. dia. flywheel. It seems that if a higher working pressure than 100lbs/sq.in. was used then an additional stool and outer bearing

for the crankshaft was provided, though not shown in this illustration. Variations were made from 6 1/2in. bore by 7in. stroke up to the aforementioned 10in. machine. A twin-cylinder engine was made in five sizes in a similar range.

Continuing the theme of the 'Archer' engine here, fig 66, is an inverted vertical tandem compound engine. As there is no apparent gland between the high (upper) and low-pressure cylinders it would seem that an inside admission piston valve is used for the high-pressure cylinder. With an outside admission slide valve - slide valves are almost always outside admission - and an inside admission piston valve, the ports between expansion stages must be 'crossed over' to allow steam to enter the cylinder bores at the tops, and bottoms, of each in turn at the same time. This engine was made for two working pressures. First for 160lbs/sq.in. with 4 5/8in. HP cylinder, 8in. LP cylinder, 7in. stroke and with a 40in. flywheel up to an 8in. High Pressure, 14in. Low Pressure, 11in. stroke and with a 66in. flywheel. The other series for 120lbs/sq.in. had slightly larger HP cylinders, LP stroke, and flywheels remaining the same. A separate starting wheel valve was fitted to introduce live steam to both cylinders when starting, as was a sight feed lubrication unit and an inverted 'Soho' governor. Tandem compound engines were also made on the 'A' frame base in both single and twin units and the example here in fig 67 is typical of the marque. We looked at another coupled to a boiler in fig 50 (M.E. 4276, 23 June 2006).

Figure 67



The tandem compound cylinder arrangement was also available on the 'A'-frame engine, more suitable for running in both directions of rotation.

●To be continued.

BRAZING ALLOYS AND COPPER BOILERS

N. L. Counsell

reports on the results of some important tests carried out as an adjunct to his boiler inspector duties.

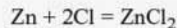
Brazing alloys cover a broad range, containing varying quantities of zinc, in some cases up to 41%. How safe is an alloy with such a high zinc content when used in the brazing of copper boilers with regard to the well known phenomenon of de-zincification? This was a question I asked myself when, as a club boiler inspector, I was presented with a boiler partially brazed with a copper/ zinc alloy containing 41% zinc.

I therefore decided to carry out some simple but meaningful tests, in which I set up test cells, and these are shown in fig 1.

The cells contained a copper cathode with a copper/zinc brazing rod as the anode. As a comparison cells were set up using a silver solder as the anode. The cells were then charged with different grades of water and were held at

room temperature, daily readings of the current flow being measured by means of a sensitive ammeter. These tests have been under way for some months, the results giving cause for concern (see below).

When a current flows in a cell the zinc is being consumed to produce zinc chloride. The chemical formula being:



The electro-chemical equivalent for zinc being 0.34mg zinc removed per coulomb. From the above the following can be calculated.

1 coulomb converts 0.34mg of zinc and requires 0.293mg chloride to produce 0.565mg of zinc chloride.

Details of Tests

Test No.1

In this test the cell was charged with town's main water which in this area (Manchester) has a low chloride content averaging 9mg/litre. The anode was copper/ zinc alloy. See **graph No.1**.

Note: The increased readings from day 10 to 12 are due to an increase in room temperature,

however the gradient of both curves converge on day 16.

Calculations:

1: Reduction in chlorides

$$(11.125 \times 16 \times 24 \times 3600 \times 0.293) / 10^6 = 4.5\text{mg}$$

2: Zinc lost by anode

$$(11.125 \times 16 \times 24 \times 3600 \times 0.34) / 10^6 = 5.23\text{mg}$$

The theoretical chlorides removed are equal to the chlorides contained in the cell therefore this test shows that zinc removal will continue until all the chlorides are converted to zinc chloride.

Test No.2

In this test, the cell was charged with rainwater. The water was boiled to remove any organic acids, the acid remaining being sulphuric due to pollution. I had no way of measuring the concentration of this acid, so the test is only included to show there is a loss of zinc even when rainwater is used in a boiler in which copper/ zinc brazing has been used. See **graph No.2**.

Note: Zinc removed over 25 days

$$(11.8 \times 25 \times 24 \times 3600 \times 0.34) / 10^6 = 8.7\text{mg}$$

Analysis Of Anodes Used

Copper zinc alloy

Copper	C	57-63 %
Zinc	Zn	30-41.7%
Lead	Pb	0.03%
Aluminium	Al	0.03%
Silicone	Si	0.2%
Tin	Sn	0.5%
Silver	Ag	0.5%

Silver solder alloy

Silver	Ag	42%
Copper	C	17%
Zinc	Zn	16%
Cadmium	Cd	25%

©

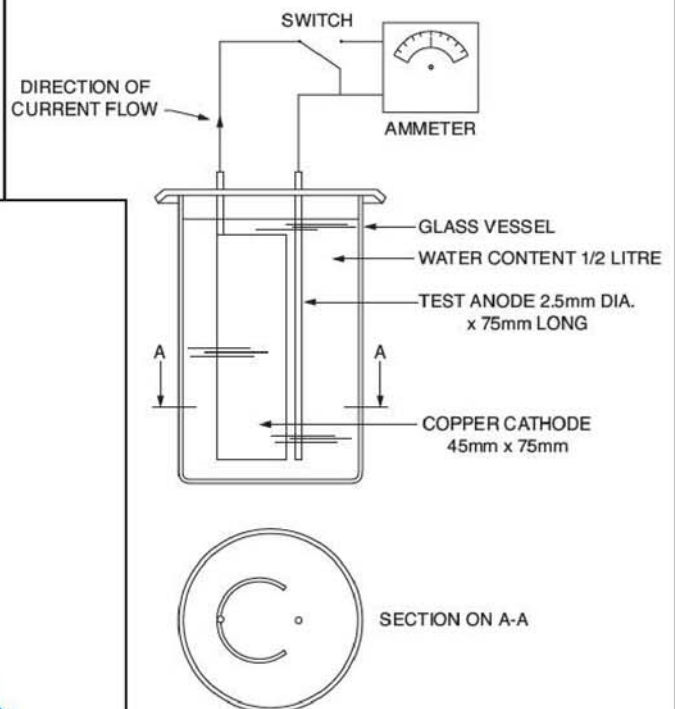
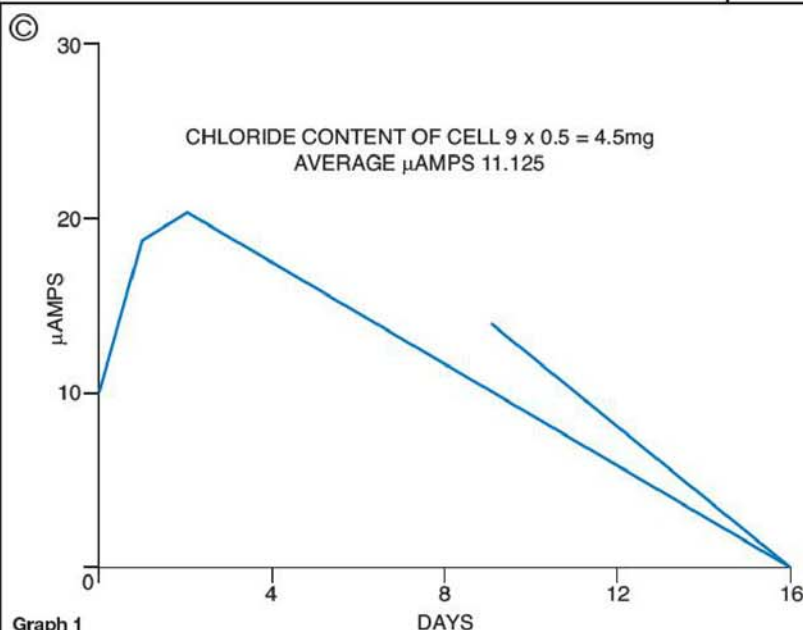


Fig. 1



Test No.3

This test was set up to assess the effect of the chloride concentration due to evaporation when a boiler has been in steam for a short period.

The locomotive used to obtain the water sample for this test is detailed below.

Boiler capacity: 3.4 litres

Measured rate of evaporation: 9.0 litres/hr

Duration of test: 2 hours

Prior to the test the boiler was emptied and recharged using feed water with 9mg/litre chloride content. See graph No.3.

Notes:

Formula for the concentration of chlorides where:

h = steaming hour

e = Evaporation rate litre/hour

f = Feed chlorides mg/litre

c = Boiler capacity in litres

Then chloride concentration:

$$\text{mg/l} = ((h \times e \times f) + (c \times f)) / c$$

The chloride concentration being:

$$((2 \times 9 \times 9) + (3.4 \times 9)) / 3.4 = 56.6 \text{ mg/litre}$$

Curve (a) copper zinc alloy:

1: Reduction in chlorides over 30 days:

$$(23.9 \times 30 \times 24 \times 3600 \times 0.293) / 10^6 = 18.1 \text{ mg}$$

2: Zinc lost over 30 days:

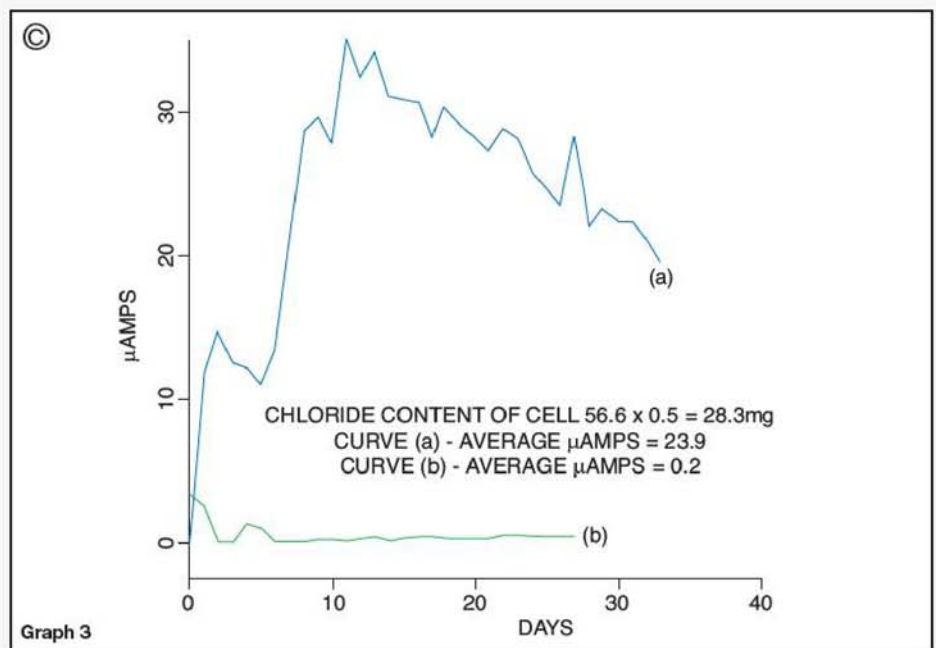
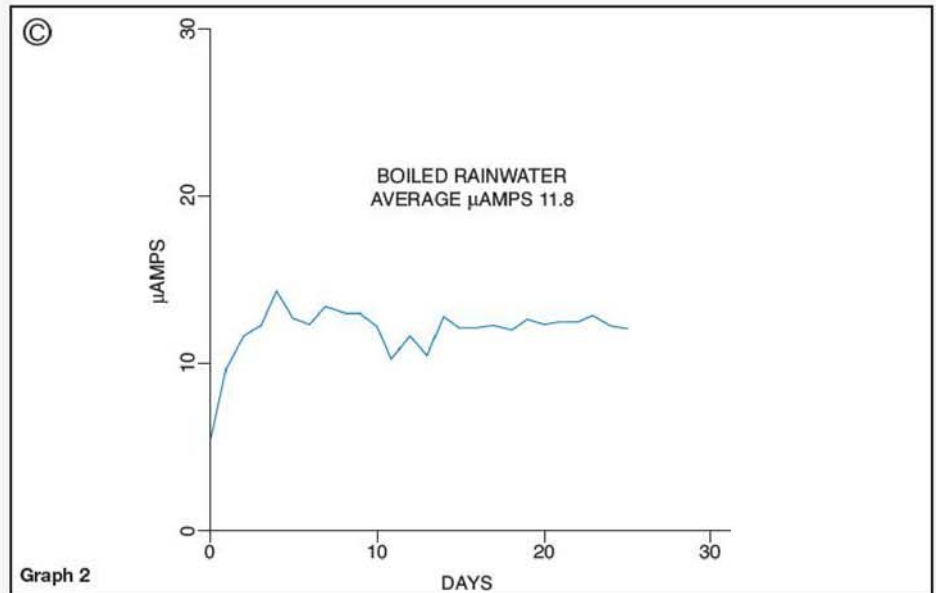
$$(23.9 \times 30 \times 24 \times 3600 \times 0.34) / 10^6 = 21.0 \text{ mg}$$

3: Zinc lost when all chlorides have been converted:

$$(28.3 \times 0.34) / 0.234 = 32.8 \text{ mg}$$

Curve (b) Silver Solder

Corrosion rate virtually non-existent.



Test No. 4

With regard to the rate of dezincification shown by test No.3 after only 2 hours steaming, using what is considered to be high quality feed water. I was interested to see the effect of operating a boiler for a considerable period using feed water having a chloride content of 20mg/litre.

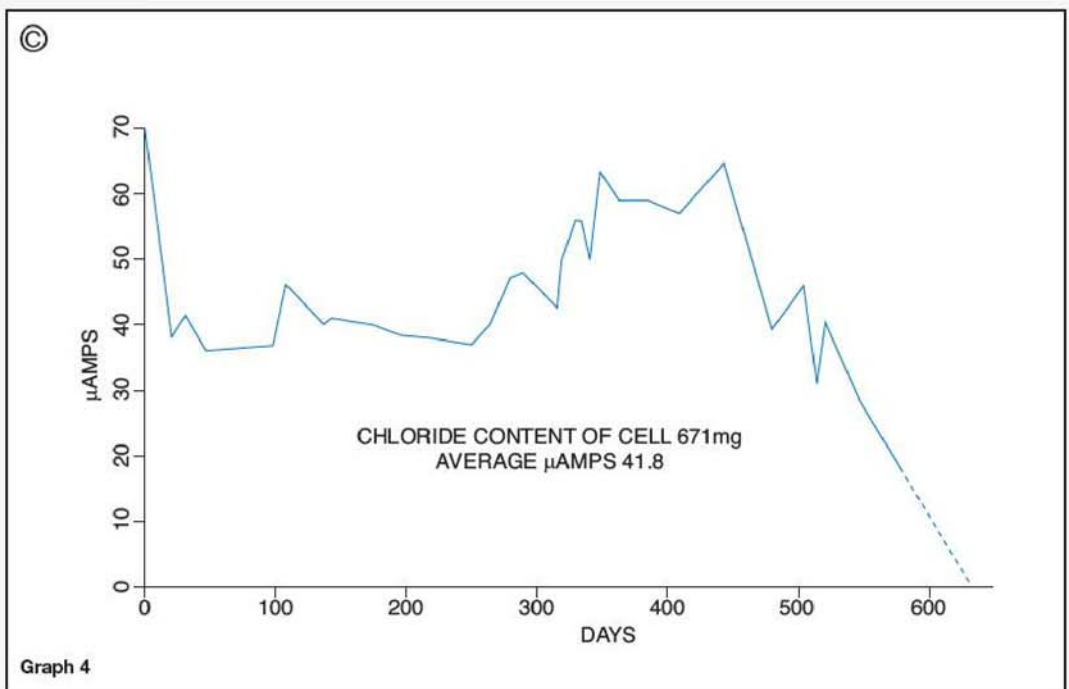
The cycle of operation chosen would be to steam a locomotive for 5 hours per week operating for 5 weeks, the water being left in the boiler for the period of the test, using a hypothetical locomotive having a boiler capacity of 3.4 litres and rate of evaporation of 9 litres per hour, see graph No.4.

Notes:

Chloride concentration:

$$((5 \times 5 \times 9 \times 20) + (3.4 \times 20)) / 3.4 = 1343 \text{ mg/litre}$$

Therefore, the required chlorides for the test cell would be $1343 \times 0.5 = 671$ milligrams. This was achieved by adding $671 - 4.5 =$



666.5mg sodium chloride to towns main water.

1: Reduction in chlorides:

$$(41.8 \times 640 \times 24 \times 3600 \times 0.293)/10^6 \\ = 677\text{mg}$$

2: Zinc lost:

$$(41.8 \times 640 \times 24 \times 3600 \times 0.34)/10^6 \\ = 785\text{mg}$$

This test shows a considerable loss of zinc when using a copper/ zinc anode. The total zinc content of the anode being:

$$(3 \times 0.0982 \times 0.7854 \times 0.3 \times 10^6 \times 41)/2.2 \times 100 \\ = 1265\text{mg}$$

The % loss of zinc during the period of the test was:

$$(100 \times 785)/1265 = 62\%$$

This is a significant amount when compared to the silver solder test detailed below, see graph No. 4a.

Notes:

1: Reduction in chlorides (extrapolated to 640 days):

$$(1.18 \times 640 \times 24 \times 3600 \times 0.293)/10^6 \\ = 19.1\text{mg}$$

2: Zinc loss (extrapolated to 640 days):

$$(1.18 \times 640 \times 24 \times 3600 \times 0.34)/10^6 \\ = 22.2\text{mg}$$

The zinc content of the silver solder is:

$$(1265 \times 16)/41 = 493\text{ mg}$$

The % loss of zinc during the period of the test was:

$$(100 \times 22.24)/493 \\ = 4.5\%$$

Test No.5

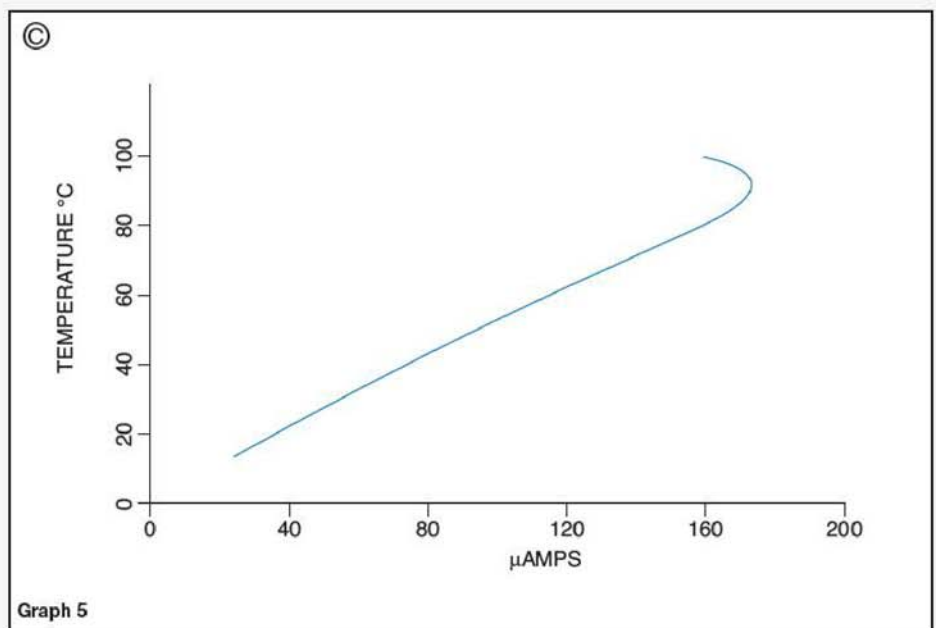
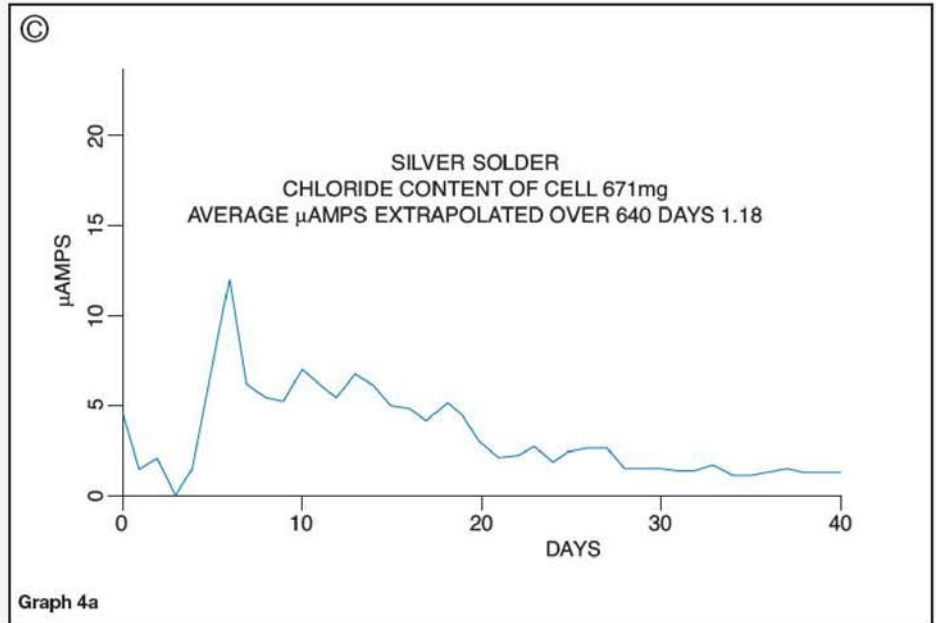
The irregular readings of the amperage during the tests indicated some phenomenon was affecting the readings. The only variation in the conditions being the temperature as I had no means of controlling this accurately. I decided to check the variation in amperage at different temperatures. See graph No.5 (the curve drawn is an average of several tests on the copper/ zinc anode).

The temperature variations during the test period was in the region of 15 to 21deg. C, this gives a variation of approximately 10 micro amps which more or less covers the variations in tests 1 to 4. To obtain more accurate readings the tests would have to be carried out under laboratory conditions.

Note: From the curve it can be seen the current flow increases with temperature until boiling point is approached (100deg. C) when the current reduces. It is possible that at temperatures above boiling point the de-zincification becomes passive. The construction of pressurised cells to check this was not considered necessary, as the rate of de-zincification during steaming becomes insignificant due to the low number of hours involved, when compared to de-zincification during the standing period if the boiler is not blown down or emptied.

Examples

Before translating the test results to a copper boiler, some correlation is necessary. The cells set up were the nearest approach to the



conditions in a copper boiler, which with the facilities available to me, would allow the current flow to be measured and the rate of de-zincification calculated.

Depending on the type of seam, there can be a reduction in the current flow of some 50%, when compared to the current measured from the cell, however this is mitigated by the well-known fact that de-zincification is accelerated at the junction of the brazing to the copper. Also, from the observation of de-zincified items, it is apparent that only about 20% of the brazing is affected before failure occurs.

Note: The copper/ zinc alloys used for bronze welding contain 30 to 41 % zinc. Such alloys when de-zincified suffer from a massive reduction in tensile strength i.e. 80 to 100 %. Another factor which increases the rate of de-zincification is when the area of copper is much greater than the area of the anode, which is the case in a copper boiler, and also applies when comparing a boiler to the test cells. Taking these points into consideration, the rate of de-zincification indicated by the cells is a conservative value when compared to a copper boiler.

Consider a hypothetical locomotive, with the

following features:

Boiler capacity (c) 3.4 litres.

Rate of evaporation (e) 9.0 litres/hour.

Total length of submerged copper/ zinc seams 80 inches.

This gives a multiplication factor when compared to the test cells:

Multiplication factor (k) $80/3 = 26.6$

The total zinc content of the seams (for convenience, assume triangular form):

$$(80 \times 0.125^2 \times 0.3 \times 10^6 \times 41)/(2 \times 2.2 \times 100) \\ = 34943\text{mg}$$

The rate of de-zincification shown by tests 1 to 4 is dependent on the chloride content of the boiler water. Graph 6 has been obtained from the tests to enable the de-zincification rate to be calculated for different chloride concentrations.

Example A

Assume the locomotive is steamed for 5 hours per week and the boiler is blown down every 5th week, the chloride content of the feed being 30 mg/litre.

The only rate of de-zincification being considered is that occurring during the standing period between steaming, with the water

remaining in the boiler.

Chloride concentration (i) = (h x e x f) + g

c = Boiler capacity

h = steaming hours

e = rate of evaporation

f = chlorides in feed mg/litre

g = chlorides in boiler prior to steaming.

Week 1 = c x f

Week 2 *et seq* = m

j = Micro amps

Micro amps (j) this is dependent on i/c (and is obtained from graph 6) x k.

Chloride reduction (l)

= (j x (168-5) x 3600 x 0.293) / 10⁶

= 0.172 x j mg

where h = (168 - 5)

Chlorides remaining in boiler (m) = i - l

Zinc removal (n)

= (j x (168 - 5) x 3600 x 0.34) / 10⁶

= 0.199 x j mg

Results

1: If the 5 week cycle is continued through the year, the number of cycles would be 10.4, (say 10). This would result in a zinc loss of 839 x 10 = 8390mg, giving a % of the total zinc content of: (100 x 8390) / 34943 = 24%

This would result in the whole of the zinc being removed in 100/24 = 4.2 years.

2: If the boiler was steamed for 5 weeks and then put away without emptying, de-zincification would continue until all the chlorides had been converted into zinc chloride.

Chloride concentration = 6128 mg.

Micro amps = 44 x 26.6 = 1170 (from graph 6)

Hours to convert chlorides:

(6128 x 10⁶) / (1170 x 3600 x 0.293)

= 4965 (30 Weeks)

Zinc removed:

(1170 x 4965 x 3600 x 0.34) / 10⁶

= 7110mg

Total zinc removal:

7110 + 839 = 7949mg

% of total zinc removed:

(100 x 7949) / 34943 = 22.7%

Time to remove all zinc from seams

100/22.7 = 4.4 years

Example B

Carrying out the same calculations with the same operating cycle, but using a good quality feed water, having a chloride content of 9mg/litre.

Results

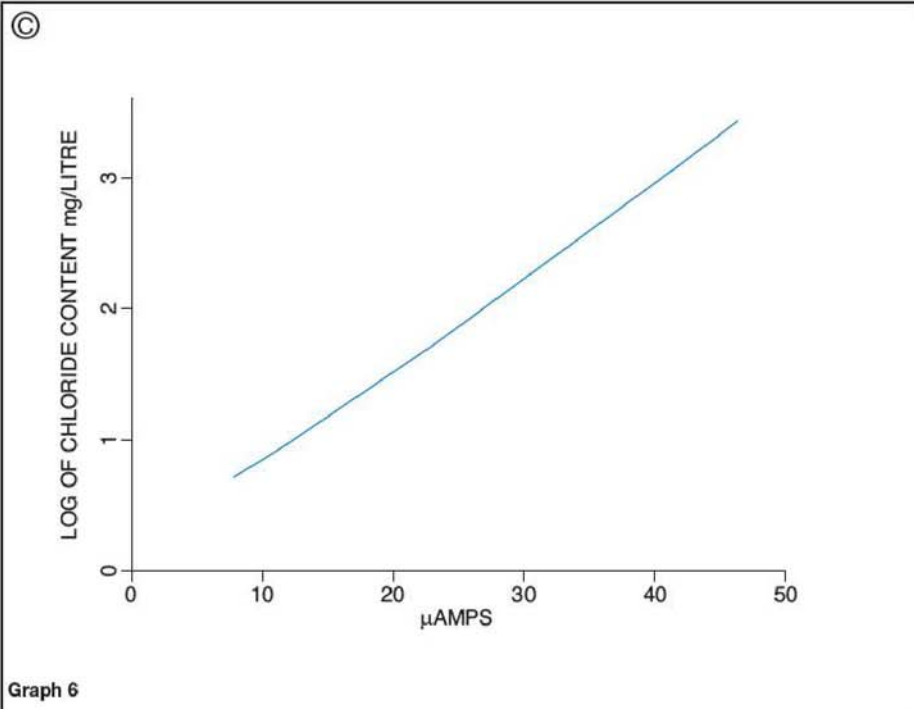
1: Again the 5 week cycle is continued through the year i.e. 10 cycles per year.

Zinc loss 673 x 10 = 6730 mg

% of total zinc (100 x 673) / 34943 = 19.2%

This would result in the whole of the zinc being removed in:

100/19.2 = 5.2 years



Example A

Week No.	(i) Chloride concentration mg	(j) Micro amps	(l) Chloride reduction mg	(in) Chlorides remaining mg	(n) Zinc removal mg
1	1452	944	162	1290	188
2	2640	1037	178	2462	206
3	3812	1104	190	3622	220
4	4972	1130	194	4778	225
5	6128	----- Blown down-----			
					Total 839

Example B

Week No.	(i) Chloride concentration mg	(j) Micro amps	(l) Chloride reduction mg	(in) Chlorides remaining mg	(n) Zinc removal mg
1	436	758	130	306	151
2	711	825	142	569	164
3	974	879	151	823	175
4	1228	918	158	1070	183
5	1475	-----Blown down-----			
					Total 673

2: Again if the boiler was steamed for 5 weeks and then put away without emptying the boiler, de-zincification would continue until all the chlorides have been converted into zinc chloride.

Chloride concentration: 1475 mg

micro amps = 35.5 x 26.6 = 944 (from graph 6)

Hours to convert chlorides:

(1475 x 10⁶) / (944 x 3600 x 0.293)

= 1481 (8.8 weeks)

Zinc removed:

(944 x 1475 x 3600 x 0.34) / 10⁶

= 1704mg

Total zinc removed:

1704 + 673 = 2377mg

% of total zinc:

(100 x 2377) / 34943 = 6.8%

Time to remove all zinc:

100/6.8 = 14.7 years

Conclusions

These tests show there can be a serious de-zincification problem when copper/zinc alloys (bronze welding alloys) are used for brazing the seams and other joints in copper boilers. The copper/ zinc alloys used for bronze welding contain 30 to 41% zinc, such alloys when de-zincified suffer from a massive reduction in tensile strength i.e. 80 to 100% respectively.

The problems when the seams and other joints in copper boilers which are bronze welded, are firstly:

1: There is a much greater area of copper when compared to the area of the seams and other joints, which increases the rate of de-zincification considerably.

2: The build up of chlorides during steaming is massive. This build up of chlorides occurs even when good quality feed water is used having a

low chloride content, this can be seen from the examples. In the case of Example A a rise of 6008% occurs and even in Example B the rise is 4820%, both these occurring after only 25 hours steaming. Theoretically, under these conditions, all the zinc would be removed from the submerged bronze welds. In the case of Example A (i) in 4.2 years, and in example B (i) 5.2 years. Failure, however, could occur more rapidly as the bronze welds became brittle.

The examples only include the rate of de-zincification during the standing period between steaming with water remaining in the boiler, the rate of de-zincification during steaming becomes insignificant due to the low number of hours involved when compared to the standing periods.

The only way to combat the above de-zincification, is for the owners of bronze welded copper boilers to ensure they blow their boilers down after each steaming, and to ensure that the water is not left in the boiler whilst out of service. If this is carried out a reasonable life can be expected from the boiler.

Due to the high concentration of chlorides even copper boilers fabricated using silver solder can be affected by de-zincification, however this will be to a much reduced extent than in the case of bronze welded copper boilers. If the silver solder used has an excess of 40% silver the seams and joints would not suffer a reduction in tensile strength to any extent, therefore failure would not occur.

However due to de-zincification some minor leakage may occur after many years. It is therefore advisable, even with silver soldered boilers, to blow them down frequently, preferably after each steaming.

I appreciate the tests have not been carried out in an actual boiler, the reasons for this are explained under Examples - see page 102. In the event, I did not accept the boiler mentioned at the beginning of this article for other reasons.

I hasten to add I am not trying to raise a hare but believe my concerns are real. Since copper boilers using the bronze welding technique are uncommon and that there is a perfectly safe alternative if a suitable silver solder is used, why take the risk?



Peter Spenlove-Spenlove
offers advice on judging heat
treatment temperatures and
boiling your breakfast egg.

There has been some correspondence over the years about the colour of steel during heat treatment processes. Some people like to think in terms of boiled carrots whilst others stick to the more common cherry red. Certainly most practical engineers working in railway works, foundries and blacksmith's workshops in the past knew the term cherry red. Very few saw the ideal, ripe fruit but everyone was familiar with the bright red glacé cherries on the Sunday tea time cake. Even glacé cherries varied slightly but not so much as the fresh fruit.

The boy who heated rivets needed to know the right colour in various conditions of day light and artificial light. The tool maker had to know the correct colour when softening a piece of steel. The blacksmith had to judge the brightness of his metal when hammering a fire welded joint. The forge master had to stop forging when the colour got too low. If he did not stop cracks would form and ruin a blank for, say, a locomotive crankshaft or ship's propeller shaft.

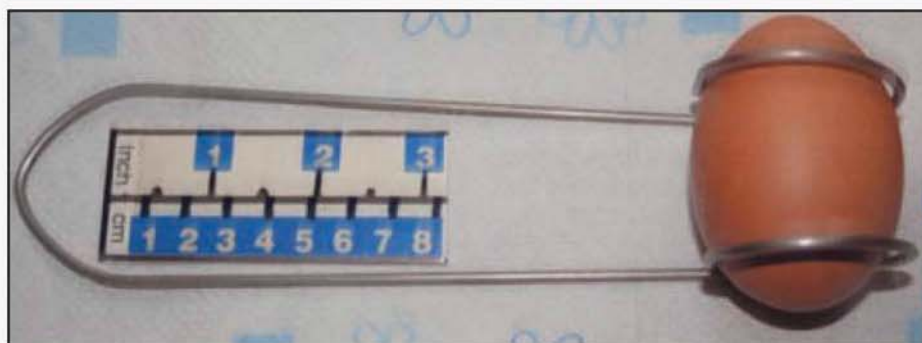
Today the engineer uses a non-contact infra-red temperature indicating gun. However, we at home must acquire the old skills. Most engineering books will include a colour table such as the one shown here. You might like to photocopy it and keep it close to the area in which you do your heat treatment. A coating of clear varnish will keep it smudge free but watch that the application of the varnish does not cause the photocopy ink to run.

The tempering colours are easiest to understand. They apply to bright mild steel, which has been freshly brightened and is free from finger marks. The colour should be observed on a surface, which is heated by direct flame. The composition of the flame (oxidising or reducing) may upset the colours. Long exposure at a colour, such as in an oven, can be equivalent to a higher temperature colour. For this reason consider setting a oven or kiln to a lower temperature. Some steel makers issue heat treatment instructions, stick to them if possible.

ON HEAT TREATMENT AND EGGS

HIGH TEMPERATURES JUDGED BY COLOUR AND COLOURS FOR TEMPERING

Degrees Celsius	Degrees Fahrenheit	High temperature judged by colour	Degrees Celsius	Degrees Fahrenheit	Colour for tempering
400	752	Red heat, visible in the dark	221.1	430	Very pale yellow
474	885	Red heat, visible in twilight	226.7	440	Light yellow
525	975	Red heat, visible in daylight	232.2	450	Pale straw-yellow
581	1077	Red heat, visible in sunlight	237.8	460	Straw-yellow
700	1292	Dark red	243.3	470	Deep straw-yellow
800	1472	Dull cherry red	248.9	480	Dark yellow
900	1652	Cherry red	254.4	490	Yellow brown
1000	1832	Bright cherry red	260.0	500	Brown yellow
1100	2012	Orange red	265.6	510	Spotted red brown
1200	2192	Orange yellow	271.1	520	Brown purple
1300	2372	Yellow white	276.7	530	Light purple
1400	2552	White welding heat	282.2	540	Full purple
1500	2732	Brilliant white	287.8	550	Dark purple
1600	2912	Dazzling white	293.3	560	Full blue
			298.9	570	Dark blue



This egg pick up device was made from stainless steel wire.

Egg picker

This is a simple device for picking eggs from boiling water. It is particularly helpful for those with hands that are getting old and wobbly. It is made from spring wire bent as shown. The material needs to be shaped such that it snaps

over the egg and does not need squeezing together with the hand to enable the egg to be lifted. The spring comes from the hairpin portion of the device. The wire is 0.104in. dia, (12 swg) hard drawn spring grade stainless steel.





UK News

As a starter for this month, I know that several clubs organise visits to the Great Dorset Steam Fair each year so a reminder of the dates of this year's event seems appropriate. The fair is held at Dairy House Farm, Child Okeford, Blandford, Dorset DT11 8HT and further details can be obtained from the show office at 01258-860361 or via the website at www.gdsf.co.uk One important point on the publicity details is that "pay on arrival" may not be available at the camp site so those intending to camp are advised to book in advance.

The members of Ashcombe Miniature Railway visited the RAF Museum at Hendon in the spring term and enjoyed the change from previous railway-oriented visits. Good progress is being made with the two major projects on the go. Wagon W3 is now due for a track test, having had a replacement steel under frame produced and the mechanical point equipment at Meadowbank is ready to be installed during the outdoor season.

The newsletter of the Bedford MES carries a report that the two

shake down days on the ground level track have helped check out the new signalling as well as the track layout. The track is reported as "bedding down well" but the club is expecting some settling to occur during the first few running sessions.

Birmingham SME has a new website at www.birmingham-sme.co.uk/ which is well worth a visit although it is still under construction.

Bournemouth DSME is organising a triathlon event for small electric-powered locomotives. The event is in three parts and consists of a speed contest over 25 yards, a hill climb and finally an endurance event to see how far the locomotives will run before the batteries give up. The club is supplying a kit of parts including a motor, motor mount and bulb holder, after that it is up to the contestant. The power is two AAA size batteries also supplied by the club. We look forward to reporting this event in the future. The bulb holder is for a bulb that will be inserted for the endurance event to increase the power used.

Another society carrying out significant work during the winter is Cambridge MES which has been

relaying the next section of track. This involves setting new edging slabs, removing the old ballast, installing a weed suppressing membrane and then relaying the ballast and track. The new track panels are of heavier gauge rail than previously. Another major project is the clearing of an extra piece of land to provide more car parking space. This task involves clearing some trees and levelling the site before constructing fences and gates. The society is also going to install a new signalling system to help the flow on the track during busy running days.

One of the visits arranged for the members of Edinburgh SME is to Secretary Robert McLuckie's attic to see his superb model of the Waverley paddle steamer engine. This model was featured in *M.E.* 3912, 3 January 1992.

The start of the running season at the Frimley and Ascot Locomotive Club has been marked by the first use of the new signalling system which many of you will have seen on the society stand at The Model Engineer Exhibition at Sandown. The system is reported as working well and the signalling team are to be congratulated on its efforts in producing this very sophisticated system.

The latest issue of the *Maxitrak*

Owners Club newsletter contains an article describing the origins of the locomotive names used by the company. Coincidentally, I have just seen on the national news pictures of what appeared to be a *Maxitrak Rushton* being used to push a truck with large barrel of water round a ground level garden track as a drought beating measure. The barrel was fitted with a battery-powered pump to power a garden spray and was filled from several water butts in the owner's garden. Perhaps if the owner reads this he could send us in some details?

The Northern Association of Model Engineers has a new secretary in the person of Alan Budd. Alan can be contacted at 39 Langford Road, Arnold, Nottingham NG5 7HR and has taken over from Nigel Thompson who held the post for six years.

Trials on the new ground level track took place at Norwich DSME in March and at one of the sessions, some members of the public took a keen interest in the proceedings and "proved very useful as passengers during the trial runs". Both the club electric locomotive and the new passenger trolleys ran well. The trolleys have been fitted with over-run brakes which also work very well.

CLUB DIARY

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

JULY

- 21 Canvey R&MEC. Meeting. Contact Brian Baker: 01702-512752.
- 21 North London SME. Loco Section Barbecue. Contact David Harris: 01707-326518.
- 21 Romford MEC. Track Maintenance. Contact Colin Hunt: 01708-709302.
- 21 Tonbridge MES. Children's Party. Contact D. C. Brunning: 01732-352153.
- 22 Canvey R&MEC. Members' Running Day. Contact Brian Baker: 01702-512752.
- 22 Chesterfield MES. Public Running Day. Contact Mike Rhodes: 01823-648676.
- 22 Hereford SME. Club Day. Contact Nigel Linwood: 01432-270867.
- 22 Hornsby ME. Family Day/Boiler Inspections. Contact Ted Gray: 9484-7583.
- 22 Ickenham DSME. Members' Running Day & Barbecue. Contact David Sexton: 01895-630125.
- 22 Leyland SME. Members & Guests Summer afternoon driving session. Contact A. P. Bibby: 01254-812049.
- 22/23 Oxford (City of) SME. Dreaming Spires Rally. Contact Chris Kelland: 01235-770836.
- 22 Romford MEC. Trackside Afternoon. Contact Colin Hunt: 01708-709302.
- 22 Steam LS of Victoria. Club Run. Contact Graham Plaskett: (03) 9750-5022.
- 22 Wigan DMES. Visit by Butterley Miniature Railway Society. Contact John Chamberlain: 01744-882255.
- 23 Amnerfield Miniature Railway. Public Running. Contact David Jerome: 0118-9700274.
- 23 Bristol SMEE. Public Running. Contact Trevor Chambers: 0145-441-5085.
- 23 Edinburgh SME. Track Running Day Steam & Diesel. Contact Robert McLuckie: 01506-655270.
- 23 Guildford MES. Driver Training. Contact Dave Longhurst: 01428-605424.
- 23 Harlington LS. Public Running. Contact Peter Tarrant: 01895-851168.
- 23 Nottingham SMEE. Public Running. Contact Gerry Chester: 0115-9259096.
- 23 Staines SME. Public Running. Contact Stan Bishop: 01784-241891.
- 23 Worthing DSME. Public Running. Contact Bob Phillips: 01903-243018.
- 23 York City & DSME. Running Day. Contact Pat Martindale: 01262-676291.
- 24 Bedford MES. The mouse trap Challenge. Contact Ted Jolliffe: 01234-327791.
- 25 Hornsby ME. Social Night. Contact Ted Gray: 9484-7583.
- 25 Romney Marsh MES. Romney Fayre Track Meeting. Contact John Wimble: 01797-362295.

- 26 Norwich DSME. Barry Gayton: Demonstration of Brazing & Soldering. Contact Paul Reed: 01603-462925.
- 27-29 Canvey R&MEC. Open Days. Contact Brian Baker: 01702-512752.
- 27 Sutton MEC. Evening Steam-Up. Contact Bob Wood: 0208-641-6258.
- 27 Worthing DSME. Ian Gledhill. Contact Bob Phillips: 01903-243018.
- 28 Hereford SME. Meeting. Contact Nigel Linwood: 01432-270867.
- 29 Romney Marsh MES. Boiler Testing & Running for Romney Fayre. Contact John Wimble: 01797-362295.
- 29/30 Sunderland (City of) MES. Public Running. Contact Albert Stephenson: 01429-299649.
- 30 Bristol SMEE. Public Running. Contact Trevor Chambers: 0145-441-5085.
- 30 Cambridge MES. Members' Steam-Up. Fulbrook Road. Contact Rex Mountfield: 01284-386128.
- 30 Canvey R&MEC. Gala Day. Contact Brian Baker: 01702-512752.
- 30 Cardiff MES. Picnic Day. Contact Don Norman: 01656-784530.
- 30 Chichester DSME. Steam on Sunday. Contact Brian Bird: 01243-536468.
- 30 Guildford MES. Members' Running Day. Contact Dave Longhurst: 01428-605424.
- 30 Hereford SME. Open Day & Charity Day. Contact Nigel Linwood: 01432-270867.
- 30 High Wycombe MEC. Public Running. Contact Eric Stevens: 01494-438761.
- 30 North Cornwall MES. Sunday Steam-Up. Contact Geoff Wright: 01566-86032.
- 30 Nottingham SMEE. Public Running. Contact Gerry Chester: 0115-9259096.
- 30 Staines SME. Public Running for Charity. Contact Stan Bishop: 01784-241891.
- 30 Steam LS of Victoria. Working Bee & Barbecue Lunch. Contact Graham Plaskett: (03) 9750-5022.
- 30 Taunton ME. Public Running. Contact Don Martin: 01460-63162.
- 30 Wigan DMES. Open Day. Contact John Chamberlain: 01744-882255.
- 31 Reading SME. Disabled Kids. Contact Brian Joslyn: 01491-873393.

AUGUST

- 1 Basingstoke DMES. Meeting. Contact Guy Harding: 01256-844861.
- 1 Romney Marsh MES. Track Meeting. Contact John Wimble: 01797-362295.
- 1 South Durham SME. Meeting. Contact B. Owens: 01325-721503.
- 1 Stamford MES. Track Running. Contact Derek Brown: 01780-753162.
- 2 Bradford MES. Meeting. Contact John Mills: 01943-467844.
- 2 Bristol SMEE. Meeting. Contact Trevor Chambers: 0145-441-5085.

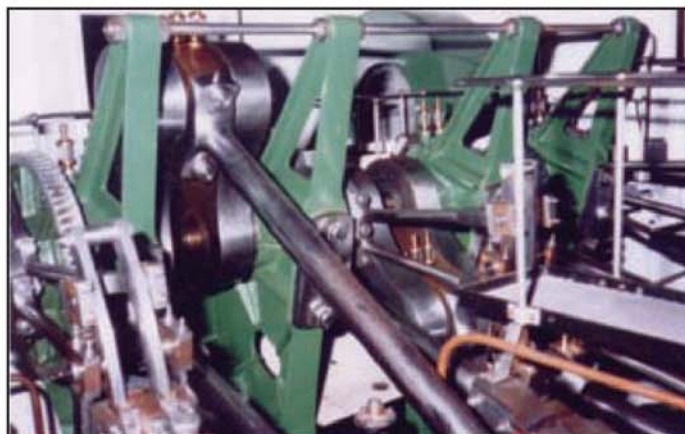
Members of Nottingham SMEE are making good progress with the 7 1/4in. gauge track extension with work on the preparation for the second level crossing and turntable well advanced. The Main Line Steam Trust provided a substantial grant for this project. The club was honoured with a visit from a party of about 25 civic dignitaries who were on a tour of several local facilities in the area. The party had a ride on the new extension followed by a look at the workshop and a presentation by Richard Tilden-Smith Chairman of GCRN Ltd. Also in the newsletter were the following, obviously produced by a feminist:

Men are all the same, they just have different faces so you can tell them apart.

Don't imagine you can change a man unless he is in diapers (nappies in UK).

Never let your man's mind wander – it's too little to be out on its own.

Romney Marsh MES reached a milestone in January with the membership figure reaching 300 for the first time. This must make the club one of the largest, if not the largest, in the country, unless of course you know differently! Another statistic in the newsletter is



Robert McLuckie, of Edinburgh SME, recently showed fellow members his fine model of the Waverly paddle engine which resides in his attic.

that since the club was formed in 1969 over 740 members have joined. As the Secretary comments "We must be doing something right". Some of those members have been busy and the garden railway and building is now virtually complete and is reported as "fully wired up for both analogue and digital control systems". It seems that model engineers now also need to be computer savvy judging by this news and the news from Frimley!

The marine section of the St. Albans DMES has seen several new models launched this year including *Panache* by Vic Driscoll, a gunter rigged sailing dingy by Alan Holt and a New England Oyster dredger *Chesapeake Skipjack* by John Cook. John uses

drafting film for sails on his models which may be a useful tip for other sailing model builders out there. Tim Hopkins and Roger Stephen have built rolling roads for their locomotives in order to be able to carry out tests at home and to avoid wasting time at the track. Both use ball races mounted on angle iron as a basis with a simple pony truck support without rollers in Roger's design. The roller units simply rest on a length of track so the rigs are very flexible.

Weymouth DMES is busy working on the track site and has completed the main oval and station loop. Work continues on the turntable and steaming bays. The society has a new website at www.weymouth-dmes.co.uk/ which was created by Mike Jackson

and "his boys". Sean Thomas received a day visit to the Didcot Railway Centre including a footplate ride as a birthday present from his wife and described his visit in the newsletter.

World News

Australia

Bob Smyth of the Adelaide Miniature Steam Railway Society describes the built up cylinders for his Silverton Class W locomotive. These are unusual in that they are a mixture of fabrication and casting. The main cylinders and piston valve bodies are bronze castings which are silver-soldered into a rectangular brass frame with the exhaust passages built up inside. The spaces round the cylinders are filled with insulating material to avoid condensation problems.

United States

The Bay Area Engine Modellers are attracting new members and some new engines are reported as having had their "first pop". These included Roger Butzen's very nice 1/4 scale 426 Hemi-Head V8 and Dwight Giles' Gray horizontal engine. Bob Kradjian is carrying out some maintenance on his Challenger V8 which has been running at club shows since 1997.

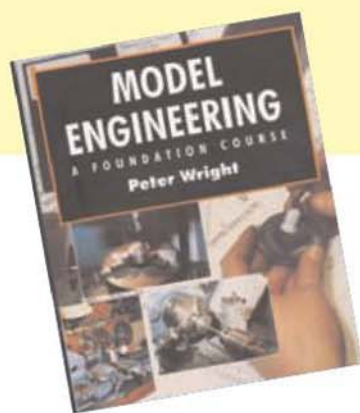
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|---|---|
| <p>2 Frimley & Ascot LC. Teddy Bear Run. Contact Bob Dowman: 01252-835042.
 2 Hull DSME. Ian Cornwall: <i>Serving my Time</i>. Contact Tony Finn: 01482-898434.
 2 Plymouth MSLS. Public Running. Contact John Brooker: 01752-671722.
 2 West Wiltshire SME. Steam-Up. Contact R. Nev. Boulton: 01380-828101.
 3 Leyland SME. Prints works visit. Contact A. P. Bibby: 01254-812049.
 3 South Lakeland MES. Meeting. Contact Adrian Dixon: 01229-869915.
 3 Sutton MEC. Bits & Pieces. Contact Bob Wood: 0208-641-6258.
 4 Aylesbury (Vale of) MES. Track Night. Contact Andy Rapley: 01296-420750.
 4 Canvey R&MEC. Meeting. Contact Brian Baker: 01702-512752.
 4 Maidstone MES (UK). Evening Run & Barbecue.
 Contact Martin Parham: 01622-630298.
 4 North London SME. Meeting & Barbecue. Contact David Harris: 01707-326518.
 4 North Norfolk MEC. At Sheringham Pool. Contact Gordon Ford: 01263-512350.
 4 Portsmouth MES. Meeting. Contact John Warren: 023-9259-5354.
 4 Rochdale SMEE. Meeting. Contact Mike Foster: 01706-360849.
 4 Romford MEC. Competition Night. Contact Colin Hunt: 01708-709302.
 5 Canvey R&MEC. Members' Running Day. Contact Brian Baker: 01702-512752.
 5/6 Dockland & E. London MES. Public Running.
 Contact P. M. Jonas: 01708-228510.
 5 Ickenham DSME. Public Running. Contact David Sexton: 01895-630125.
 5 Isle of Wight MES. Track & Pond. Contact Malcolm Hollyman: 01983-564568.
 5 Maxitak Owners Club. Maxitak Rally, Leatherhead.
 Contact Eric Penn 0208-979-4335.
 5 New Jersey Live Steamers, Inc. Work Day. Contact Karl Pickles: 718-494-7263.
 5 Romford MEC. Trackside Afternoon. Contact Colin Hunt: 01708-709302.
 5 York City & DSME. Summer Meeting. Contact Pat Martindale: 01262-676291.
 6 Bristol SMEE. Public Running. Contact Trevor Chambers: 0145-441-5085.
 6 Cardiff MES. Steam-Up and Family Day. Contact Don Norman: 01656-784530.
 6 Frimley & Ascot LC. Public Running. Contact Bob Dowman: 01252-835042.
 6 Guildford MES. Driver Training. Contact Dave Longhurst: 01428-605424.
 6 Leighton Buzzard NG Rly. Family Fun Day. Enquiries: 01525-373888.
 6 Malden DSME. Public Running. Contact John Mottram: 01483-473786.
 6 Northampton SME. Public Running. Contact Pete Jarman: 01234-708501 (eve).
 6 Nottingham SMEE. Public Running. Contact Gerry Chester: 0115-9259096.
 6 Peterborough SME. Visit by Erewash Valley MES.
 Contact Ted Smith: 01775-640719.
 6 South Durham SME. Running Day. Contact B. Owens: 01325-721503.
 6 Guild of Model Wheelwrights. Bewdley Horse Event, Holbeache Farm, Trimpey, Nr. Kidderminster. Contact Biddy Hepper: 01492-623274.
 7 Peterborough SME. Bits & Pieces. Contact Ted Smith: 01775-640719.
 8 Dockland & E. London MES. Meeting. Contact P. M. Jonas: 01708-228510.
 9 High Wycombe MEC. Evening at Track. Contact Eric Stevens: 01494-438761.
 9 Norwich DSME. Barbecue. Contact Paul Reed: 01603-462925.
 9 St. Albans DMES. Ron Dean: Preparation of model boat kits.
 Contact Roy Verden: 01923-220590.</p> | <p>10/11 Ascot LS (2003). Frimley & Ascot LC Open Days.
 Contact Derek Alford: 01344-482485.
 10 Bedford MES. School Holiday Running. Contact Ted Jolliffe: 01234-327791.
 10 Sutton MEC. Chat Night. Contact Bob Wood: 0208-641-6258.
 10 Worthing DSME. Bits & Pieces. Contact Bob Phillips: 01903-243018.
 11-13 British Columbia SME. Train Fest Meet.
 Contact Sean Laurence: (604) 931-1547.
 11/12 Frimley & Ascot LC. Open Days. Contact Bob Dowman: 01252-835042.
 11 Hereford SME. Meeting. Contact Nigel Linwood: 01432-270867.
 12 Brighton & Hove SMLE. Fun Run. Contact Mick Funnell: 01323-892042.
 12/13 Guildford MES. OMLEC. Contact Dave Longhurst: 01428-605424.
 12 Maxitak Owners Club. Seventh Ipswich Maxitak Meet.
 Contact Eric Penn 0208-979-4335.
 12 Portsmouth MES. Efficiency Comp. and Concours d'Ellegance.
 Contact John Warren: 023-9259-5354.
 12/13 Guild of Model Wheelwrights. Sandringham Show.
 Contact Biddy Hepper: 01492-623274.
 13 Cambridge MES. Public Running. Fulbrooke Road.
 Contact Rex Mountfield: 01284-386128.
 13 Canterbury DMES (UK). Public Running. Contact Mrs P. Barker: 01227-273357.
 13 Edinburgh SME. Track Running Day Steam & Diesel.
 Contact Robert McLuckie: 01506-655270.
 13 Harlington LS. Public Running. Contact Peter Tarrant: 01895-851168.
 13 Hereford SME. Public Running. Contact Nigel Linwood: 01432-270867.
 13 High Wycombe MEC. Club Running afternoon.
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 13 Hornsby ME. Running Day. Contact Ted Gray: 9484-7583.
 13 Leeds SMEE. LSME August Rally. Contact Colin Abrey: 01132-649630.
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 13 Nottingham SMEE. Public Running. Contact Gerry Chester: 0115-9259096.
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 Contact John Brooker: 01752-671722.
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 13 York City & DSME. Running Day. Contact Pat Martindale: 01262-676291.
 14 Bedford MES. Centring. Contact Ted Jolliffe: 01234-327791.
 14 Erewash Valley MES. Meeting. Contact Jim Matthews: 01332-705259.
 14 Melton Mowbray DMES. Summer Evening Steam-Up.
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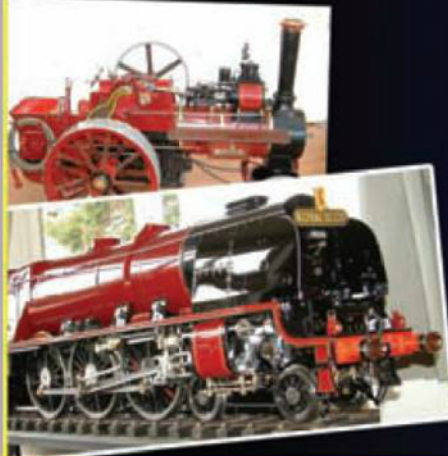
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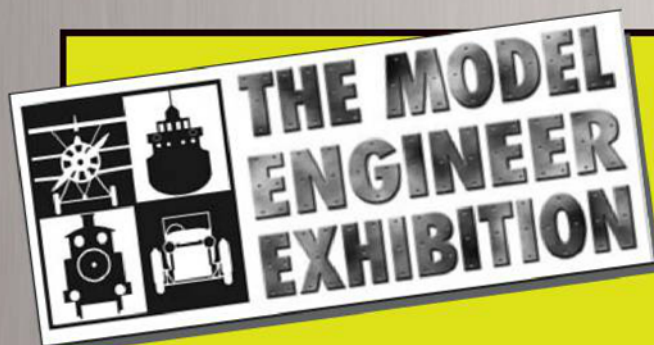
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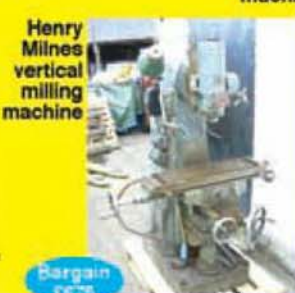
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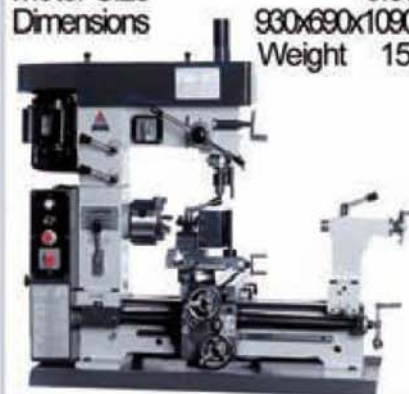
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