

MODEL ENGINEER

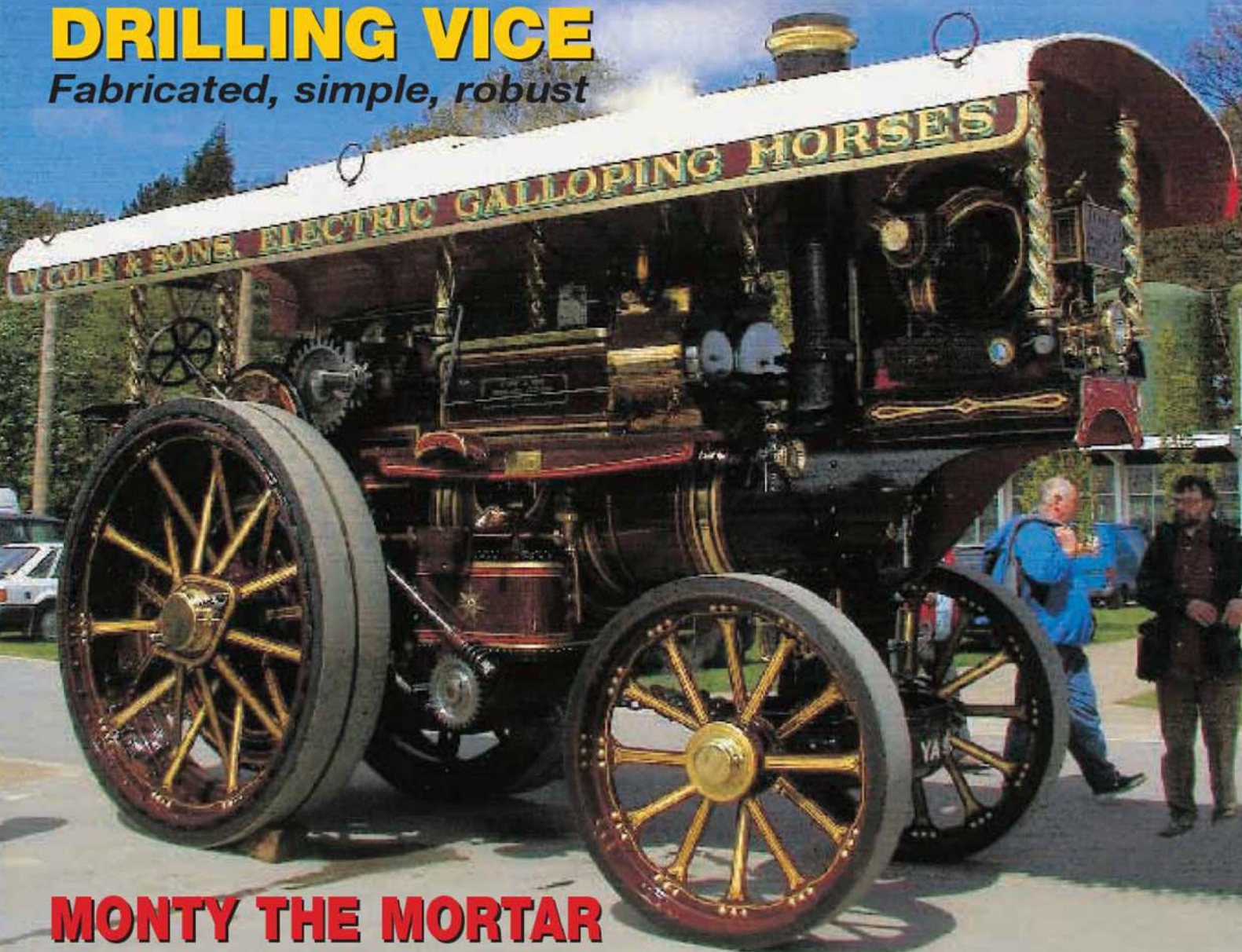
Vol. 188 No. 4172

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An imaginary run on the Leeds SMEE track
at Eggborough during IMLEC 2002.
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On the cover ...

One of the high spots of the
National Model Engineering &
Modelling Exhibition held at Harrogate
during the weekend of 10-12 May 2002
was a visit from this immaculately restored
full size Fowler showman's specification
road locomotive. Originally built c1909
it is rated at 6/7 nominal horse power.
The engine had been coach painted using
traditional brush applied techniques and
featured some of the most impressive gold
leaf lining to be seen on a fully working
engine. The presentation of the engine
was a credit to the current owner,
Robin Knox, and his team of specialist
restorers used to recreate this fine
example of a product from the famous
Leeds based Steam Plough Works.

(Photograph by Mike Chrisp)

KEITH'S COLUMN: SAINT CHRISTOPHER

A GWR LOCOMOTIVE for 7 1/4in. gauge

Detailing the smokebox and its associated
furniture and fittings. Part XXVII.
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An inexpensive design capable of being
easily made in the home workshop from
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The Clock Repairer's Handbook [Penman] £15.19
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Clock & Watch Escapements [Gazeley] £22.20
This book describes in detail the various types of escapements found in clocks and watches, with a lot of incidental information on making and repairing them. A good starting book for someone wanting to get seriously involved in horology, and a required reference book. 195 pages, very well illustrated with b&w drawings and photos. Hardbound.



The Watch and Clockmakers' Handbook, Dictionary and Guide [Britten] £18.90
Extraordinary amount of information in the 499 pages of this book, first published in 1915. Some is historical rather than useful, but it is all here, and well illustrated to boot, mainly with engravings. Hardbound.



Wheel and Pinion Cutting in Horology [Wild] £32.65
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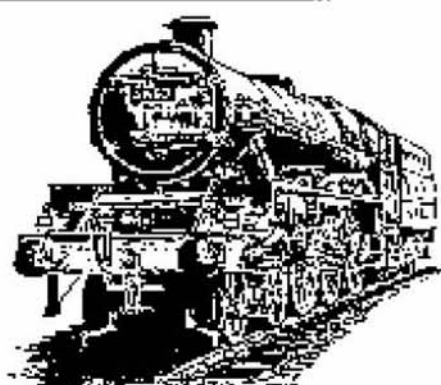
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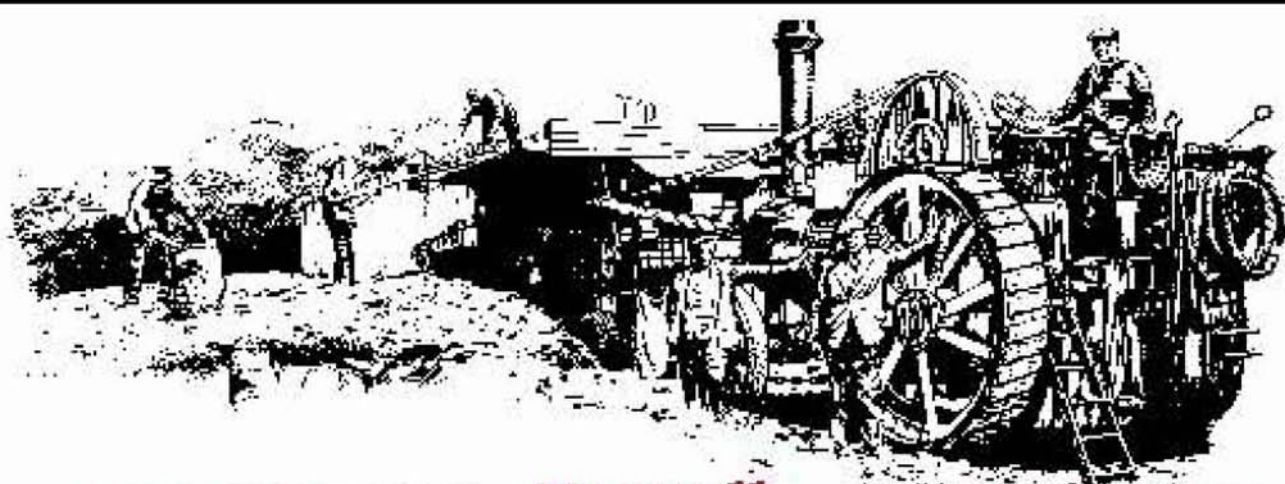
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3" 5" 0-8-0 Netla Tank Loco
3" 5" 2-10-0 Finning Star Loco
3" 5" 2-2-2 Jenny Lind Tender Loco
3" 5" 2-2-2 Jeanie Deans Loco
3" 5" 2-4-0 Mankie Tank Loco
3" 5" 2-4-0 Petrols Tender Loco
3" 5" 2-4-4 Lucky 7 Tank Loco
3" 5" 2-6-0 GW 43XX Tender Loco
3" 5" 2-6-0 Marquess Tender Loco
3" 5" 2-6-2 Bantam Cock Loco
3" 5" 2-6-2 Betty Tender Loco
3" 5" 2-6-2 Firefly Tank Loco
3" 5" 2-6-2 Mountaineer Tank Loco
3" 5" 2-6-2 WFFam Tank Loco
3" 5" 2-6-4 Jubilee Tank Loco
3" 5" 2-8-0 Buffalo Tender Loco
3" 5" 4-4-0 County Carlin Loco
3" 5" 4-4-0 Derby 2P Tender Loco
3" 5" 4-4-0 Rococo Tender Loco
3" 5" 4-4-0 Virginia LB Tender Loco
3" 5" 4-4-0 Virginia SR Tender Loco
3" 5" 4-4-2 Maizie Tender Loco
3" 5" 4-6-0 1000 Class Tender Loco
3" 5" 4-6-0 75000 Class Tender Loco
3" 5" 4-6-0 Doris LMS Tender Loco
3" 5" 4-6-0 Greene King Tender Loco
3" 5" 4-6-0 Lifford Hall Tender Loco
3" 5" 4-6-0 Princess Marina Loco
3" 5" 4-6-0 Spencer Tank Loco
3" 5" 4-6-0 St Christopher Loco
3" 5" 4-6-2 Britannia Tender Loco
3" 5" 4-6-2 Hylan Lattle Tender Loco
3" 5" Passenger Car Bogies

5" LOCOMOTIVES

5" 0-4-0 Ajax Tank Loco
5" 0-4-0 Dolgich Tank Loco
5" 0-4-0 Dolgich Tank Loco
5" 0-4-0 Garmna Tank Loco
5" 0-4-0 Hunslet Tank Loco
5" 0-4-0 Marie E. Tender Loco
5" 0-4-0 Railmotor 1 Tank Loco
5" 0-4-0 Railmotor 2 Tank Loco
5" 0-4-0 Railmotor 3 Tank Loco
5" 0-4-0 Scamp Tank Loco
5" 0-4-0 Swiss Molly Tank Loco
5" 0-4-2 Didcot Tank Loco
5" 0-4-2 Telford Thunderbolt Loco
5" 0-4-2 Tom Rolt Tank Loco
5" 0-4-4 Fishbourne Tank Loco
5" 0-6-0 Achilles Tank Loco
5" 0-6-0 Aspinall Tender Loco
5" 0-6-0 Boxhill Tank Loco
5" 0-6-0 Jack Tank Loco
5" 0-6-0 Jill Tank Loco
5" 0-6-0 Jinty Tank Loco
5" 0-6-0 Medusa Tank Loco
5" 0-6-0 Parsy Tank Loco
5" 0-6-0 Peon Pom Tender Loco
5" 0-6-0 Sally Tank Loco
5" 0-6-0 Simplex Tank Loco
5" 0-6-0 Speedy Tank Loco
5" 0-6-2 Barnet Tank Loco
5" 0-8-0 Netla Tender Loco
5" 0-8-0 No. 138 Tender Loco
5" 2-4-0 Asia Tender Loco
5" 2-4-0 Metro Tank Loco
5" 2-4-2 Lanky Tank Loco
5" 2-6-0 BR Class 2 Tender Loco
5" 2-6-0 Horwich Crab Tender Loco
5" 2-6-0 Maccallin Mar Tender Loco
5" 2-6-2 BR Class 84000 Tank Loco
5" 2-6-2 GW 51XX Tank Loco
5" 2-8-0 Nigel Gresley Tender Loco
5" 2-8-0 R.O.D. Tender Loco
5" 4-2-2 Princess of Wales Loco
5" 4-2-2 Sterling Single Loco
5" 4-4-0 Bulldog Tender Loco
5" 4-4-0 Dukedog Tender Loco
5" 4-4-0 Etha Tender Loco
5" 4-4-0 Glen Tender Loco
5" 4-4-0 Maid of Kent Tender Loco
5" 4-4-0 New York Central and HR Loco
5" 4-4-0 Robinson Tender Loco
5" 4-4-0 Washington Tender Loco
5" 4-4-2 Jersey Lily Tender Loco
5" 4-6-0 Black 5 Tender Loco

5" 4-6-0 Eastern Belle Tender Loco
5" 4-6-0 Fury Tender Loco
5" 4-6-0 Immingham Tender Loco
5" 4-6-0 King's Own Tender Loco
5" 4-6-0 Lander Tender Loco
5" 4-6-0 Royal Engineer Tender Loco
5" 4-6-0 Springbok Tender Loco
5" 4-6-0 Torquay Manor Tender Loco
5" 4-6-2 Doncaster Tender Loco
5" Passenger Car Bogies

7.25" LOCOMOTIVES

7.25" 0-4-0 Hunslet Tank Loco
7.25" 0-4-0 Arden's 84 Tank Loco
7.25" 0-4-0 Dolgich Tank Loco
7.25" 0-4-0 Edder Tank Loco
7.25" 0-4-0 Hercules Tank Loco
7.25" 0-4-0 Jessie Tank Loco
7.25" 0-4-0 Locomotion Tender Loco
7.25" 0-4-0 Marie Estelle Loco
7.25" 0-4-0 Railmotor Tank Loco
7.25" 0-4-0 Runabout Tank Loco
7.25" 0-4-0 Tug Tank Loco
7.25" 0-4-2 Brigette Tank Loco
7.25" 0-4-2 Dart Tank Loco
7.25" 0-4-2 Edward Thomas Loco
7.25" 0-4-2 Tom Rolt Tank Loco
7.25" 0-6-0 Deyn Goods Tender Loco
7.25" 0-6-0 Hermes Tank Loco
7.25" 0-6-0 Holmside Tank Loco
7.25" 0-6-0 Newport Tank Loco
7.25" 0-6-0 Paddington Tank Loco
7.25" 2-4-4 Maxi Lucky 7 Tank Loco
7.25" 2-6-0 GW 43XX Tender Loco
7.25" 2-6-2 Lynton & Barnstaple Loco
7.25" 4-2-2 Lorna Doona Loco
7.25" 4-4-0 Gosh Tank Loco
7.25" 4-4-0 New York Central and HR Loco
7.25" 4-4-2 Adam's Radial Tank Loco
7.25" 4-6-0 Highlander Tender Loco
7.25" 4-6-0 King George V Loco
7.25" Denver and Rio GR-C19 Loco
7.25" Passenger Car Bogies
7.25" State Waggons

12.25" LOCOMOTIVES

12.25" 0-4-0 Darjeeling & H.A. Loco
12.25" 2-6-4 Leek & Menfold Loco

STATIONARY ENGINES

Border Engine
Centaur Gas Engine
Commander Compound Launch Engine

Consort Vertical Engine
Diagonal Paddle Engine
Double Tangye Horizontal Engine
Empress Vertical Engine
Hills Rotary Engine
Heinrich Hot Air Engine
Hercules Steam Crane
Lady Stephanie Beam Engine
Marcher Vertical Engine
Marston Vertical Engine
Mary Beam Engine
Master Oscillating Range
Model Engineer Beam Engine
Monarch Vertical Engine
Nicholas Vertical Engine
Perseus Horizontal Engine
Popular Oscillating Range
Regent Vertical Engine
Sheldon Vertical Engine
Sovereign Vertical Engine
Steam Hammer
Tinker Horizontal Engine Pump
Triple Expansion Engine
Trojan Vertical Engine
Unicorn Horizontal Engine
Vulcan Beam Engine
Warrior 2 Vertical Engine

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1" SC Mickle Convertible Engine
1" SC Mickle Engine
1.5" SC Alchin T. Engine
1.5" SC Marshall Portable Engine
2" SC Clayton Wagon
2" SC Lincolnshire LAD T. Engine
2" SC Shand Mason Fire Engine
2" SC Thelford Town T. Engine
2" SC Titan Tractor
3" SC Askinson Wagon
3" SC Foden Wagon
4" SC Foden STD Wagon
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SMOKE RINGS

With the Editors

Precisely

To most people the words 'accuracy' and 'precision' are synonymous – indeed they are defined as such in many dictionaries. However, to an engineer they have very distinct meanings and it is irritating, to say the least, to see these words used in the wrong context. Writers of advertisements are particularly prone to witter on about, for example, a 'precision' vice when they really mean that the vice is accurately made. Conversely, someone may speak of an accurate process when they really mean it is precise. We therefore felt that it would be a public service to point out the accepted use of these words in engineering circles so that all our readers can become equally incensed by their sloppy use in everyday English.

Most people remotely interested in engineering matters know that no production process can

make parts that are identical in size day-in, day-out. Size will vary due, for example, to such things as thermal effects, the hardness of the feed stock and tool wear. For this reason, full size engineering drawings all carry dimensions that have a tolerance. The designer specifies the variation in size he can tolerate before the design is compromised. The relationship of the expected spread in size holding of the process to the required tolerance is therefore a subject of prime importance to the production engineer.

It is quite common to measure parts coming from a process and record the results on a chart. This chart usually has a horizontal axis marked with incremental sizes and the vertical column shows the number of parts that hit a given size over a specified period (perhaps one working day or shift). As the chart builds up it will probably take on a characteristic bell shaped curve called a normal distribution curve (fig 1). Most of the parts are within a certain size band, but a few are either relatively large or relatively small and, as the tails of the chart go off to infinity, there is always the remote chance of making parts that are very small or very large.

Engineers can use the normal distribution concept to do all sorts of fancy mathematics. This can be used to give them a better grasp of the behaviour of the process. However, for our present discussion it is sufficient to use it to better define the words 'accurate' and 'precise'. First of all we need to compare the size distribution from the process, like the one in fig 1, to the aim size required of the process.

Figure 2 shows the size spread of a process that is accurate but not precise. The aim size is being hit regularly but there is a good deal of scatter in the results and we end up with a very wide distribution. Conversely, fig 3 shows a process that is precise but not accurate. The size spread is very small and we have a very narrow distribution but it is way off the aim size.

The ideal is, of course, shown in fig 4, which indicates a process that is both accurate and precise. Readers who have followed the arguments so far will probably realise that precision is often a function of the process and not easy to change but accuracy can usually be modified by adjustment.

LMS Royal Scot drawings

We have received a plea for assistance from Mr. Nicholas Jeary in Wiltshire who is finishing a part-built model of the LMS Royal Scot 4-6-0 to the design of Messrs. Greenly and Steel. He has some of the drawings, which carry the date 14 February 1952. However, he lacks drawings 1, 4, 5 and 8 for the locomotive and all of the tender drawings.

If any reader(s) can help Mr. Jeary with the drawings he needs, he can be contacted by letter at 11 Petty Lane, Calne, Wiltshire SN11 9QY; by e-mail on: DAGJeary@aol.com. or via his father on 01249-814959.

AUTOX

A call for assistance has also been received from Tom Paddock in Hampshire who is seeking the feature describing AUTOX, the 'robot' noughts and crosses 'machine' described, he believes, in *Model Engineer* in the '50s. We have a vague recollection

Calling Jo Scopes

Not so very long ago, Jo Scopes in Hampshire produced a computer index for *Model Engineer* which has been popular with a number of readers.

Len Partridge in Scotland wrote recently to say that, hoping to bring his index up to date, he had tried to contact Jo only to learn that she had moved away from her previous address.

If you're reading this Jo and are still producing your index, please get in touch with the *Model Engineer* Editorial Office at PO Box 310, Hemel Hempstead, Hertfordshire, HP3 8LX (tel/fax: 01442-269366).

of this article but without a full electronic index listing all articles and authors for all ten or more decades for which this magazine has been published, have not been able to locate the feature.

We are sure that there must be one or more readers who have a better recall (or a better indexing arrangement) than us, or may even have built AUTOX for themselves. Tom would very much appreciate their assistance which should be sent, as usual, to the *Model Engineer* Editorial Office at PO Box 310, Hemel Hempstead, Hertfordshire HP3 8LX; fax 01442-269366.

Accolade

We reproduce below a recent News Release from Age Concern.

"*Octogenarian Maurice 'Monty' Ellis of Rangeworthy has won the Age Concern South Gloucestershire 2002 Senior Learner of the Year Award. Learning has been in his blood all his life.*"

"*Monty's outstanding achievements were recognised at a Bristol & South Gloucestershire Outstanding Adult Learners' Reception on Monday 13 May 2002 when he was presented with a framed Certificate and a cheque for £50.*"

"*I did not return to learning in retirement,' says Monty. 'I simply carried on as I had done since the war. Sometimes I studied simply because I was interested in the subject and wanted to know more about it. For example: Industrial Archaeology, History of Church Music.*"

"*On other occasions I learned new things from a sense of public duty. For example, I took the St. John First Aid and Home Nursing Certificates. When the war began I became Secretary of the Manchester Post Office C Division.*"

"*When I wanted information for a book or an article I had to do the necessary research. I have written three books on the history of the telephone service in Bath, Bristol and Weston-Super-Mare (published by BT) and I've done a critical examination of the legend that Marconi once stayed in Weston-Super-Mare (published in the Journal of the Bristol Industrial Archaeological Society)."*

"*Monty has enjoyed the satisfaction of personal achievement as well as doing things that would be of benefit to others. He began learning Welsh when he was well into his 50s and gained a First Class pass in Welsh Level 03 (modern language) in 1974. In fact, he became fluent enough to be taken for a genuine Welshman!*"

"*Having attained fluency in Welsh, Monty is now studying German, in the hope of attaining the equivalent of German O-Level. 'We have wonderful friends in Germany with whom I am capable of corresponding in German,' he says.*"

"*Monty is also writing a series of articles for Model Engineer magazine with the title Letters to a Grandson. 38 have already been published and he has just completed article No. 113."*

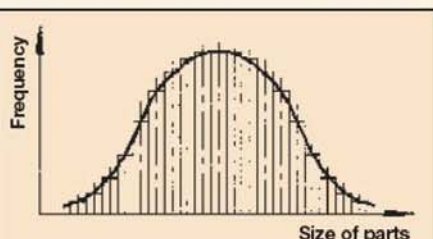


Figure 1 - A normal distribution curve constructed by plotting the frequency of sizes achieved on successive parts.

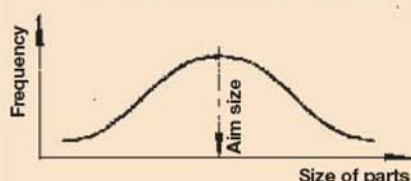


Figure 2 - An accurate but imprecise process.

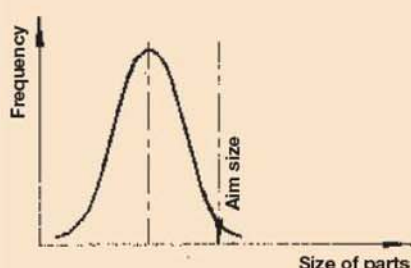


Figure 3 - A precise but inaccurate process.

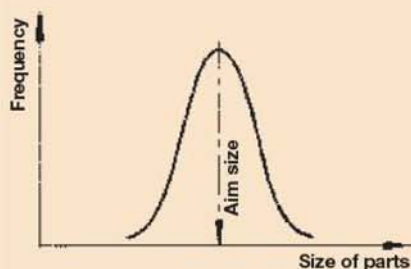


Figure 4 - That's better! A process which is both precise and accurate.

POST BAG

Norman Lowe

SIRS, - I met Norman on a few occasions. He was a charming and knowledgeable man whose models were well up to the standard set by Bill Carter. The incident at Wembley in 1981 to which John Chamberlain referred hurt him a great deal. I believe a Silver Medal was the top award in those days, but he did not get any of the cups. The 1981 exhibition was one in which several first-class locomotive exhibits appeared, some by builders known to the judges which regrettably may have affected the results. The comments were made later in an exhibition review, although to be fair to the author, I think the early engines were fitted with fish-bellied coupling rods, while later ones were straight.

Although Norman never entered a model in any subsequent competition, he ran them regularly and showed them at events in the north of England. I had the honour and pleasure of judging with him at a couple of exhibitions when I discovered that his knowledge of locomotives in particular was second to none. He invariably showed at least one model at the exhibition at which he was a judge, and on each occasion it was of a better standard than anything else in the show.

To model engineers in the north, particularly the north west, Norman was a thorough gentleman, the accent being on *gentle*. He was the absolute tops.

I must record my great sadness on learning of his passing. Without doubt, we have lost one of the finest model makers that there ever was. We are unlikely to see another with his ability, as such perfectionists are no longer created by industry.

He is well worthy of a special place in our memories.
Stan Bray, Lincolnshire.

Swindon recollections

SIRS, - One Saturday back in '39, I visited Swindon with a school party. The teacher who arranged the visit was a very keen and capable modeller who made sure we were suitably impressed.

I can't remember when the Zeiss system was introduced, but I believe it was installed in the '20s and was described in *M.E.* 1952, 6 October 1938. Further development involved setting a huge surface plate in a section of track, guide ways in the plate controlling the motion of a couple of grinding machines arranged with a swinging arm which

could be indexed at 90deg. to grind the internal and external hornblock faces to dimensions obtained by the targets used with the Zeiss equipment in the AE shop.

Ken Gibbs, an apprentice from '44 to '51 wrote a book *Swindon Works - Apprentice in Steam*, the foreword to which was written by The Rt. Hon. The Lord Marsh of Mannington who I believe started at 16 on the white collar route in the plant.

When Stanier left Swindon and went to the LMS as Chief Mechanical Engineer he didn't waste any time in Swindonising the LMS and introducing the Zeiss system. Unfortunately, he didn't have much time there as the government grabbed him when the war clouds gathered.

Returning to Mr. David Hawkins' Swindon recollections of the machine he saw working on the frames, I understand at one time slotting was used on that type of work. In the period between the early 1900s to the early 1920s, Churchward introduced a lot of new equipment. He had the axle journals ground instead of turned and polished with emery, and I believe that magnificent stationary testing unit was one of his schemes, introduced as a reliability test rather than for assessing performance, as happened later.

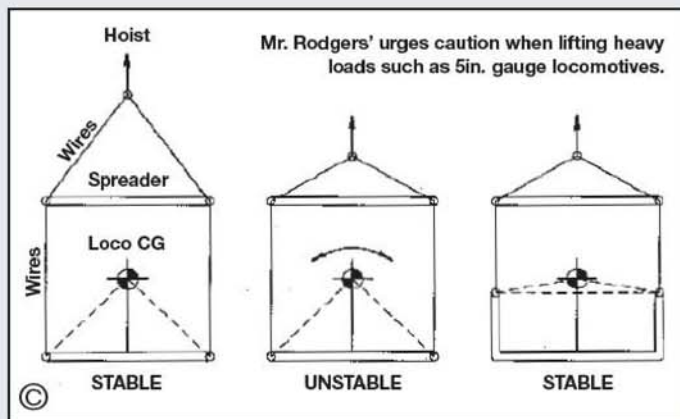
One surprise I remember was the Swindon method of cutting the cab sides; they were gas cut in multiple thicknesses. I don't know how it was done, but oxy-acetylene wasn't used — they must have developed another fuel gas.

Ken Hague, Victoria, Australia.

Loan models at MEX

SIRS, - May I through the pages of *Model Engineer* clarify my position regarding two loan locomotives in the recent Model Engineer Exhibition at Sandown Park Exhibition Centre. As mentioned in *M.E.* 4166, 5 April 2002, I was responsible for entering Fred Cottam's 5in. gauge GWR *Saint Sebastian* and a 2 1/2in. gauge *Evening Star*. Both these models are held by the Great Western Railway Museum 'Steam' in Swindon. In the case of Fred's locomotive, on loan to the museum from the Cottam family.

Almost 2 years ago I spoke with the Editor concerning the possible display of Fred Cottam's locomotive at the Model Engineer Exhibition some time in the future. At the time I had not started cleaning and painting it. The new museum 'Steam' had not opened. As a member of the Friends of Swindon Railway



Museum (volunteer railway addicts of the GWR), I had spoken with the Curator concerning all the models held. No one had shown interest in restoring or cleaning the model engineering side of the displays so it has come about that I took the job on. I knew the *Saint* from seeing it at previous M.E. Exhibitions at Wembley, but had not realized the depth of detail Fred had put into the model. When I started cleaning and removing rust from the tender, the workmanship rapidly became apparent. At first the Curator Tim Bynw, wanted the brasswork lacquered only. But I had other ideas and painted the tender buffer beam, this immediately bought the response "Paint it!" 15 months and over 300 hours later, the model was ready for the M.E. Following further discussion with the Editor, it was decided to enter Fred's loco in the Loan Section.

At the same time, I was working on other models in the museum. *Evening Star*, a 2 1/2in. gauge locomotive needed some minor cleaning and paint repairs and this too was entered as a loan model, the model being intended to show working valve gear of the class, rather than a fully functional steam locomotive. I do not know who built the model, but it is to a high overall standard. Unfortunately, somewhere along the line the fact that it was a loan model was not made clear, a situation compounded by an incorrect exhibition class and number.

The models in the Great Western Railway Museum cover a wide range, one I would love to steam is a 1:12 scale broad gauge 4-2-2 tender locomotive but I don't know any club with a 7in. gauge track! Also the boiler inspector might have his doubts; the model was built in 1885. Many other models together with

other relics are due to be displayed in a new section of the museum from 20 July. It is intended that *Saint Sebastian* will be one of the main stars of that section.

Alan G. Wheeler, Gloucestershire.

Lifting safely

SIRS, - I refer to the article *General Steam Navigation - A Hoist in M.E.* 4166, 5 April 2002.

All lifting gear is potentially dangerous, and the assembly shown is close to actual danger.

Ideally, the design should commence with known loads and calculation of stresses. The finished equipment should be proof tested at twice the working load and marked with the safe working load (SWL). As Peter Lewis discovered, the frame will yield gently if it is overstressed, but wire ropes assemblies are more risky. The wire itself is very strong, but the end fixings tend to be unpredictable. If they fail under load, the strain energy turns the wire into a whip which could cause serious injury.

The last two photographs in the article show a four wire spreader assembly reaching to the corners of the lifting frame. Depending on details and tolerances, 90% of the load could be carried by two of the wires. Tracing off the photographs and drawing a triangle of forces shows that the load in a spreader wire could be 1.5 x the weight of the locomotive!

A little known risk with low headroom slings like this one is that of geometric instability. If the centre of gravity of the locomotive is high enough, the loco will flip over suddenly and come to rest upside down. Hopefully the sling is fixed to the buffer beam and not to the short length of track.

L. J. Rodgers, Derby.

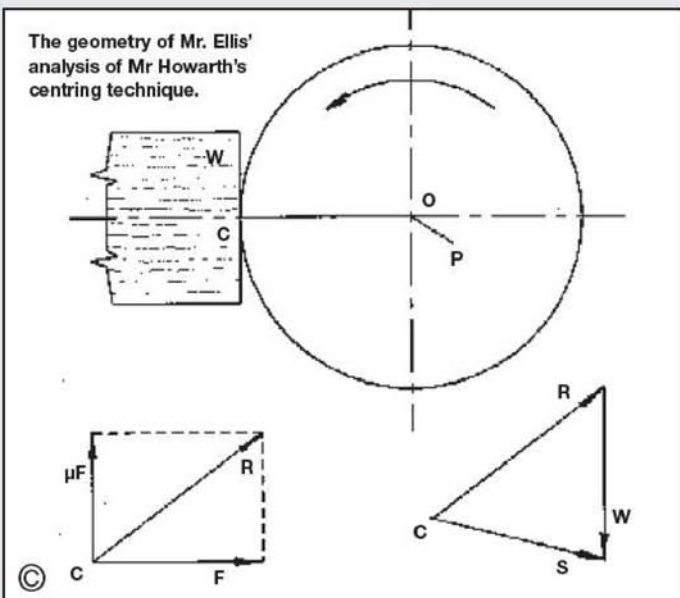
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Correspondence may also be sent to the Editor at PO Box 310, Hemel Hempstead, Hertfordshire, HP3 8AX; fax: 01442-269366; email: mike.chrisp@virgin.net or neil.read@nexusmedia.com or scalemodels@compuserve.com

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Publication is at the discretion of the Editor. The content of letters may be edited to suit the magazine style and space available. Correspondents should note that production schedules normally involve a minimum lead time of six weeks for material submitted for publication.

The geometry of Mr. Ellis' analysis of Mr Howarth's centring technique.



Analysis

SIRS, - I read Mr. Howarth's account of his method for centring the end of a round bar in the lathe (*M.E.* 4167, 19 April 2002) with much interest. I do not question that his method works, but I would like to submit the following observations:

1: My method is applicable to hexagon, as well as round bar stock, whereas I am not sure that Mr. Howarth's method would be.

2: My intention was to demonstrate to my grandson a sequence of original thought. It led to the conclusion that the simplest method of centring was to grip the work in the 3-jaw chuck with its end face in contact with, the point of a (Morse taper) centre in the mandrel, and simply give the Morse taper centre a few taps by means of a bar through the hollow mandrel. With respect, I don't think that anything could be more simple than that.

3: Mr. Howarth uses a Morse taper centre with the point ground to the shape of a square pyramid. This requires care in the making to avoid the formation of a chisel end rather than a true pyramid. I suggest that a triangular pyramid might be preferable, not only on this account, but also because it might well cut more freely.

4: Intrigued by Mr Howarth's system, I attempted to work out how it succeeds. It appears to me that the weight of the bar is an important factor (see sketch). It can only be when the work, rotating about the provisional, and by hypothesis, inaccurate centre P comes into contact with the wood W that the corrective action takes place. Let O be the true centre of the work, and C the point of contact with the (assumed vertical) face of the wood. Then CO is horizontal. Let the force exerted normally on the work at C be F. It will give rise to a vertical frictional force μF , μ being the coefficient of friction.

The resultant of these two forces, R is now in a direction well away from that of O>P, which is the direction in which a force would need to act in order to draw the true centre of the work towards the pyramidal 'centre' at P.

If, however, the component of the weight of the bar which falls on the pyramidal centre is a force W, it operates vertically downwards through O, and in conjunction with R, it gives a final resultant force S much more in the required direction. Since the bar is more or less in equilibrium, S must be balanced by an equal and opposite force exerted by the pyramid point on the work.

There may be critics who say, truthfully, that I have cut corners in this analysis; for example, there is no mention of the couple which causes the work to rotate. But at least, it does provide an explanation, as plausibly as the text-books which talk of a unit magnetic pole (when no such thing exists) producing 4π lines of force (which don't exist either). Besides which, how can there possibly be a fraction (an irrational. one at that) of a line?

Monty Ellis, Bristol.

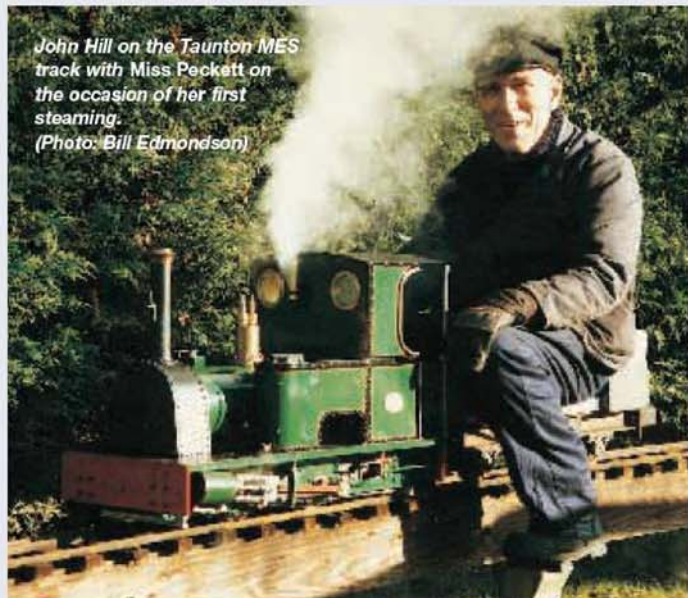
Best interests

SIRS, - I have returned to *M.E.* after a lapse of some 10 years. It is a great pleasure to see the continuing high quality of the articles and exhibition hardware in the magazine. The following points are made in the best interests of the publication.

1: The *Post Bag* section has no response address and searching for addresses on the contents page is most unfriendly.

2: It is infuriating to start taking the magazine again and to read articles that are midway through presentation; only to reach the final article and find no photograph of the completed project at the end! I refer specifically to Bailey's *Bee*. I desperately wanted to see the

John Hill on the Taunton MES track with Miss Peckett on the occasion of her first steaming.
(Photo: Bill Edmondson)



finished engine and yet am expected to back-order *M.E.* 4155, 2 November 2001 (see cover) to satisfy this aspiration. Here we have an author who has struggled through all this explanatory text, whetting new readers' appetites on the way, and yet he is not given the accolade of the finished object being reproduced in his final article! Those of us who have come aboard in the middle of the series regret the time spent reading about it at all. Shame on you!

3: Finally, John Hill's article in *M.E.* 4166, 5 April 2002 concerning *Miss Peckett*. What a gem! But wait a minute, is he pulling my (our) leg(s)? What are all these treacle mines, sugar cane beds, cheese quarries, and rum contracts? How dare he whet our appetite like this and then dump us? Is this a con, or something absolutely delicious?

Please consider further material from John Hill, elaborating on his theme. It could be spiced with the odd reference to widgets and gizmos, thereby meeting the criteria for *M.E.* while at the same time educating and entertaining us all!

M. R. Clay, Kent.

John Hill replies:

I am pleased to read that Mr. Clay has taken to reading *Model Engineer* after such a long lapse, but feel that he is being a bit hard on our Editor who has limited space to allocate to an article. Had he printed the photograph of Bailey's *Bee* yet again, I'm sure he would have had complaints of over-exposure of the subject from those who take the magazine regularly. Editors can't win.

Like many other magazines, it must be faced that *M.E.* has suffered a fall in circulation during recent years and all credit must go to Mike Chrisp for pulling it round and making it again the one that model engineers want to read. Of my home society with its membership of around 34, I doubt if more than half

a dozen buy *M.E.* at present, but I'm sure this will improve.

With regard to Mr. Clay's doubts about *Miss Peckett* and her background, I can assure him that he can visit the Tiverton canal basin, he can buy fine cheese from Quicks at Newton St. Cyres, and he can have a superb pint at *The Beer Engine* pub by the station. The synthetic rum was kept a close military secret as the Admiralty feared mutiny if the truth got out. Ask any old Bomber Command Aircrew about the brilliant green TIs.

Any South Devonian knows of the Dunchideock treacle mines, only the Incomers doubt it, but the site has long been reclaimed by nature. He can read about the Pecketts *Crookall*, *Fylde* and *Hodder* in Harold Bowtell's book *Lesser Railways of Bowland Forest and Craven Country* (Plateway Press).

I didn't mention the even older treacle mine in Cornwall, Wheal Clidgy, but this I believe this closed down in the copper boom of the 19th century and little is now known of its operations. Clidgy is old Cornish for treacle. Perhaps a Cornish reader knows more?

Mr. Clay wants more and I can tell him that we are on the track of photographs of the Foden Steam Waggon that was sold by Dunchideock to Horrells Stoke Vale Cider of Stoke Cannon, but this letter has already taken up quite enough space and modelling time.

Hindley/Alcazar engines

SIRS, - I would like to thank Messrs Pat Hurley and Noel Meeke for their replies to my enquiry regarding Hindley steam lorries.

Although neither were able to help with my specific enquiry, they have increased the total number of surviving Hindley steam engines so far known to me! They are all stationary plant machines.

Nigel Graham, Dorset.



Stephan Kastner operates the lathe in his 1:15 scale c1923 Steam Powered Workshop which fascinated every visitor who saw it. It gained a First Certificate, Precision Paints Trophy and Best in Show award.

HARROGATE 2002

THE NATIONAL MODEL ENGINEERING & MODELLING EXHIBITION

Neil Read

reports on his visit to the ninth of these very popular annual events organised by Lou Rex and his team.

●Part I



The exhibition was opened by David Shepherd who then spent much of his time signing prints!

This was my first visit to the Great Yorkshire Showground and also to the National Model Engineering & Modelling Exhibition. I must say that both the venue and the quality of the exhibition itself impressed me. This was the second year for the event in the extended Flower Hall and as I toured the building it set me wondering if the designer of the building was in fact a model engineer or, at least, someone who likes to attend model engineering exhibitions. It seemed to me that the venue could hardly be bettered for the purpose. Of course, the layout adopted by the organisers helped. Using wide gangways and separating the bulk of the trade stands from the model display areas and club stands helped keep the 'shoppers' out of the hair of the 'viewers' and *vice versa*. This sound arrangement helped prevent the buildings becoming too hot and oppressive even when bulging at the seams with visitors on what must have been one of the warmest weekends of the year so far.

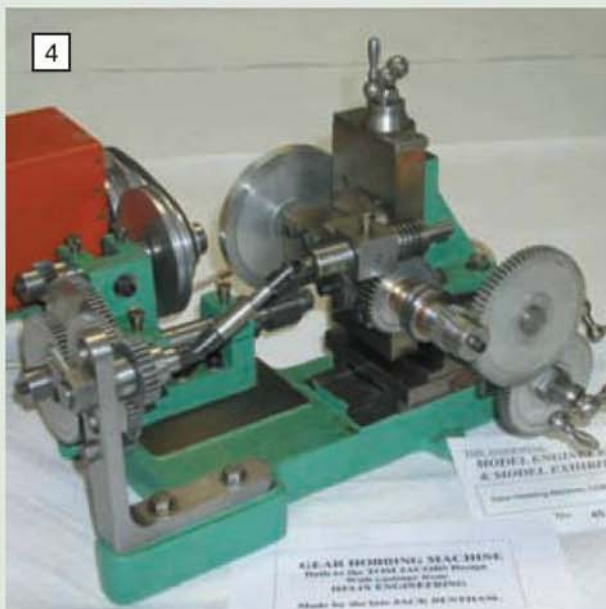
Competition entries

I understand that the competition entries were down this year compared to last year but the quality of the entries was still very high. Stephan Kastner's 1:15 scale Steam Powered Workshop of 1923 (photo 1) was a superb representation of an engineering workshop of that era complete with a miniature lathe, shaping machine and horizontal boring machine with other machine and hand tools. The workshop is powered by its own steam engine and boiler situated in an adjoining 'room' in the display cabinet and drives the machinery via appropriate line shafts.

As much care had gone into constructing the building housing the machinery as had been expended on the machines themselves, and a sense of scale was provided by appropriately dressed figures 'operating' the steam engine and the machine tools. The judges had no hesitation



Dave Bramwell had removed a cover from his 18cc V6 aero engine to reveal the valve gear.



Left:
The late Jack Bentham's gear hobbing machine, built to a design by Tom Jacobs, was awarded Second Certificate in Section 45.



Right:
Malcolm Leafe's 1:4 scale milling machine has been augmented with additional items including duck boards and a spare arbor.



Second Certificate in Section 42 was awarded to this handsome 5in. gauge Hunslet Dholpur built by Don Thorpe.



George Wainwright's lovely 5in. gauge Johnson J Class 2F 0-6-0 Midland Railway locomotive of 1897 was given some work to do.



The replica 1907 Stanley steam car owned by David Beale was superb in every detail. I regret missing the opportunity to see and hear it running.



Roddy Morris' powerful 4in. scale 65HP Case traction engine was awarded First Certificate in Section 47: Road Vehicles in Steam.

in awarding this outstanding exhibit First Certificate in the Stationary Engine section (Section 48) of the competition and the Barry Jordan Trophy for the Best in Show. Herr Kastner also gained the Precision Paints Award for the Best Finished Model.

Second Certificate in this section was awarded to Dave Bramwell for his 18cc, 6-cylinder aero engine (photo 3). This model was displayed with one rocker box removed to allow visitors to examine the fine detail of the valve gear. The engine is of

5/8in. bore, 9/16in. stroke, has 24 valves and an included cylinder angle of 70 degrees. Ignition is by means of a coil and distributor.

First Certificate in Section 42: Locomotives was awarded to George Wainwright for his 5in. gauge Johnson J Class 2F 0-6-0 engine of 1897 which was also awarded the Myford Shield for the Best Locomotive. This locomotive was featured on the front cover of *M.E.* 4166, 5 April 2002. The model was presented at Harrogate, associated with the GL5MLA display, hauling a train of

appropriate rolling stock (photo 7) and made an impressive and eye-catching display. Second Certificate was awarded to Don Thorpe for his 5in. gauge Dholpur Hunslet locomotive (photo 6), a most attractive exhibit in its cream livery and doubtless a powerful performer on the track.

No exhibition would be complete without some workshop equipment, and we were pleased to have another opportunity to see the 3in. scale Elliott Victoria type MO milling machine made by Malcolm Leafe. This machine was featured in



10
With polished brasswork and all the fittings, Dragon, William Renwick's 2in. Burrell showman's engine took First Certificate in Section 46: Road Vehicles.



11
Winner of the Raymond McMahon Trophy and Second Certificate in Section 47 this fine 4in. Burrell steam wagon was built by Cyril Richardson.



12
Stan Reffin spent some 1000 hours spread over 18 months building his model of the Liberty Ship James Blair from a Deans Marine kit.



13
Brian Chambers' model of HMS Nelson was scratch built to a scale of 1:96. A substantial model, it was able to reflect the detail of the prototype.

M.E. 4160, 24 December 2001, following its appearance at the Midlands Exhibition last year. Further work has been done on the model (photo 5) since it was photographed then, and it was awarded First Certificate in the Workshop Equipment Section, and the Chester Shield for Workshop Equipment. Second prize was awarded to the late Jack Bentham for his Gear Hobbing machine (photo 4) based on the design of Tom Jacobs and appearing to be an accurately made and well thought out machine. It was certainly very well

finished and was presented with a box of finished and part finished hobs.

As already mentioned, the weather was kind to us during the event and this encouraged a good turnout of model traction engines 'in steam' outside the exhibition halls. A sound feature of the Harrogate event is that awards are made to working models as well as to those offered purely for display. This year, First Certificate in Section 47: Road Vehicles in Steam went to Roddy Morris for his 4in. scale 65HP Case traction engine (photo 9). Despite its immaculate appearance I can testify that Mr. Morris' engine runs very well as I had to trudge some distance in order to track it down for a photograph.

The Raymond McMahon Trophy for the Best Road Vehicle and Second Certificate was awarded to Cyril Richardson for his 4in scale Burrell single crank wagon (photo 11). Although not a model, David Beale's replica of a 1907 Stanley steam car (photo 8) was certainly a fine example of craftsmanship. Unfortunately I did not see it in steam during my time at the exhibition.

Section 49: Miscellaneous is always an intriguing group since one is never too sure what one is likely to find. Horse drawn wagons rub shoulders with models of level crossings and, frankly, how the judges cope I do not know. However, decisions have to be made and this year first prize went to Don Dowie for his 1:12 scale King Tiger Tank (photo 15). The model was presented in an unpainted condition which enabled visitors to fully appreciate the skill of the builder in forming the armour plating.

The event enjoys the active support of the model boat fraternity and a number of model boat clubs

were present. Competitors can enter one of two classes: Section 51 is for kit built boats and Section 52 is for scratch built craft. First Certificate in the former was awarded to Stan Reffin for his 1:96 scale model of the Liberty ship *James Blair* (photo 12). In the scratch built class, First Certificate was awarded to Brian Chambers for his model of the battleship *HMS Nelson* (photo 13), also to 1:96 scale.

A full schedule of Results and Awards will be published in Part II of this brief series.

●To be continued.



14
Brian Young adjusts his 1:12 scale McKay Sunshine Harvester before the show opened.



15
Don Dowie's superb radio controlled King Tiger tank was awarded First Certificate in Section 49.

SIMPLE SURVEYING

Philip Amos

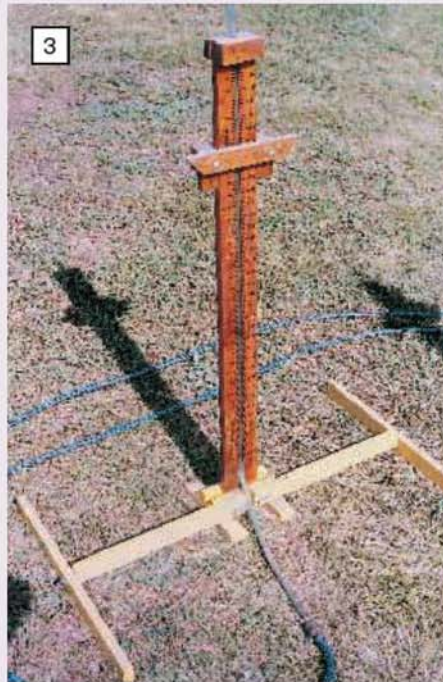
continues his explanation of the techniques of surveying for those with building projects in mind.

●Part II continued from page 392
(M.E. 4169, 31 May 2002)

The simplest way to determine height above mean sea level is to consult the Ordnance Survey map, on which heights are depicted by contour lines (of equal height) and spot heights are usually shown for specific features such as hill tops.

The measurement of height is readily accomplished with a barometer which measures air pressure which diminishes at the rate of roughly 1mm of mercury for each extra 10.8 m of elevation. Air pressure varies with the weather; it is therefore necessary to zero the barometer at a known height before using it to determine an unknown height. Surveyors use very sensitive aneroid barometers which will even register the height change if the instrument is moved from a table to the floor.

While height above sea level is of interest to map makers and people constructing drainage canals and similar works, it is more often the relative heights of two points which is to be determined. Sometimes this height difference



A vertical water tube stand showing details of construction, including the scale marked in $\frac{1}{4}$ in. steps from 0 to 36 inches.

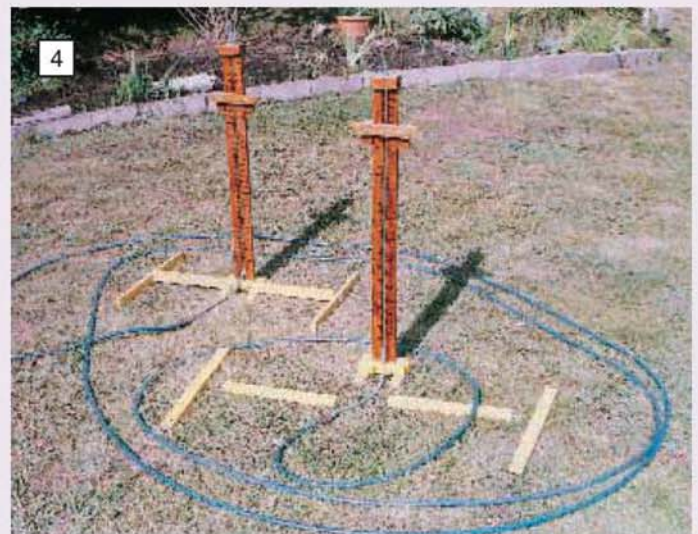
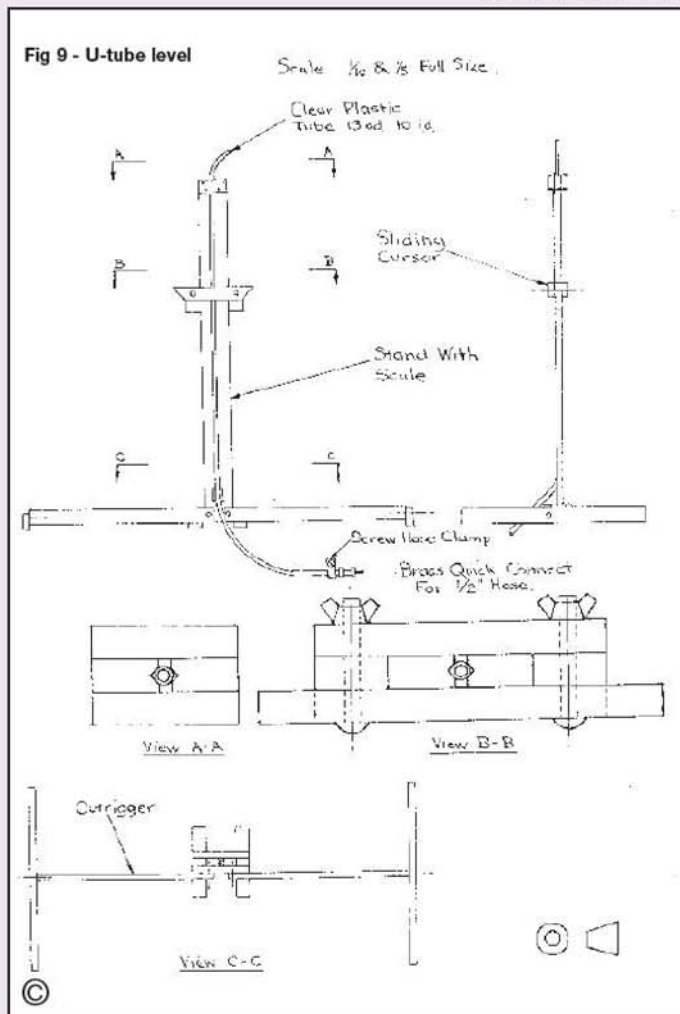
can be measured directly, but usually some other means is required.

U-tube water level

Since water will always find its own level, the heights of the water columns in the two arms of a U-tube are the same. This concept can be extended to having two vertical transparent tubes joined by a long flexible hose with water filling the whole assembly. Photographs 3, 4 and drawing 9 show such a device. The vertical tube stands remain upright on paths or lawns, but in a paddock require outriggers to prevent overturning. I find this device useful on my farm in setting out drainage channels to achieve a fall of about 1 in 120 which gives positive flow without scouring.

The apparatus is made from 40 x 2mm timber. The uprights have a Vee groove on the inner sides to keep the plastic tube straight and in place. The brass quick-connect plugs engage with similar sockets on a $\frac{1}{2}$ in. garden hose to join the two vertical stands together. There is also a quick-connect plug the top of one of the stands to allow connection to another garden hose for filling the whole contraption with water from the tap.

The idea of using a coloured dye in the water column was initially considered but rejected as most such dyes stain the plastic permanently and would thus render the device unreadable.



The complete U-tube water level apparatus. The horizontal range can be extended by using more garden hose to link the vertical stands. Note the removable outriggers for paddock use.

Fig 10 - Hand level

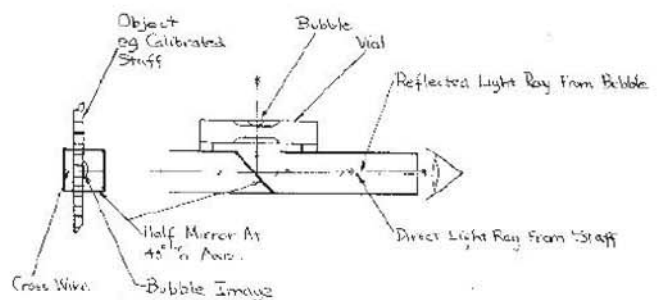


Fig 11 - Abney clinometer

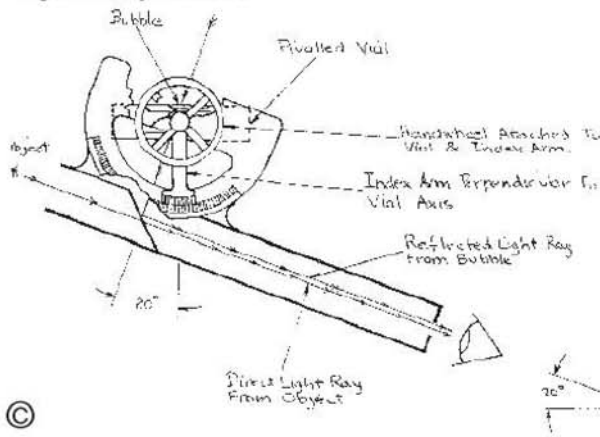
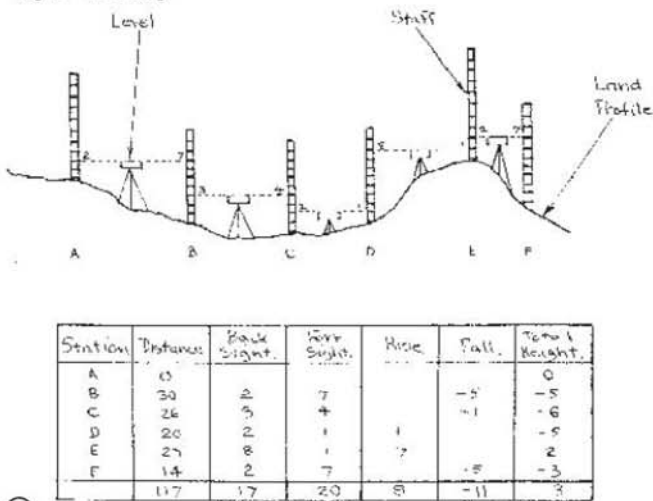


Fig 13 - Levelling



Hand level

Used in earlier times, this device is arranged as shown in drawing 10. A line of sight is defined by a pinhole at the eyepiece end and a cross-bar or edge of a rectangular opening at the other. A mirror at 45deg. allows the observer to view the bubble in the level through an aperture in the top wall of the sighting tube. Telescopic forms were also available.

Abney level

An improvement on the hand level was the Abney level or clinometer. This is similar to the hand level but the bubble vial is mounted on a pivot with a pointer and angle scale, so it can be used to find angular elevations as well as for levelling (drawing 11).

Dumpy level

However, the most commonly used instrument is the Gravatt's/Builder's/Dumpy level, an instrument which comprises a telescope mounted horizontally on a tripod. The telescope allows the height markings on a staff to be read at a distance (drawing 12).

Rigidly fixed on top of the telescope is a spirit level as well as an inclined mirror allowing the bubble to be seen from the viewing position. It also has a small cross level.

The height differences between different locations can be measured with this instrument (drawing 13). Note that the actual height of the level itself is unimportant; provided it can horizontally sight

graduations on the staff scale at the desired stations, it need not even be on the same line of route as the stations. A tabular method of recording is commonly used as shown on the drawing.

Nowadays, a more rapid measurement can be made using a laser beam to replace the line of sight from the telescope, and a detector which can be slid up and down the staff; the detector has an audible tone to indicate the location of the laser light beam. This is very useful in concrete pours and similar activities when speed of operation is an advantage. Also it allows one man operation if need be.

A carpenter's level having a laser pointer incorporated is now available. This device projects its axis for ease of levelling in building work and is suitable for use up to about 10 metres distance.

The actual survey

There appear to be five main approaches to conducting a survey, as follows.

Fig 12 - Dumpy level

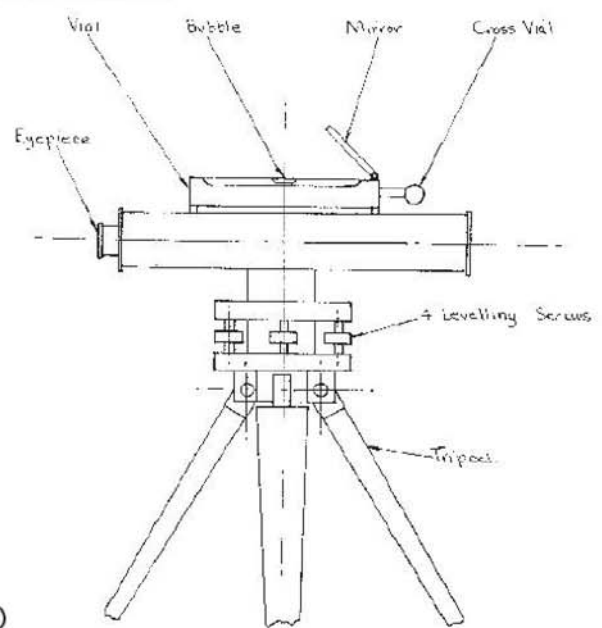
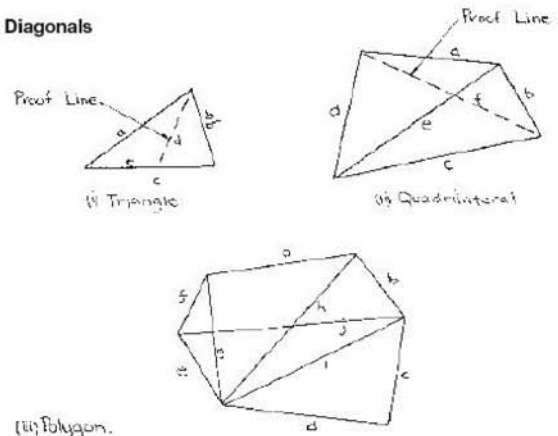


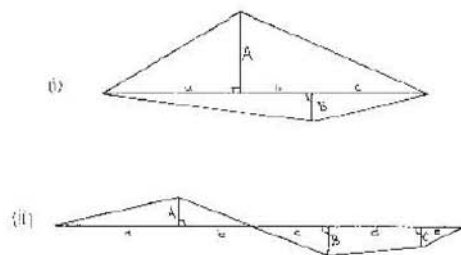
Fig 14 - Survey methods

a: Diagonals



Required No of Diagonals = No of Sides minus 2.

b: Perpendiculars (Offsets)



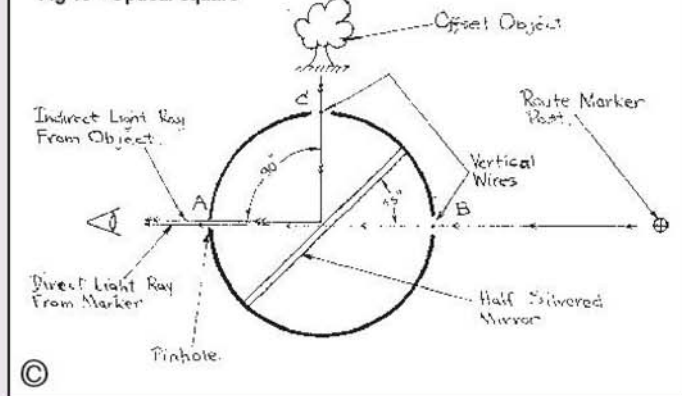
a: Diagonal method

Drawing 14(a) shows that the sides of areas are measured as also are the diagonals. Provided sufficient diagonals are measured to divide the figure into triangles, a full solution is achieved. An extra diagonal (called a Proof Line) can confirm the accuracy of the other measurements.

b: Perpendiculars or Offsets method

Drawing 14(b) shows how the area can be completely defined by measuring at right angles to a

Fig 15 - Optical square



route, the distances to the corner points of the area.

The optical square shown in drawing 15 is a useful aid for this process. It is simply a box with sighting holes on opposite sides containing a mirror with half its silvering removed and set at 45deg. to the line of sight. Thus, by looking into hole A the observer can see straight through hole B and, via the half mirror, out at right angles through hole C. Such a device is easily made in the home workshop if desired.

c: Angular or Polar method

The area can be completely defined by progressively moving around the area, measuring the lengths of sides and the angles between them (drawing 16c i).

Alternatively the angle from a selected corner to all other corners and the distances to them can be measured, and this set of data also completely defines the area (drawing 16c ii).

d: Triangular or Geodetic method.

In the geodetic method (more correctly, triangular method, except where the curvature of the earth's surface must be taken into account) the angular direction of a point is measured from each end of an accurately measured baseline. By trigonometry the position of the unknown point is thereby

determined as well as the distances from the ends of the baseline. These sides of the triangle so formed can also be used as baselines for the determination of the position of further points, and so on *ad infinitum* (drawing 16b). These results can be plotted as a scale drawing and the method is the normal survey technique used to map countries.

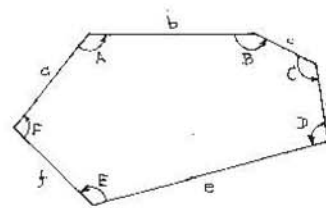
e: Trilinear method

This method is useful for such activities as measuring the depth profile of lakes, rivers and estuaries. For a boat located at a point S the depth is found with lead and line, and the location of S is determined by sightings from three known points A, B and C on land, using the construction shown in drawing 17.

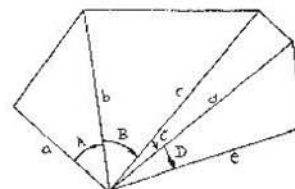
Fig 16 - Survey methods

a: Angular (Polar)

(i) Cheminement (Method of Progression)



(ii) Method of Radiation.



b: Triangular (Geodetic)

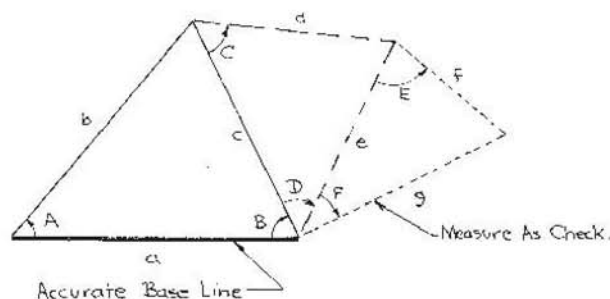
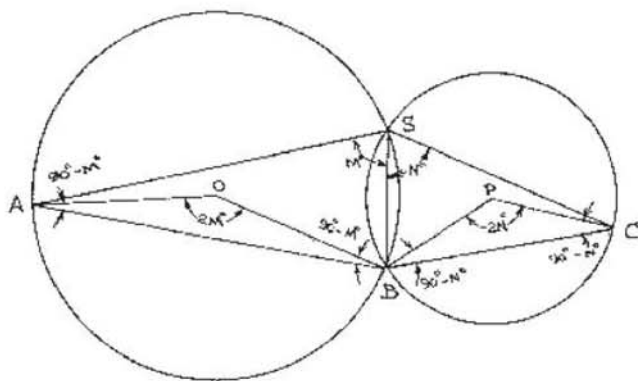


Fig 17 - Survey methods

a: Trilinear

Useful When Point S Is Inaccessible.



Measure $\angle ASB = M^\circ$ and $\angle BSC = N^\circ$
 Draw AO and BO so that $\angle OAB$ and $\angle OBA$ each equals $90^\circ - M^\circ$.
 Similarly BP and CP so that $\angle PBC$ and $\angle PCB$ each equals $90^\circ - N^\circ$.
 Draw circles centre O and radius OA, and centre P with radius PB.
 Intersection of these yields location of S.

Layout of a miniature railway track

Before the track can be laid, the lateral position of its critical points must be established, as well as their intended relative heights. It would seem that this requirement can be attained with adequate precision by the use of a minimum of equipment — a plane table with simple alidade, an orienteer's compass, a 100 metre tape and a U-tube water level. A copy of the local Ordnance Survey map is also a useful aid.

Straight sections are easy to peg, and circular curves can be effected with a string of length equal to the desired radius and a central peg.

In full-size practice superelevation is provided on curves, and transition curves are also introduced; these topics will be addressed in Appendix B to follow.

Conclusion

While very accurate instruments and considerable skills are required for professional surveys, for club and individual model engineering activities it would seem to be practicable to effect simple survey work with very limited equipment.

References

- 1: Gillespies Land Surveying: Gillespie, 1855.
- 2: Gillespies Higher Surveying: Gillespie, 1870.
- 3: Plane & Geodetic Surveying, Vol. 1: Clarke 1945.

●To be continued.



MONTY THE MORTAR

Stan Bray

takes a break between larger projects and introduces an attractive little model with a variety of uses.

●Part 1

In case the appearance in *Model Engineer* of constructional articles of a cannon and then, almost simultaneously, a mortar give readers the idea that our editor has decided to embark on a cunning plan to rule the model engineering fraternity by force, let me hasten to start by saying that the appearance of the two articles is pure coincidence. After completing lengthy projects such as the Ransome & May horizontal mill engine, I always like to go out into the workshop and potter for a while. This is after having cleaned out the accumulated swarf and sorted out the tools that have been put away in the wrong place, if indeed they have been put away at all.

The pottering usually involves making some little tool or model that is quickly built and can be made from materials to be found in the scrap box. Thus *Monty the mortar* (photo 1) took shape. Since as a rule these projects involve using materials that I happen to have by me they do not normally get described in the magazine as obviously many readers will not have the same materials.

I am sure you will all know the sort of thing, which goes something like this:

"I was driving down the motorway, when the lorry in front broke down and the half shaft fell off. I picked it up and thought to myself, now I know just exactly what I can make out of that."

"I reached the motorway service station and there, as I was parking the car, was an old teleprinter that I happened to know contained a set of 53:1 gears, which was just what the project needed."

"On the way home a fence made of solid mahogany fell down and I was able to obtain half a dozen nice planks of wood."

"I went home and made this lovely thing-a-me-bob, which everyone wants and for which I am sure everyone will have the material in stock."

Well, it is very doubtful if more than a dozen or so readers would be able to go out and happen to stumble upon those sort of materials and even in simplest terms, an article that tells builders that the object of desire happens to be made of an old wind turbine that was in the workshop is not a lot of good unless the reader also happens to have an identical or at least a very similar wind turbine.



Stan's nearly completed model of Monty the mortar executed in bronze and brass. A decorative object in its own right which would serve well as a conversation piece, paper weight, small pen stand or even a small flower vase.

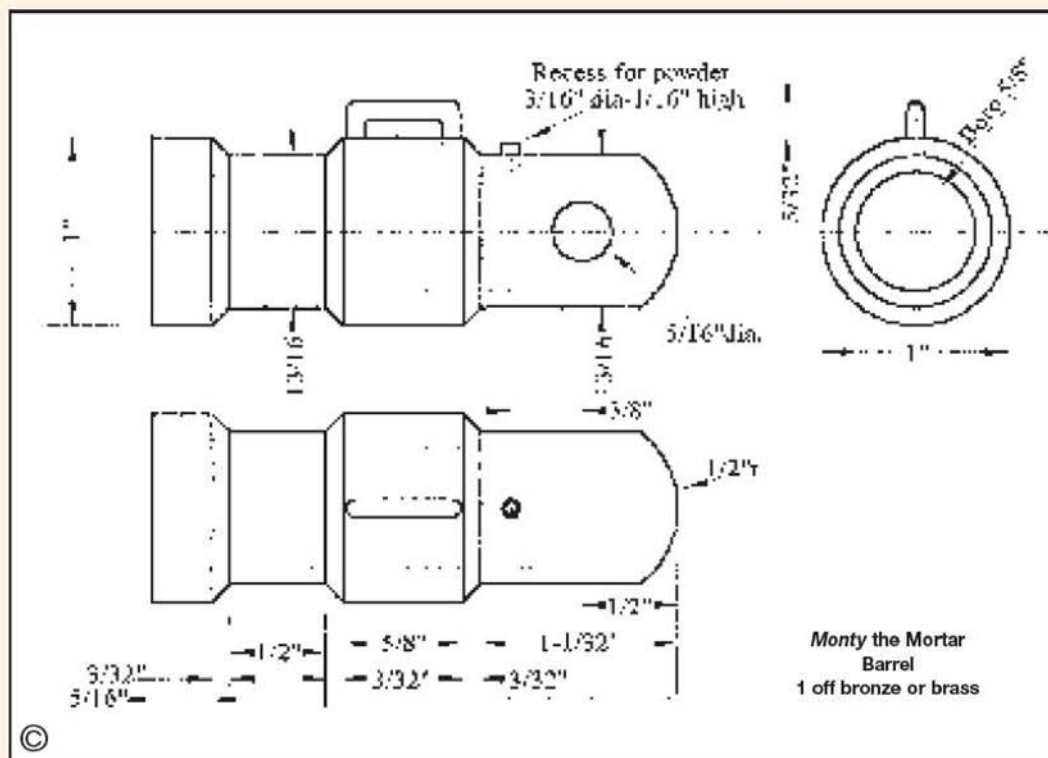
Many of the little bits and pieces that I make are constructed from junk of the type unlikely to be found in the average workshop and therefore not considered worthy of a description in the magazine. *Monty* was certainly made from scrap but the type of scrap that a few readers might

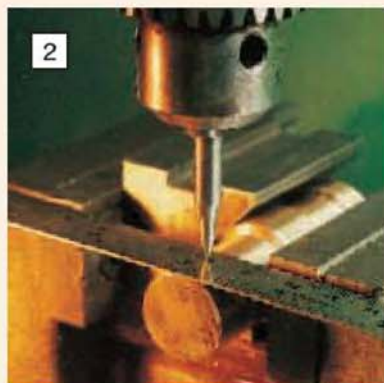
find they have around. It is very easy to make, in fact it is something that would be worthy of a school project because it is so easy and, although described as a mortar, it actually makes a very nice pen stand or even a little flower vase which can be presented to She Who Must be Obeyed, just before you want to buy that new lathe or milling machine.

Old engraving

The mortar was scaled from an old engraving. It seems that it was a type that was used by the British Army on the North West Frontier, so I suppose it is topical as well as historic. Reading the article from which the details were gleaned, it seems that there were probably many variations and so, if the constructor desires, it can be adapted to suit whatever materials happen to be resident in the scrap box. For example, although more often than not the barrel would have been of bronze or brass, there were examples of iron barrels. These were certainly not common because they had a nasty habit of shattering when the charge exploded, doing no good at all to the operator. Was this the first example of a mishap with friendly fire?

Although there are some photographs of the model, it is not yet completed as there is a handle on the top of the barrel which was not fitted when they were taken, and the wedges should be fitted with chains, obviously either to stop a careless squaddy from losing them, or to stop the Afghans from popping along and pinching them. As yet, I have no idea where to get a suitable chain and will probably end up making it unless I happen to be driving along a motorway ...

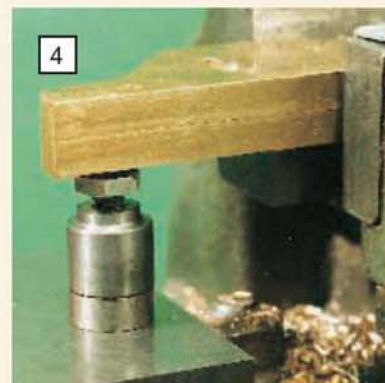




Setting up for cross-drilling with a rule nipped between a pin in the drill chuck and the barrel, which is adjusted until the rule is horizontal.



Stan made his frames by soft-soldering 16swg brass sheet together. If you have some spare 1/4in. material to hand, so much the better.



The frames were drilled as a pair to ensure the alignment of the holes. The small home-made screw jack supports the overhanging material.

Barrel

The barrel is a simple enough turning exercise and can be made from a piece of 1in. dia. brass. The one shown was in fact made from a short length of 1 1/2in. dia. bronze that some moron in a garage had been using as a drift, before it was rescued so that it could serve a higher purpose.

If the odd length you happen to have found is a bit tight and there isn't sufficient material to put it in the chuck and part it off when all the operations are finished, start by drilling and boring the hole. Then turn a piece of hardwood to a tight fit in the hole and ram the barrel home on that to machine the outside.

Assuming it will eventually grace the ancestral home, and a nice bright finish is required, don't throw the wood away but keep it for later use as a mandrel for polishing after the external holes, for the pivot, handle and firing chamber have been drilled.

Down more years than I care to recall, I have made a number of devices for accurately cross-drilling holes but, of course, it is somebody-or-other's law that none would fit this job. To drill the pivot hole therefore, the barrel was mounted in the vice, using a vee block at one side, and a 6in. rule laid across it. A pointed steel pin (a headless nail will serve provided its point is fairly

true and reasonably sharp) was lowered onto the rule which tilted one way or another depending on which side and how far off centre the point was (photo 2).

It was an easy matter to adjust the setting and nip up the securing bolt for the vice before using a centre drill and drill to make the hole. Anyone with a desire to be really accurate can drill and ream the hole if they wish, which will ensure that the pivot is a nice tight fit.

Frames

It is difficult to know from what material the frame should really be made. Certainly, some mortars had wooden frames, but others appear to have been of cast iron, although how on earth these things were ever lifted up for transportation is difficult to imagine. In this case I decided to use brass. Once again I was looking for something that would grace my desk, if it didn't get pinched to put on the mantelpiece, and polished brass sounded like a good idea at the time.

Now the snag with using brass was that *Monty* needed pieces 1/4in. thick (photo 3) and even if I had happened to have a sheet of that thickness I would have thought twice about using it for this purpose. My simple solution was to soft-solder four pieces of 16swg together and use that.

The few holes there are should be drilled first of all with both sides clamped together. Dowels should then be put through two of them so that both sides can be cut out as a single piece.

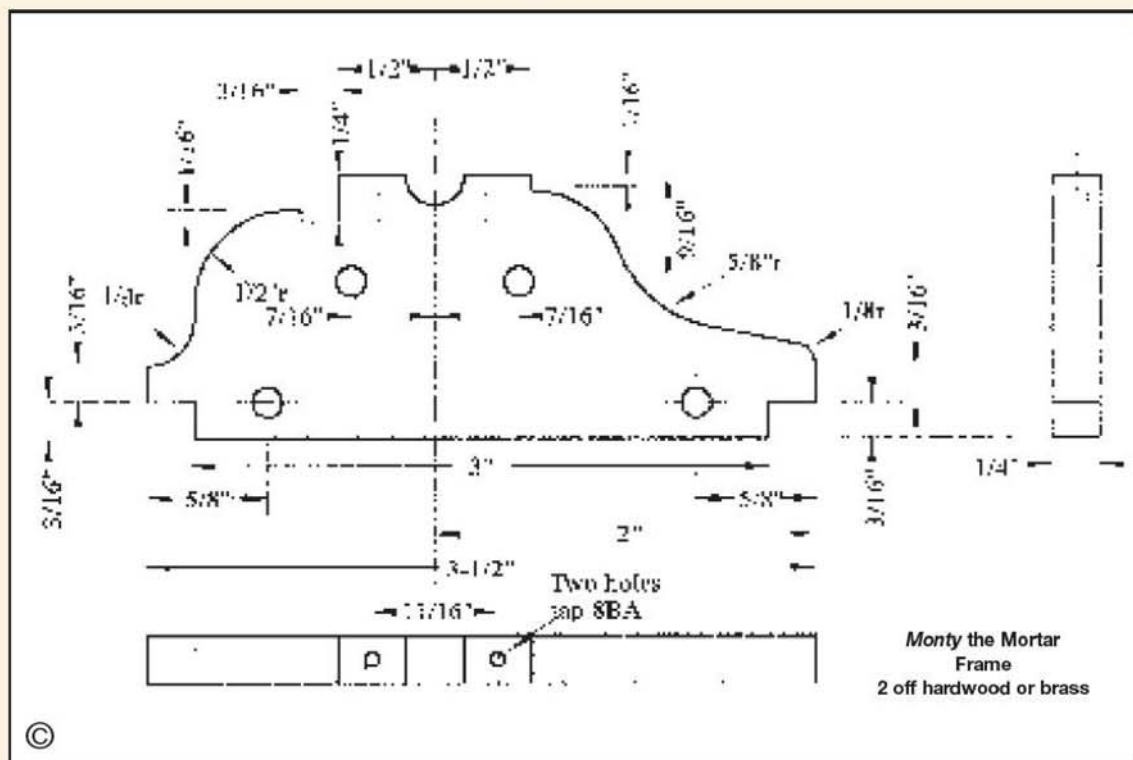
Cutting out the shape should not create any problems even to an absolute beginner. It is simply a case of marking it out and, if our Editor has sufficient space in this issue to print the drawing full size, you could even trace it. It is then a case of making strategic cuts with a hacksaw and blending in the curves with a file. Admittedly it calls for the expenditure of some energy, but that is likely to be quite good for you.

If you have made the sides out of four sheets soldered together, get a scribe and gently chase out some of the soft-solder in the joints around the edges. Mix up some quick setting epoxy resin adhesive with lots and lots of brass dust from all the filing that that just been done until the mixture resembles a sort of brassy putty. Don't use shavings, only the dust. The mixture can be spread around the edges, and sanded off when hardened. Your frames will then have the appearance of being made from a solid piece of brass, and as the hair-dresser says "You'll not be able to see the join."

The only job left on the frames is to make the pivot recess and to drill and tap the holes either side for the wedge blocks. If four pieces of

brass have been soldered together for the frames don't follow the drawings and put the holes in the middle of the edges as they will run into the join, move them over far enough so that the drill will be in line with one of the metal sections to give more strength. The recess for the pivot was made using the side of a 5/16in. end mill and was the only awkward set up encountered. On the model shown it was made after the frames were cut out which made matters even more difficult, but even so it is bound to involve a considerable overhang from the vice jaws. This overhang should be supported by whatever means is convenient and available to prevent it moving while the milling is carried out (photo 4).

●To be continued.



A FERRIS WHEEL CLOCK

Richard Stephen

finishes the escape wheel and starts on the frames.

●Part IV

continued from page 398
(M.E. 4170, 31 May 2002)

The escape wheel should be crossed out at this stage. Titanium is quite easy to cut with a fine piercing saw, and to file, provided again one takes it slowly. The rim of the wheel can be made about 1.5mm thick, or less, with no danger of the wheel being too fragile. By now you will have discovered just how strong and rigid titanium is. You must finish the crossing out at this stage, including burnishing the spokes and the inside of the rim. The sides of the wheel can also be finished and polished. The wheel collet should also be made.

If you can find a scrap of 8mm titanium rod, use this for the collet, as any way of reducing the weight of the wheel will improve the escapement action. Fix the collet to the wheel with Loctite High Strength Retainer. Fix the wheel to a short length of 2mm rod (about 30mm long and perfectly true) using Loctite Screwlock. The wheel can then be removed easily at a later stage by heating the rod to break the joint.

Grinding the front faces of the escape wheel teeth

Fly-cutting the teeth of an escape wheel, whether the wheel is made of hard brass or, as in this instance titanium, produces some distortion of the teeth. In my experience it is almost impossible to prevent this distortion from occurring. The consequence of this distortion is that the spacing between successive teeth of the wheel is not exactly constant. Setting up the escapement then becomes a problem since in some positions of the wheel the escapement will hang up, in others the drop may be excessive, and in the rest it will be just right.

I like to have a maximum drop of no more than about 0.1deg., which translates to a clearance between the pallets and the escape wheel teeth of about 0.01mm. I have never been able to fly-cut an escape wheel to give me this degree of accuracy in my escapements. To achieve this degree of precision, the teeth of the escape wheel need to be trued up.

Photograph 10 illustrates the set-up I use. Replace the fly cutter with a carborundum dental cutting disc. These carborundum cutting discs are readily available from dental equipment suppliers for which addresses



A view of the Author's prototype Ferris Wheel Clock, showing the column of driving balls being lifted to re-enter the Ferris wheel and so drive the mechanism. The three frame members which hold the clock together are also apparent and are described in this article.

and telephone numbers of a local supplier can be found in *Yellow Pages*. Alternatively, you can get them from Proops Bros. in the UK (see Part I, M.E. 4166, 5 April 2002).

These cutting discs seem to work equally well on brass or titanium and, having many uses in the workshop, are quite invaluable. Return the escape wheel on its arbor to the set up used to fly-cut the teeth. Using a dial gauge, you must check that the arbor is running absolutely true. The escape wheel should first be ground true on its arbor. The crossing out, filing and burnishing may have slightly distorted the wheel. The diameter of the wheel also needs to be reduced to precisely 25mm. Bring the carborundum disc up to the tip of one tooth. Disengage the dividing or indexing attachment so allowing the lathe spindle to rotate freely. With the grinding disc rotating as fast as possible, rotate the escape wheel against the grinding disc. Reduce the diameter to exactly 25 millimetres. Re-engage the dividing or indexing attachment. Adjust the position of the wheel and the grinding disc so that the front face of a tooth is parallel to the face of the grinding disc. Bring the side of the disc up to the tooth face and grind approximately 0.02mm from the first tooth. Lock the disc in this position and grind all the front faces at this setting. Do not try to grind off too much at one time.

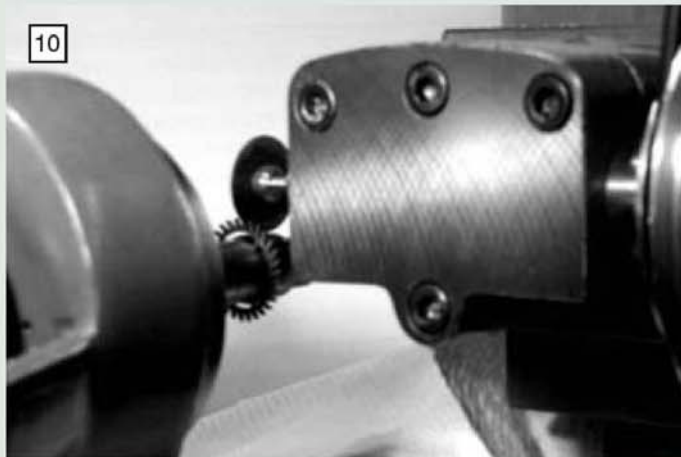
As you index the wheel around you will be aware that you are grinding more material off some teeth than others. The backs of the teeth now need to ground to reduce them to their final size. When finished, the witness should be about 0.15 millimetres. Because titanium is so much stronger than brass it is possible to make the witness much less than one would with a brass wheel.

It now time to begin setting up the escapement; the escape wheel will be matched exactly to the pallets and the pallet nibs ground to suit.

Fitting the escape wheel to the pallets

The drawing of the escapement, fig 11a, illustrates a tooth of the escape wheel having just dropped onto the left hand locking pallet face. The eighth tooth, counting clockwise around the escape wheel, has also just dropped off the right hand impulse pallet face. To understand the fitting procedure we need to consider the situation when an escape wheel tooth has dropped off the left hand impulse face and the eighth tooth clockwise around the escape wheel has dropped onto the right hand locking face of the pallets. This situation is shown in fig 11b.

To fit the escape wheel and pallets you will need the depthing tool made earlier. The advantage of this type of



The method used by the author to correct the escape wheel geometry by means of a small carborundum cutting disc.

Rotate the escape wheel one tooth clockwise so that the next tooth has 'dropped' onto the locking face of the left hand nib. You will see that the external face of the right hand nib extends a little beyond the tip of the tooth of the escape wheel. This tooth had previously 'dropped' onto the locking face of the right hand nib. This is because earlier we did not reduce the width of the nibs sufficiently. Now is the time to reduce the width of the nibs. Grind down the external faces of the nibs, constantly checking the pallets against the escape wheel. The clearance at the external nib faces should be the same as that at the internal faces. It is better that the clearances are too tight, as these can be adjusted once the impulse or lifting faces are ground.

Grinding the impulse faces

The same set up as was used to grind the external faces of the nibs is used to grind the impulse faces. Position the centre of the 2mm peg in line with the grinding face of the lap. Advance the 2mm peg past the grinding face (i.e. towards the headstock) by the radius of the impulse circle of the pallets. For this escapement the radius of the impulse circle is 4mm. Simply hold the nib firmly against the lap and grind the first impulse face. To grind the second impulse face, retract the 2mm peg 4mm past the grinding face (i.e. towards the tailstock). Again simply hold the nib firmly against the lap and grind the second impulse face.

A constant check must be kept while grinding the impulse faces, by trying the pallets with the escape wheel. The impulse faces will have been ground back enough when a tooth sliding up an impulse face and just at the point of dropping off the nib, allows the tip of the opposite nib to just about clear the back of the relevant tooth. At this stage the pallets should just 'hang up'.

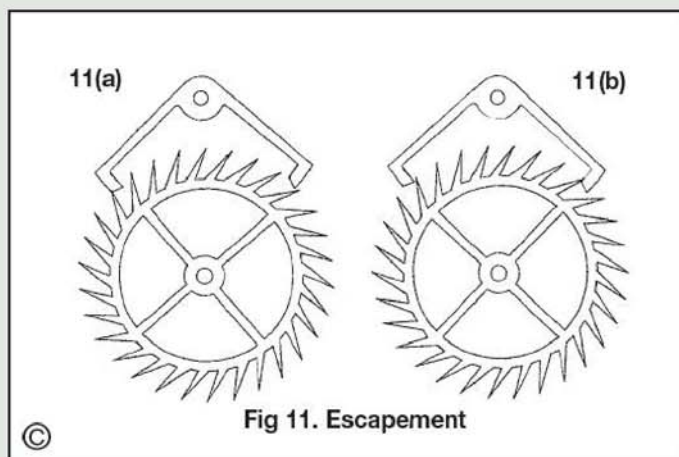


Fig 11. Escapement

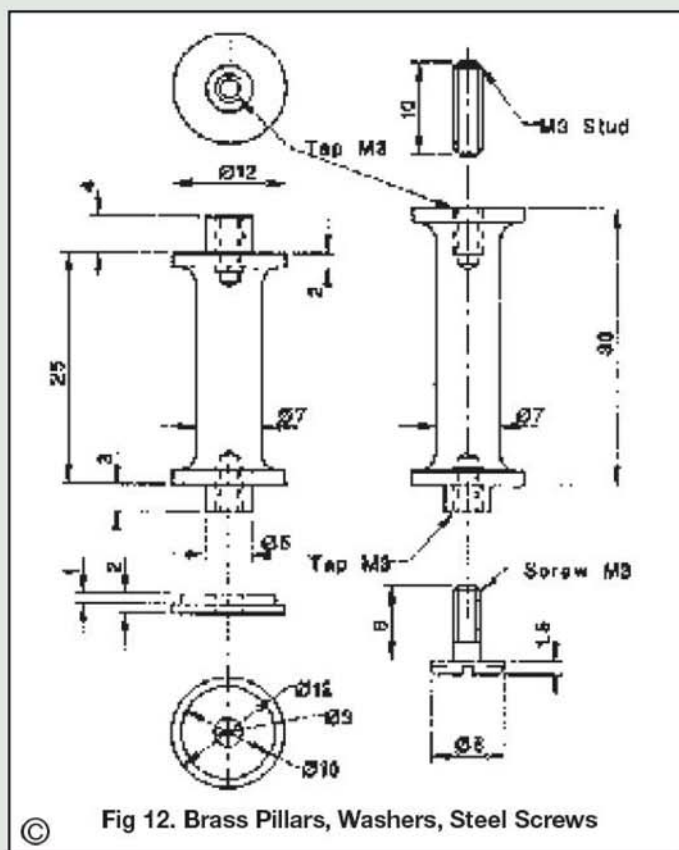


Fig 12. Brass Pillars, Washers, Steel Screws

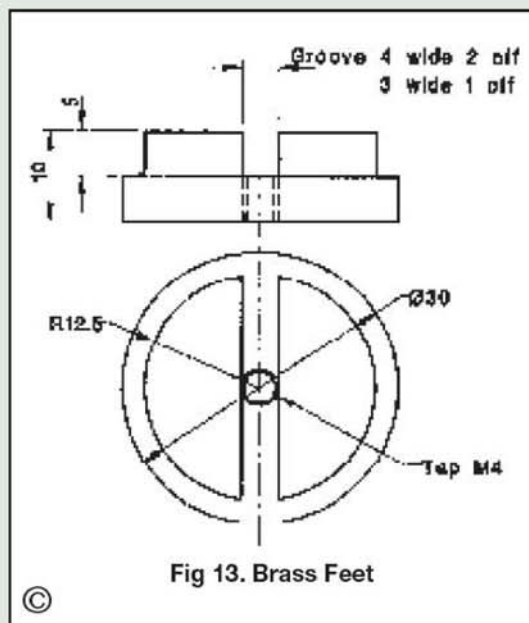


Fig 13. Brass Feet

The final adjustments are made using a 6 micron lap. Lap the external circular faces of the nibs and the impulse faces, constantly testing the escapement to see if it releases. It may also be necessary to adjust the separation between the arbors. If you find that the 'hang up' is caused by the internal edge of the left impulse face or the external edge of the right hand impulse face catching against the back of the teeth, then correct this by carefully lapping these sharp edges. This generally cures the problem and you will suddenly find that the escapement releases and 'works'. Finally, polish the faces with a 1 micron lap.

With care you should be able to produce an escapement with the absolute minimum of drop. Measure the spacing between the arbors using a micrometer and note it down.

Plates

Now that the escapement is made and working, a start can be made on the rest of the clock. The drawings for the back plate and the two time bars of the clock frame are given in **fig 14**. For the back plate you require a piece of CZ120 brass sheet 200 x 300mm, 4mm thick. For the middle and front time bars you require a piece of CZ120 brass sheet 300 x 100mm, 3.5mm thick. I cut out my plate and time bars using my Wabeco CNC milling machine which did a super job leaving me with little finishing work to do on the edges. How you cut out the plates will depend on the equipment you have available.

After cutting out the plate and time bars, the holes for the pillars should be drilled and reamed. Align the back plate and the two time bars and clamp them together. Drill and ream the first pillar hole. Fit one of the reg-
 ists into the hole. Now drill and ream
 e for the second pillar.

Pillars

You will require a 180mm length of 12mm brass rod to make the four pillars. In addition you will need two 20mm lengths of 3mm (or the nearest BA equivalent, eg. 6BA) brass threaded rod. If you have no threaded rod, either make some or cut down a couple of screws of suitable length.

The dimensions of the pillars are given in fig 12. The rear ends of the two front pillars are tapped 3mm and a length of threaded rod inserted and secured with Loctite High Strength Retainer. Alternatively, you could thread the end of the pillar. I prefer to insert a length of threaded rod as this produces a perfectly square shoulder and allows the pillar to pull up squarely onto the middle plate.

The four pillar screws and the four brass washers should also be made. These are also shown in fig 12. The screws are made of

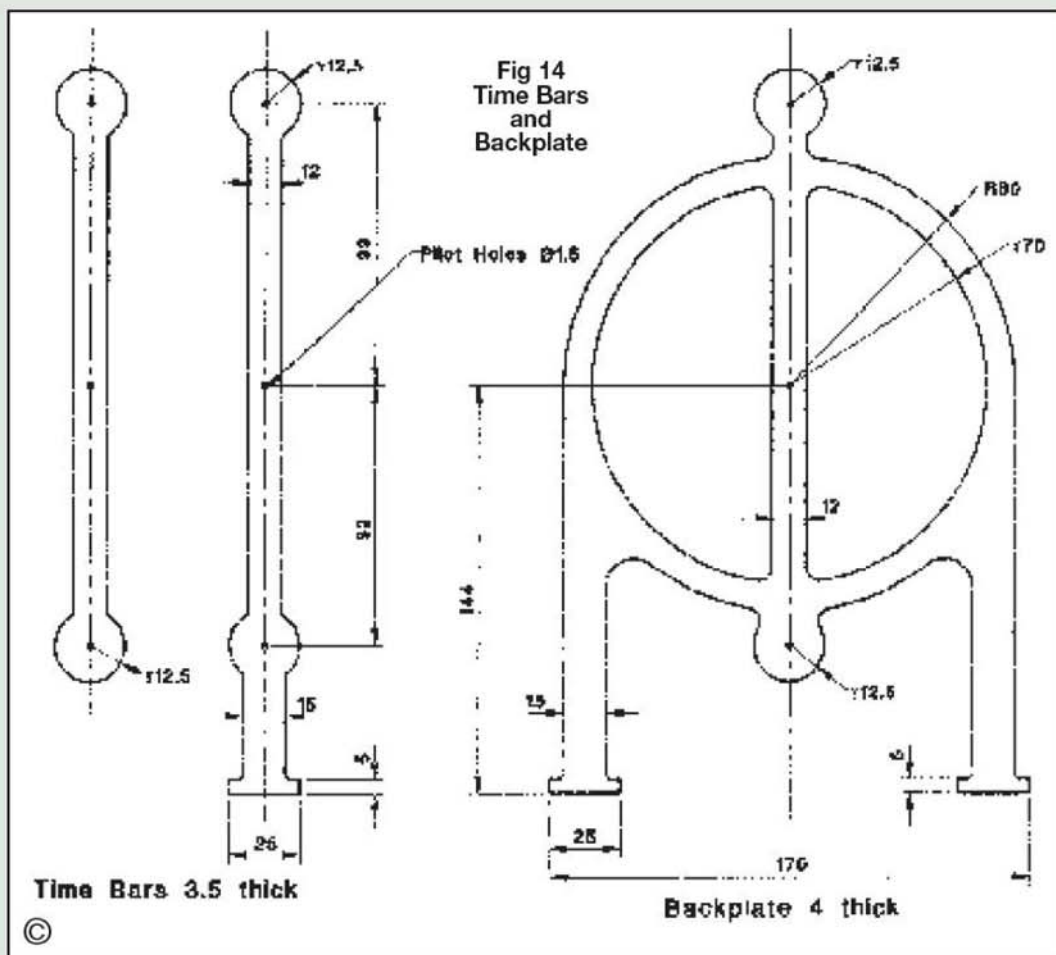
8mm diameter EN1A (mild steel) rod. You could use any other mild steel, however you will find that EN1A threads a lot better than any other mild steel. The slots in the heads of the screws are best cut in the milling machine using a slitting saw of the appropriate thickness. Ensure that you cut the slots absolutely centrally as off-centre slots look awful.

The dimensions of the three feet for the plates are shown in fig 13. The feet are silver-soldered to the plates. If you have any, silver-solder shim is the easiest material to use here. If you have no shim, then hammer flat a length of silver-solder wire. Assemble the plates and pillars. Check that the assembled plates sit squarely when placed on a true flat surface. Cut off three lengths of silver-solder shim sufficient to cover the bottom of the grooves milled in the feet. Place on a flat fireproof surface. Heat each foot until the solder flows. You may have to apply a little extra solder if necessary. Leave in position and allow to cool. Clean off any excess solder with a fine file and finish with wet and dry paper. Again check that the assembled plates with their feet now silver-sol-

dered in place sit squarely on a true flat surface. If the plates do not sit squarely you will have to take remedial measures before proceeding further

with the construction. The screw threads in the feet may have to be cleaned out with a tap.

●To be continued.



LARGE SCALE MODEL RAIL

The Large Scale Model Rail show held at the Warwickshire Exhibition Centre, 20/21 April 2002 was entirely devoted to scales of 4mm and above with a total of twelve layouts operating constantly throughout the weekend. Two large Gauge 1 layouts were situated side by side in the 20,000sq.ft. exhibition hall for the first time ever, and at any one time some 30-40 Gauge 1 locomotives could be seen in

steam or awaiting their turn. From the appropriate vantage point, four trains could be observed running on the main lines while other engines were either moving off shed or shunting in the background, making an impressive sight. These two large layouts were augmented by two smaller operating layouts and the Gauge 1 Model Railway Association report this as being the first time four Gauge 1 layouts had been presented together in the same event.

With five layouts in operation, the second part of the hall was devoted almost exclusively to 16mm gauge, and to complete the picture, a superb fine scale 0-Gauge layout was displayed to remind visitors of the early days. John Pentney presented an extremely large historical Hornby layout, and Imp Models showed a large number of items from their extensive Lionel collection, one of the gems of the exhibition because it is rare to see so many Lionel items in such pristine condition. Mike Mobley was very pleased with the response from visitors and is keen to present a working Lionel layout next year.

All who participated in the exhibition, including the 35 companies, thoroughly

enjoyed their weekend and are keen to be present next year. There was so much for the visitors to see and do that everyone went home highly satisfied, since when the organisers have received numerous calls and letters encouraging them to repeat the show. With nearly 2,600 keen garden gauge railway enthusiasts at the event it clearly fulfilled a need and will be repeated, but bigger and better next year.



Photo: Meridienne Exhibition Large Scale Model Rail.



Photo: Meridienne Exhibition Large Scale Model Rail

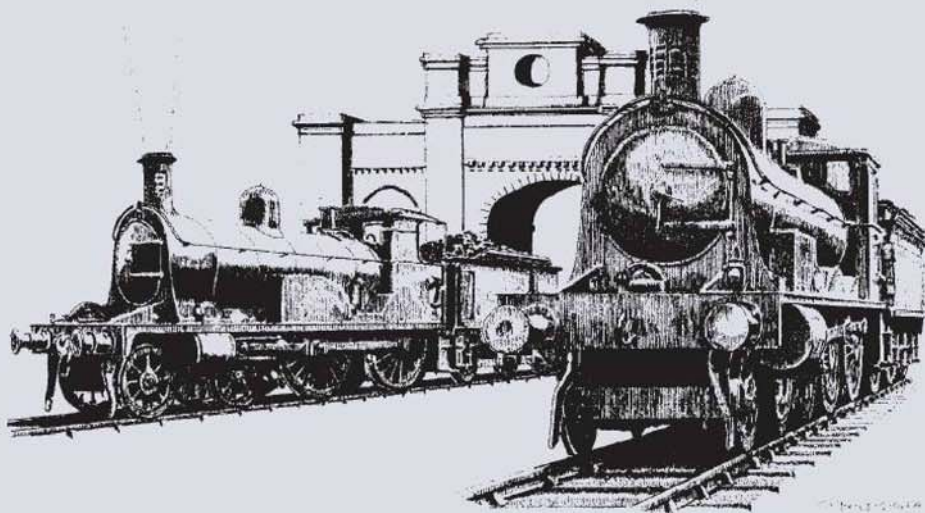
Neville Evans

describes the construction of the 'Loch' smokebox, notes that not all brasses are equal, and comments on the current debate concerning drawings and dimensions.

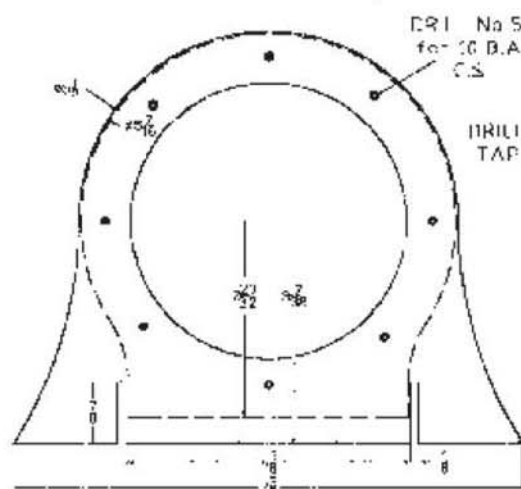
●Part XV II continued from page 402 (M.E. 4170, 31 May 2002)

The next items on the agenda are the smokebox assembly and the steam circuit. I have decided to detail the two locos separately, to avoid confusion between the drawings which look somewhat similar, but are quite different.

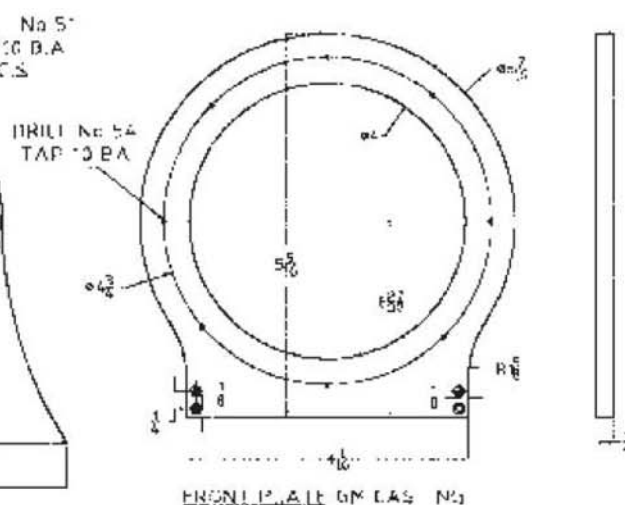
We are lucky, in that we have a pair of castings for the front and rear plates of the smaller 'Loch' smokebox. The front plate is a matter of machining to width and boring the centre hole out to 4 inches. The outside can then be filed or finished to size using a belt sander. Be careful when you bore the hole for the door that the casting is running pretty true, otherwise you won't have enough room left on the outside for the cleaning up process. For those who possess a rotary table, it would be a wise precaution to machine the outside curves to size first, with the two castings superimposed, so that



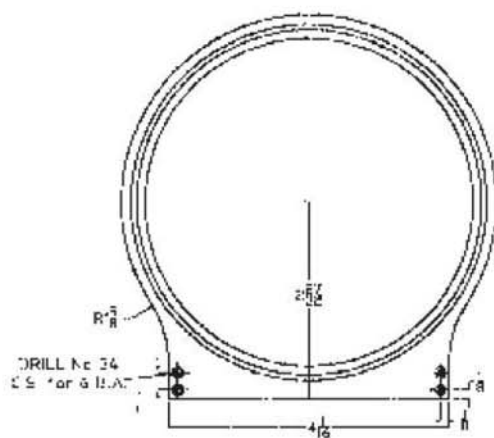
THE HIGHLAND RAILWAY JONES 'BIG GOODS' & LOCH 4-4-0 LOCOMOTIVES IN 5in. GAUGE



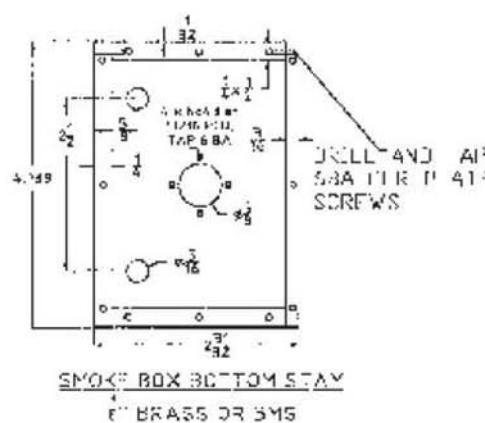
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FRONT PLATE 5in. GAUGE NO. 1



REAR PLATE 5in. GAUGE



SMOKE BOX BOTTOM STAY
1/8" BRASS OR 3MS

LOCH SMOKEBOX

the smokebox will be parallel on assembly.

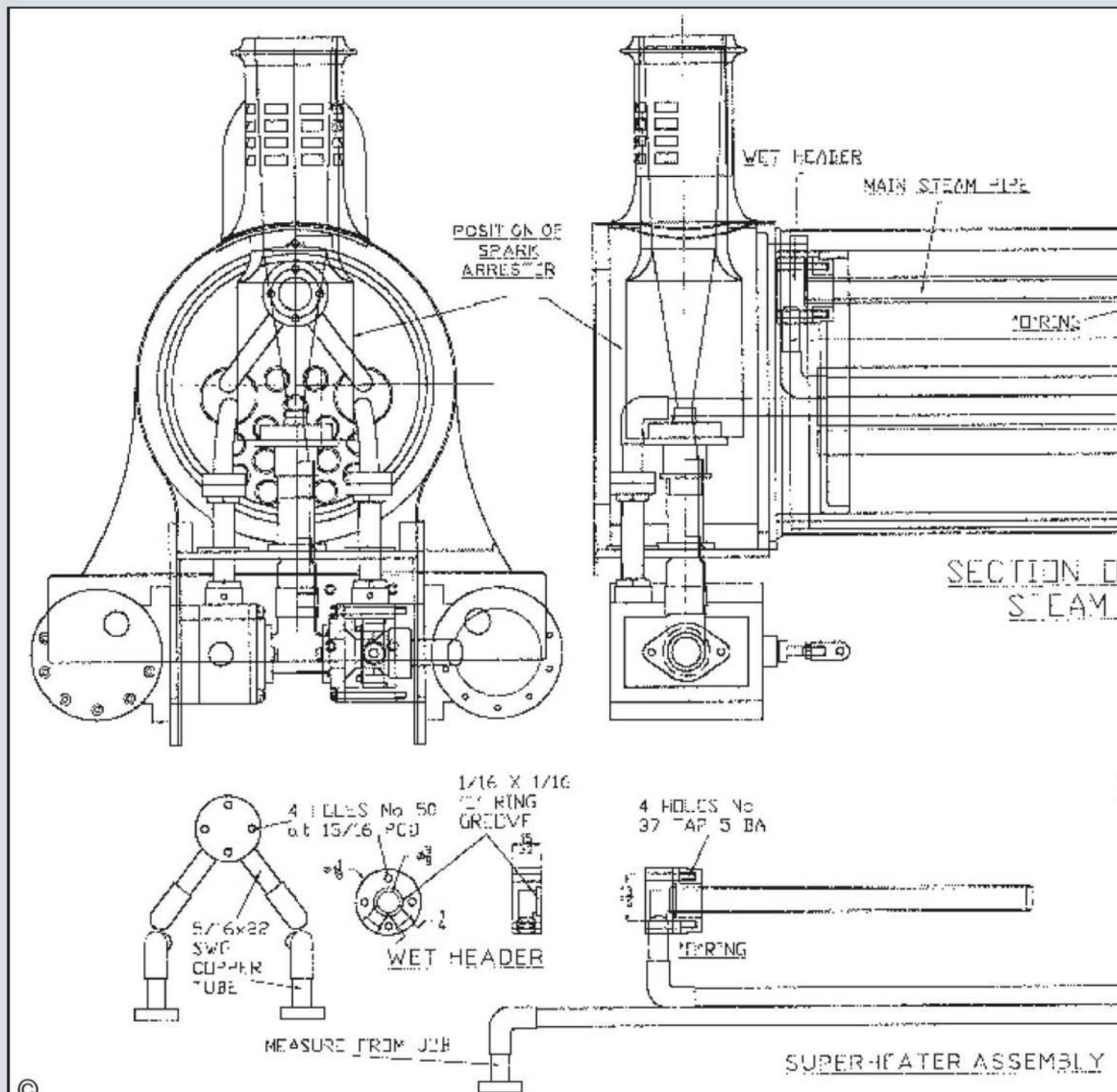
The rear plate is a bit different in that we need to turn the register into which the boiler fits, and the steps that support the lagging, as well as finishing the outside to match the front plate. The smokebox sits on and is part of the horizontal stay which forms the floor of the assembly. The stay is quite straightforward and there should be no problems in following the drawing.

The wrapper is made of $1/32$ in. brass sheet, cut to length and width, with the emphasis on the width. Make sure that the wrapper is as near to $2\frac{1}{32}$ in. wide as you can get it. I must emphasise

that the assembly be parallel and true, nothing looks worse than a badly made smokebox: the only answer is to consign the lot to the scrapbox. The two plates are mounted on the horizontal stay, which is basically a rectangle in $1/8$ in. brass, with two lengths of $1/4 \times 1/2$ in. bright mild steel screwed to the sides as shown. The smokebox wrapper is held between the $1/4 \times 1/2$ in. strips and the frame by six 6BA screws. I haven't dimensioned the holes otherwise you won't be able to see the drawing for dimensions. I think that it's pretty straightforward and shouldn't tax the average builder too much.

This business of working brass is not, in fact, the doddle that people make it out to be. This is partly because brass can vary enormously in constitution and condition from dead soft to extremely hard and brittle, depending upon how much zinc it contains, and in the case of brass sheet, which is what concerns us at the moment, how thin it has been rolled out. In years gone by, brass sheet was obtainable in many states of hardness, from a quarter hard, which was lovely, ductile stuff, to spring quality. Nowadays we seem to be limited to the latter variety.

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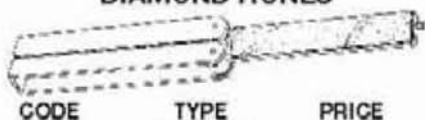
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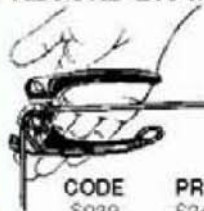
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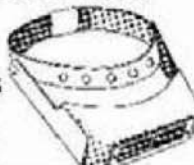
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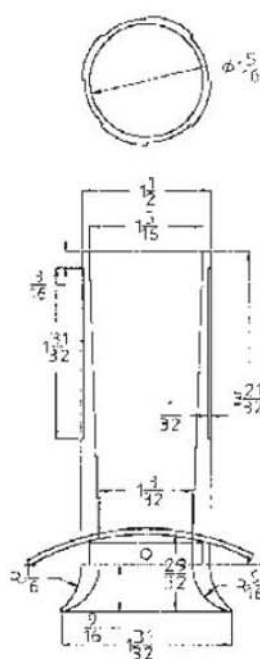
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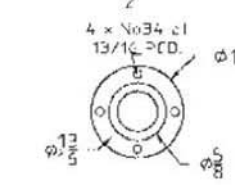
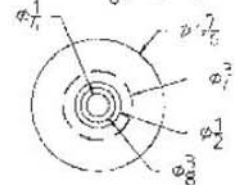
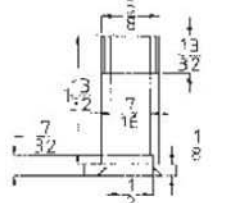
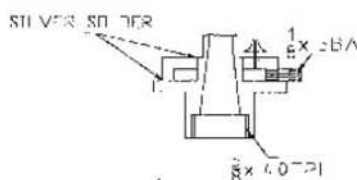
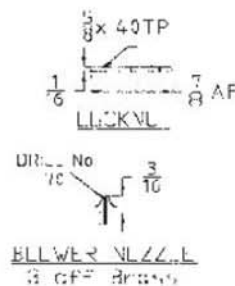
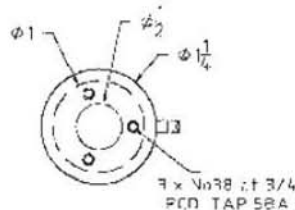
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onto the end. Silver-solder has too low a melting point for this application. I have used copper elbows to join the copper tubing to the stainless. This kills two birds with one stone: we don't have to bend any pipes, and it all looks neat and tidy. I have specified flange fittings for the two joints because I don't particularly like cones and the flanges allow the joints to slide when the superheaters are being removed for servicing.

If anyone prefers the more usual screwed fittings, please feel free to modify them. The holes in the stay where the pipes pass through, are sealed with 5/16in. I/D steel washers, which in turn are covered in sealant. Oil is fed to the main bores via the two steam pipes, by way of the two banjo fittings which sit on top of the steam chests. I have used some red fibre washers above and below the banjos and the whole lot is held down by a couple of nuts; all very straightforward.

The exhaust is built around a 15mm copper tee-piece. Years ago, someone carried out a few experiments as to whether it was worthwhile gas flowing the steam circuit in a small locomotive; the answer was no. A tee-piece is just as good as a lovely smooth bend. We are back to low steam velocities in small engines again. The tee-piece is sealed by a pair of O-rings bolted up by flanges. To dismantle, undo the four bolts and pull the whole lot downwards. See the cylinder notes for further elucidation. A short brass distance piece holds a 15mm to 10mm reducer, this in turn pushes into the blast pipe and is sealed by yet another O-ring. The whole blastpipe assembly, is quite normal and therefore doesn't warrant any description. Before you go any further however, why don't you re-read John Hill's recent letter (p122, M.E. 4165, 22 March 2002) in which he describes how to set up a 17 1/2deg. blastpipe in some detail? Not to be missed.

Readers letters

There has been much of interest in the *Post Bag* columns of late. I must say that the lengthy correspondence about dimensioning techniques has intrigued me somewhat. I really can't see what all

the fuss is about, though it has had the effect of concentrating the mind, rather like impending execution. I have therefore decided that in future, I shall dimension on drawings in decimals, to the nearest thousandth of an inch, which is how I measure anyway. There will be exceptions, in that I shall specify hole sizes, or indeed anything else that I see fit, in fractions, if applicable.

The obvious point is that the accuracy is there to be used if you need it (as with small detail on drawings, which you can add, or leave out). There is no excuse in these days of cheap and cheerful digital calipers, not to measure to quite fine limits. If you don't require great accuracy, then use a rule, or whatever. It must always be borne in mind though, that steam engines in general don't like close fits, except in places like pistons and the like. As a small boy, I well recall hearing from my Father of a batch of Southern 'Moguls' from Greenwich Arsenal that were made to close fits and tolerances. They had to be re-machined to far wider clearances before they were of any use at all.

If there is anyone around unable to grasp the fact that an axle turning in an axlebox requires a nice relaxed sort of a fit, whereas a shaft pressed into a hole so that it doesn't come out again, needs a rather more restrained sort of a fit, then perhaps they should take up knitting.

It reminds me of years ago when, once a year, we of Bomber Command, paused from our task of holding back the Red Hordes at the Rhine, to attend a lecture on 'Defence h'Against h'Atomic h'Attack' which was given by a dear old Warrant Officer at RAF Halton. The fact that the surrounding area was a prime spot for a 'booze-up' had of course, nothing to do with the large turn out. Every year the D.O.W.O. said "In the centre of a h'atomic explosion it is very 'ot.'" whereupon the youngest Pilot Officer was briefed to ask "Excuse me Warrant, but approximately how hot is it in the centre of a hatomic explosion?" Came the answer "Flamin' 'ot. That's all you need to know, lad." or words to that effect, to the accompaniment of thunderous applause. The point I'm trying to make is that most model locomotives are designed and

described neither by, nor for professional railway engineers, and we can all be thankful for that.

Drawings are produced which seem to be able to be read and interpreted by people of average intelligence and little experience. Many thousands of *Simplexes* have been built, made to all kinds of standards of accuracy, yet they all seem to give a performance, in relation to their size, that is entirely satisfactory.

We must approach the building of small engines with a modicum of common sense. If we lack that desirable commodity then, no matter how much 'full-size experience' we have, we are doomed to fail.

Diversions

A few months ago, I waxed lyrical, about the shortcomings of several RAF aircraft, notably those produced by the Hawker aircraft company. (If you think that I was hard on the *Hunter* just wait until I start on the *Gloster Javelin*). My lyricism drew a sharp rebuke from an ex-airline Captain, who strongly objected to my use of the word 'mediocre' when referring to the sacred *Hawker Hurricane*. Well, the acknowledged first attribute of a fighter, is speed. If you have an interceptor which is 30mph slower than the opposition and inferior in climbing power, acceleration and diving speed, then you are in dire straits. The old chestnut of tight turning ability is then trotted out.

Think about it. If you don't time your turn away to the split second and turn too early, you are presenting your opponent with an easy shot at a huge target, the plan view of your aircraft. If it's too late, then you'd better hope that he's not a very good marksman, otherwise two 20mm Mauser cannon will have bisected your bottom. Nasty! As to my comment that the *Harrier* was irrelevant, I think that by now the role of this aircraft has been usurped by the various attack helicopters, which can do the job of the *Harrier* and perform a hundred and one other tasks as well. I know that the US Marines use the *Harrier*, but it seems like a rich man's toy to me.

●To be continued.

Martin Wallis

discusses various methods which can be used to machine the cylinder bore and deals with making and fitting the liner.

●Part XXVI continued from page 408 (M.E. 4170, 31 May 2001)

A single core in the cylinder casting cores out both the cylinder liner bore and the steam uptake to the regulator chest at the top of the block. Once the cylinder liner is fitted, the steam still makes its way up to the top via a cored out recess to the left of the bore. This is probably best indicated by the sectional drawing included this time.

The 3in. scale cylinder casting must be opened out to 1.750in. for the liner with its 1.500in. bore. The cylinder cover at the trunk guide end is recessed into the cylinder so that the cover is invisible when the trunk guide is fitted. In full-size, the trunk guide was cast integrally with the cover which in our scale, even if it were possible to cast, would be next to impossible to machine.

Last time, we saw that the machining of the saddle could be tackled in a variety of ways, and we now discover that the machining of the cylinder bore is equally diverse. Fortunately, the exact dimension is unimportant because the cylinder liner will be machined to suit.

The bore of the cylinder liner may be tackled in many ways too, for it may be mounted in the lathe gripped in a 4-jaw chuck, or clamped to the faceplate, or mounted on the cross-slide. Then again, it could be bored in a milling machine of either the horizontal or vertical variety.

Plug gauge

Internal micrometers are available that will measure these bores. However, they are expensive and unlikely to be used very often. Good quality vernier calipers will probably do the job, but should be checked over before use. The little prongs used to measure internal diameters can be bent if the calipers are dropped. The bore in the cylinder needs to be the correct size for the piston rings, but the bore in the casting to take the liner is less critical since the liner may be turned to fit afterwards.

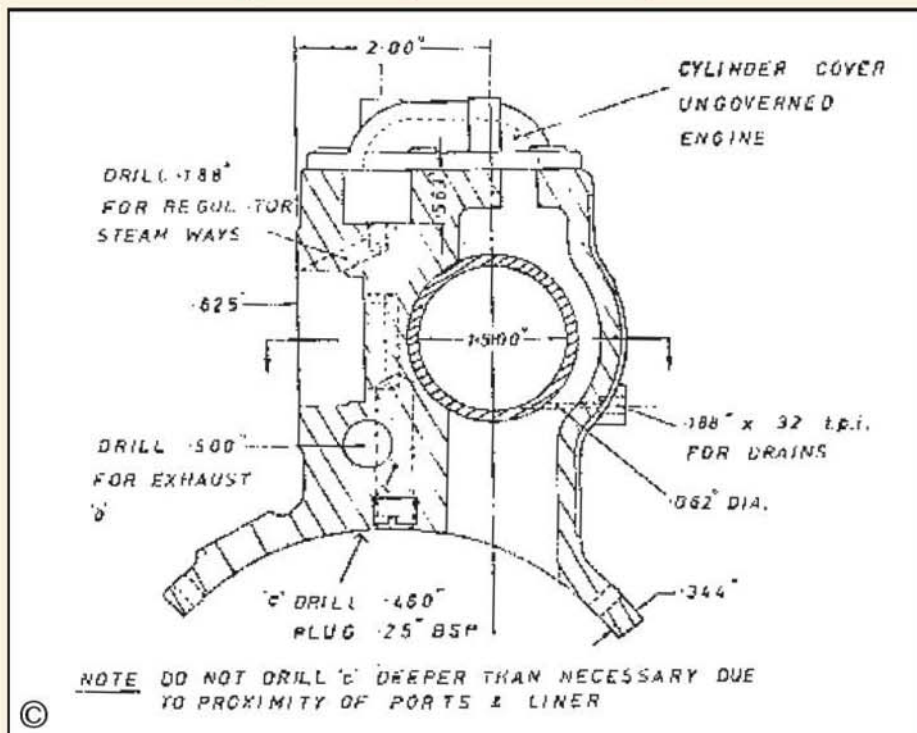
I prefer to make and use a plug gauge to check a bore. A short piece of precision ground bar will do nicely. Take about 5 thou. (diameter) off the last few millimetres (length) in the lathe; this will warn you when machining the bore that you are getting close to size. Note also that a short plug gauge is easier to offer up to the work. A small hole for a little handle is worthwhile, making it more convenient to offer the gauge up to and remove from the job.

A piece of bright bar might suffice for the plug gauge, but bright drawn bar is usually a thou. or two undersize.

Using a 4-jaw chuck

Stan mounted his cylinder in the 4-jaw chuck with the trunk guide end towards the tailstock so that

SAVAGE'S LITTLE SAMSON in 3in, 4in. (and other) Scales

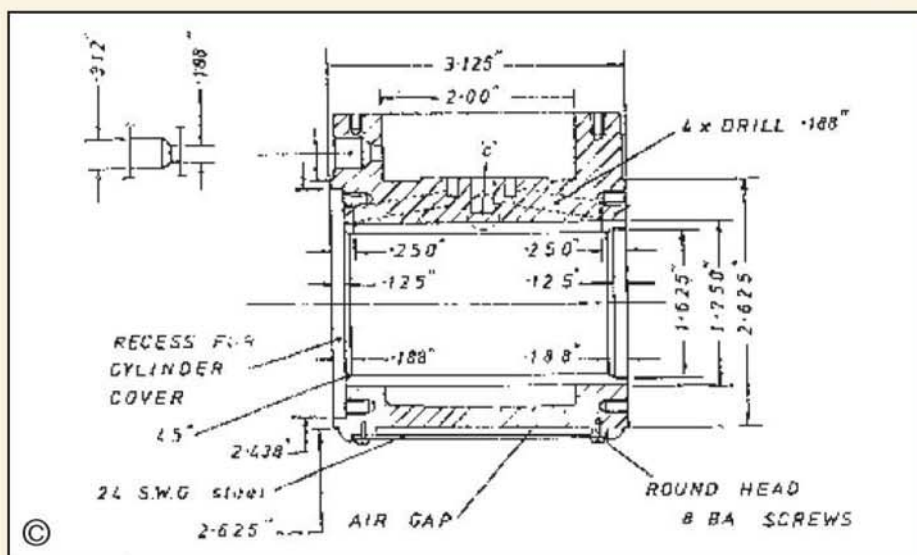


the cylinder cover recess may be machined at the same setting as the bore thus ensuring that the trunk guide would be truly co-axial with the bore.

The cylinder was zeroed in with the aid of a lathe centre and a dial test indicator (photo 1). Once the cylinder was running as desired, boring was completed from the toolpost in the conventional manner, taking the final skims with little or no cut applied. These last few passes were to work out any spring in the tool, more important with this job than usual since the cut was intermittent in the middle where the steam uptake core is situated.

If the bore is to be machined in the 4-jaw chuck or on the faceplate, it may be wise to take a very light final cleaning-up cut over the saddle radius afterwards. This is because the cylinder cover face, turned at the same setting as the bore, is a very good face on which to register. Once removed from the lathe, the cover face may be clamped onto a ball race spacing ring, directly to the milling machine table. The saddle may then be lightly skimmed ensuring it is axially parallel to the cylinder bore.

Do check that the milling machine head is square to the table if you're working from the quill.



Mandrel

The chimney end of the bore may be faced off in the lathe by holding it on a mandrel. A mandrel is not difficult to make and grips the work more firmly than some folk seem to think. The method is easy: grip a piece of bar just a little bigger than the target size. Turn it to 2-3 thou. bigger than required and then take it down to a snug fit for three-quarters of its length. A thou. is then taken off part of the tiny step that is left and the cylinder tried on for fit. If it is very tight, complete the cut and take off another thou. over part of its length. The desired fit, when the block wrings on the last bit by hand, will be achieved very quickly. Three quarters of the fit is snug and the remaining quarter is tighter and takes the drive.

Don't get the fit any tighter than a hand fit; it just isn't necessary. Given light cuts, a good hand fit will be plenty strong enough. A little oil is desirable to make sure the two metal surfaces don't 'pick up' which may result in the two parts having to be separated with a mallet and probable damage to one or other or both machined surfaces.

Such mandrels are shown in **photo 3** in which Stan is facing the end of the cylinder, and in **photo 9** where David is facing off *in situ* the end of the fitted liner and adding the chamfers that help the piston rings into the bore. An expanding mandrel is shown in **photo 6**.

Between centres on the lathe

Readers will remember the clever arrangement devised by John Freeborn for machining his 4in. cylinder. A virtue of this method is that both the saddle and the cylinder bore are machined without disturbing the set-up. After flycutting the saddle, the cylinder was advanced the correct distance until the cylinder bore was in place. This was then cleaned out with a 1 1/2in. dia. boring bar held between centres. Putting the cut on is a fiddly affair involving the slackening of a cap head screw and very gentle taps with a small hammer to advance the tool.

Fortunately, as mentioned above, the eventual size of the cylinder liner hole, given a thou. or three, is of no significant consequence. If a plug gauge is to be used, the between-centres boring bar will need to be removed each time.

Using a milling machine

The job may equally well be done on a vertical or horizontal milling machine using a boring head. Boring heads are a great deal cheaper now than they used to be, the imports from the East being very competitive. Some British boring heads are still available which, in my opinion, are much better engineered, but they are also much more costly. As with most things you get what you pay for. The tooling in a boring head will be much less robust than a between-centres boring bar and to avoid chatter, light cuts will be necessary.

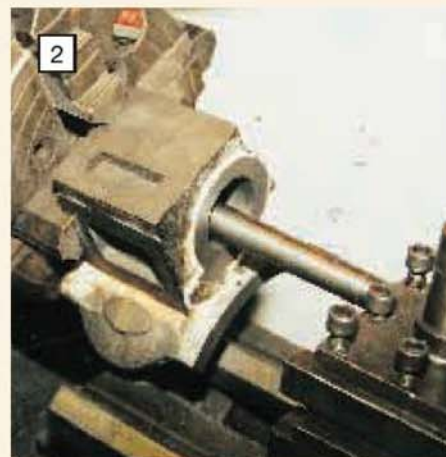
Cylinder liner

For what it is, this has a lot of metal on it, the reason for the very generous machining allowance being to ensure the good soft metal that is needed. If cast with too thin a wall it might cool too quickly in the sand with the associated risks of chilling or hard spots.

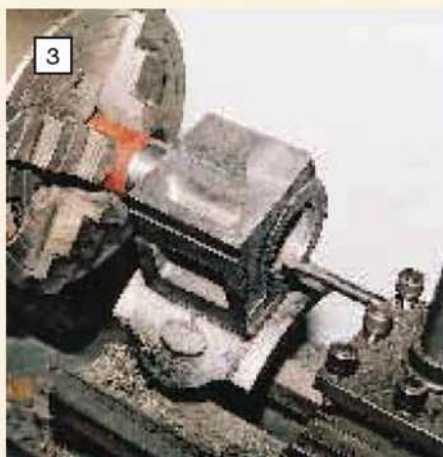
The liner should be machined all over to release any internal stresses before any attempt is



Setting a 3in. scale cylinder casting in the 4-jaw chuck using a 'floating' centre and dti. The casting must also be set square to the chuck.



A stout boring tool will soon clean out the bore and will cope with the intermittent cut involved without distress.



With the cylinder block mounted on a stub mandrel, the end face and cover recess can be machined. (Photos 1-3: S. Nipper)



John Freeborne machined his 4in. scale liner bore after machining the saddle as previously described. (Photo: P. Kybert)

made to reach the dimensions. Some thought now needs to be given to the bore. If the liner is going to be press fitted into the cylinder, or fitted with heat, it would be wise to leave it undersize. It may then be taken to final dimension after fitting. If it is a light press fit or Loctited in place, it may be taken to size before fitting, if preferred.

With the liner held in a 3-jaw or 4-jaw chuck, its bore is first taken to dimension, allowing for a final cut later, if desired. Avoid gripping it too tightly, as too much force will distort the thin section. Once the bore has been machined, the liner will need to be slid onto a mandrel (photo 6),

to machine the outside diameter. David preferred a mandrel of the expanding variety which is split lengthways and has a cap head screw which engages in a partially tapped hole. When the cap head screw meets the incompletely threaded part of the hole it causes the mandrel to spread the tiny amount necessary to grip the liner.

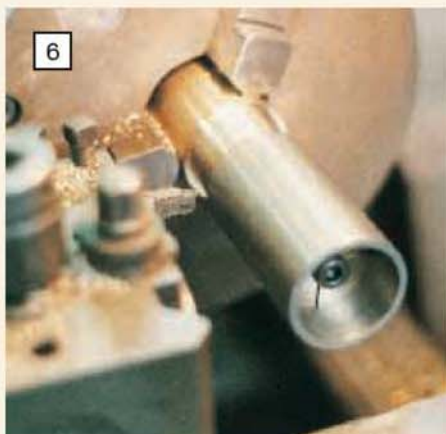
Press fit, Loctite or liquid nitrogen

If the liner is to be press fitted into the cylinder, a really tight press fit is neither necessary nor desirable. However, a good, tight, push fit is required to prevent live steam from bleeding through from the live steam uptake to the ends of the bore. The sort of fit we need is that which can be started by hand but has to be completed in the vice or with the aid of a mallet and block of wood.

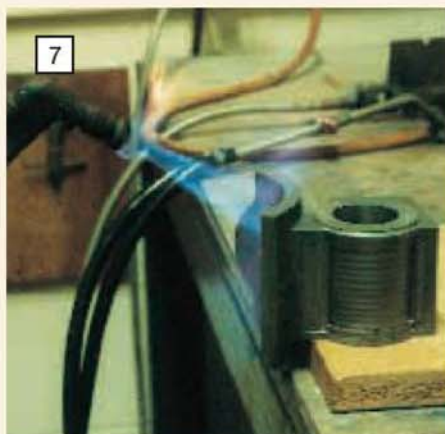
The tighter the fit, the more likely the bore will be pushed out of round where the steam uptake passes the bore asymmetrically. With any sort of press fit I think it would be as well to allow for a final light skim after the liner has been inserted.



David's 3in. scale Little Samson cylinder was machined on a horizontal milling machine with the aid of a boring head. Note that the tool is relatively slender, limiting progress to light cuts.



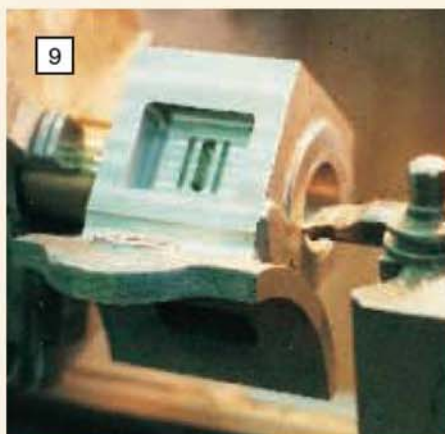
6
A 3in. scale cylinder liner is given a careful skim on a stub mandrel. The target diameter was for a shrink fit, requiring careful measurement. (Photos 5 & 6: B. Camps)



7
The cylinder block is gently heated to about 200deg. C using a gas/air blowtorch. The temperature need not be so high as to discolour the metal.



8
The cylinder liner has been immersed in liquid nitrogen at -196deg. C, ready to be dropped into place. Note the protective gloves to guard against dangerous contact with the very cold metal.



9
After fitting, the liner is given a very light skim across the cylinder ends to blend it all together and provide a good surface on which the covers can bed. (Photos 7-9: B. Camps)

The liner should not be allowed to move while the recesses for the steam passageways are cut in the ends, so it cannot be any sort of loose fit.

I would be happy using Loctite; some grades of which I understand can now cope with the temperatures associated with steam at 125psi without significant degradation. That said, I would however, urge builders to contact their suppliers to get confirmation. It is important to realise that in these circumstances the adhesive is not being used structurally but is acting more as a sealant. Nothing will blow up if it does fail because the liner is entirely captive.

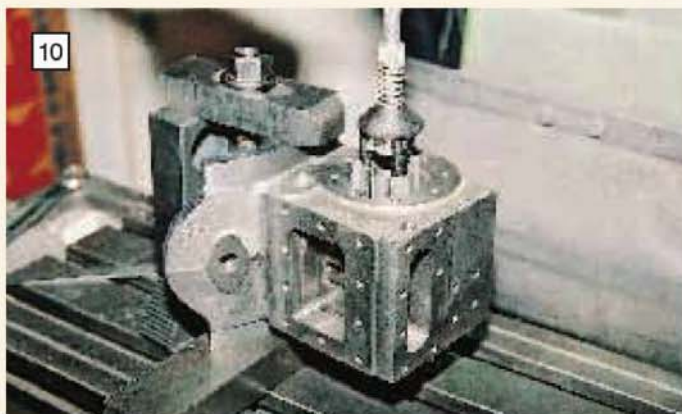
In industry, interference (press) fits, may be most easily achieved by shrinking a component using liquid nitrogen. It is a well known fact that metals expand with heat and, of course, will shrink when cooled. If one component of an assembly is heated a little, and the other cooled in liquid nitrogen the components may temporarily go from being an interference fit into a clearance fit, thereby permitting easy assembly — if you're quick!

When equilibrium is restored by the return of the assembly to room temperature, it will be just as tight as you like. This process is shown in photos 7 and 8.

Honing

A final pass through the cylinder bore after fitting the cylinder liner into the cylinder casting is a good idea. This should give as good a finish as is needed. If a better finish is desired this may be achieved by honing. I have no experience of this but Stan has sent us a picture (photo 10), and writes:

"I bought a hone from Bruce Engineering a



10
Stan used one of the Bruce Engineering hones (tel: 01932-245529) to obtain an excellent finish in his cylinder bore. (Photo: S. Nipper)

few years ago. It is an expanding mechanism with three stones. I had some bronze cylinders for a locomotive, and couldn't cure a very fine chatter in the bores, so fine that it was probably acceptable. The honing improved the finish and the engine is still running with the same O-rings in the pistons after three years.

"I then used it on the Little Samson bore; this time in cast iron cylinders, of course. The finished turned bore was quite good. However, honing brought it up to almost a mirror finish. I held the hone in the 3-jaw chuck of the mill and fixed the cylinder to the table. The hone has a flexible drive so it that automatically takes up small misalignments. I ran it at 420rpm with a lot of light oil, thinned with paraffin. I kept the cylinder moving gently back and forth over the rotating hone, making sure to avoid 'bellmouthing' by keeping the majority of the length of the stones within the bore.

"I didn't aim to remove any significant amount of metal since the bore as turned was near spot on. It takes a lot of time to remove a thou. by honing and I was only after a good finish. I am aware that some finish with a very slow rotational speed and a rapid axial movement to produce a diamond pattern to improve oil distribution. I didn't, as I believe the pattern would wear off very quickly in use. I just sat back and admired the beautifully smooth finish, then hid it from sight by assembling the cylinder covers.

"I have since used it on the LP bore of the Savage wagon. It needs a little more work to get a really fine finish. The HP bore is too small for this hone. As the finish is already good I will leave it at that."

When complete the cylinder bore should be both parallel and on size. The need to maintain the diameter at 1.5in. for 3in. scale and 2in. for 4in. scale is so that commercial rings may be fitted. If the bore is too big, the ring gap will be too great; if too small, it may not fit at all. A small gap is needed to guard against uneven expansion should the ring get hot and expand more quickly than the cylinder itself.

A final job on the liner is to put it up on a mandrel in the lathe and to cut the 45deg. chamfers, which are there to aid assembly when the piston rings are on the piston. A small cut may be taken across the cylinder cover faces just to blend the liner into the cylinder. By the time this is done it will probably be impossible to see that a liner was ever fitted in the first place.

Further work on fabricated block

An interesting operation required on Jonathan Milne-Fowler's beautiful little 1in. scale *Little Samson* cylinder was machining the internal semi-circular annular steam way that allows the steam to get past the liner on its way to the top of the regulator chest. This is cored out on the castings supplied in the larger scales.

The ingenious set up devised by Jonathan is shown in photo 11. A boring bar is held in the self-centring chuck and the cylinder in a 4-jaw chuck in a home made dividing head bolted to the top of the crossslide. The dividing head was used like a rotary table, rotating the cylinder as the cut progressed. The annulus machined was 80 thou. in radial depth and 0.625in. in axial length. It extended around the bore a little over 180

degrees. Toolmaker's clamps were used as saddle stops on the rear bedways as a precaution against ruining the job by excessive movements towards or away from the chuck. Felt tip pen marks were made on the boss of the 4-jaw chuck to indicate the limits of rotation, and a piece of paper, held in place by a pot magnet, served as a fiduciary mark.

'Fiduciary' is a new word to me; the dictionary has it listed 'assumed as a fixed basis of comparison'. (Or think of it as a datum mark—Ed.)

Still to do

Before the cylinder is completed the ports have still to be cut, the cylinder drains to be drilled, and a multitude of holes to be drilled and tapped for the various studs which hold the covers down. We shall deal with these next time.



Jonathan's set-up to machine the internal steam uptake in his fabricated 1in. scale cylinder block. (Photo: J. Milne Fowler)

As an aside, Stan has made excellent progress on the Savage wagon, destined to be serialised post *Little Samson*. The chassis is now assembled

and all the larger parts of the undertype compound engine are now complete. It will be wheeled shortly. There are slightly fewer builders in the 'advance party' for the wagon than there were for *Little Samson*. If any reader might still be tempted to build it (any scale) and would like to discuss the project further please do not hesitate to make contact. Road Steam experience is not required.

Supplier

A *Little Samson* catalogue listing drawings, copies of works drawings, materials and castings in 3in. and 4in. scale is available for £2.50 post paid (UK) from *Little Samson Models*, 38 Wheatsheaf Way, Linton, Cambridge CB1 6XD. Visit <http://homepages.tesco.net/~little.samson>

●To be continued.

MIDSUMMER MADNESS!

Arthur Bellamy

takes us through an imaginary IMLEC run on the Leeds SMEE track at Eggborough.

Many years ago, about Christmas time, LBSC would write a Christmas Ghost story, usually describing a futuristic express locomotive on a hypothetical journey over some interesting route. I will try to emulate him, but with a timing nearer Midsummer's Day and with an express locomotive on a very real track up in Yorkshire.

Our driver arrives at his 'booking on time', which is an hour or so before departure time and signs in, has a look at the notices to make sure of any changes to the plan — there aren't! He has a chat with other drivers and meets his observer. He now can get his locomotive on to the track and down to the steaming bays. This isn't hard using the hydraulic table, and the turntable allows him to face the locomotive the right way round. He notes the axle weighing facility and, if time permits when the boiler is full, intends to check the weight distribution on the locomotive.

The steaming bay has all the facilities expected, 12+ volts for the blower, or compressed air if preferred, water in abundance either by hose pipe or in the can so we may as well fill the boiler and tanks, check the lubricators, oil round and make sure the wheels are clean. We don't want slipping on the start with chosen load. Now is the time to collect the coal, and to see its weight checked with the observer. The coal — sorry, just anthracite this year, has been prepared in 2lb. bags with all the fines riddled out of it. It's time to think about lighting up. The kindling has been soaking in paraffin for days and there are stacks of it. Now there's time for a smoke or whatever else one does when there are a few minutes to spare, accept the good wishes offered by spouse and friends, and as if by magic pressure is showing on the clock. Not too much pressure too soon. Check the time, we dare not put any coal on yet, it's all booked for the

run. The previous competitor comes out of the tunnel and into the station to complete his run. Now is the time to burn coal! Open up the blower and bring the boiler up to full pressure.

The previous competitor will take a few minutes to uncouple, pull forward and retire to the steaming bay. Now we await the stationmaster's instructions. He will have marshalled the train as requested, with the dynamometer car at the front. He will ask our driver to pull forward beyond the traverser and stop. When the traverser is reset to the main line, the engine can reverse on to the dynamometer car at the front of the train. The driver and observer can check the dynamometer settings and couplings, etc. The passengers will all be aboard and waiting to go. Timekeeper Brian has done this job for years, I know he lives in Birmingham but he is a Leeds member, so we asked him to do it again. When Brian gets the signal from Edwin, the Chief Judge, Brian will tell the driver he can start and the clock will start as the engine crosses the white line.

Now the real fun starts, the track will have been cleaned for many yards, the safety valves are almost lifting and the wheels just turning with this heavy load. Not like Kings Cross, where they had banking engines — they're not allowed here. Now we're moving steadily into the first curve, 100ft. radius and over the traverser. No golfers today, they will be starting on the second tee. How's that fire? Is it burning through? Can we manage without the blower? On to the straight and a modest climb of 1 in 200 which levels out for the second curve, this time of 75foot radius. I shouldn't think the flanges would squeal, as it is an aluminium alloy track. Time to put on another shovelful of coal?

Under the footbridge and then another 1 in 200 climb along a short straight and an 82ft. reverse curve to the summit. Experienced competitors will climb this 1 in 200 gently so as not to have excessive speed on the next downhill section and through the tunnel. We can tell when we are nearly at the summit by the paint splash on the left hand side of the concrete. Now we're past the summit we'd better check the speed; it's downhill at 1 in

100, and on a right hand 75ft. curve. Get the injector on and we're into the dark tunnel. Out of the tunnel and through the station. We're not stopping; we are an express, remember, and into the station straight. It should be alright at the moment, but take notice of the water pick-up arrangement on this straight; it's that table with bottles on it. We help ourselves! Is the injector still on?

If the loco is too heavily laden, the problem is reaching the summit with low boiler pressure, so it may be necessary to set back, build up the boiler pressure and have another go. If, however the engine has warmed up and our driver feels that additional passengers are in order, this year's rules allow the express to stop in the station and take on extra passengers, but not additional coaches. The driver has to make up his own mind whether it is worth losing a little time to pick up passengers and face the problem of restarting to register a higher drawbar pull. It's not unlike Formula 1 car racing, and there's just as much buzz!

Our driver will be told when 25 minutes running time have elapsed, and he will have to judge when to stop. He will not be permitted to start another lap after 30 minutes have elapsed. On completion of the run, our driver can acknowledge the applause, see that the dynamometer readings are in order and return the engine to the steaming bay as directed by the station master or his assistant. Now is the time for a cup of the 'engine man's best friend.'

All the above of course takes place at the Leeds Society's Track at Eggborough, and for the IMLEC weekend we have thought of the inner man — and his wife. There will be light catering in a marquee and in the Sports Club they are geared up for bar meals on Saturday lunchtime and evening. On Sunday a 3-course Carvery meal will be available, excellent value at £3.95 for a single course, but it is advisable to book a table during the morning. The Sports Club often caters for 200 meals on a Sunday lunchtime.

If you plan to bring your caravan or tent it will cost you £10 for the weekend, but please give me a ring on 01757-702863 beforehand!





Keith Wilson

deals with the smokebox and its associated fixtures and fittings.

●Part XXVII continued from page 414
M.E. 4170, 31 May 2002

There is a crime so wicked in many eyes, so serious that no-one else dares even to mention it. Even the Bible is silent on the matter. It appears in no book of laws, and it is talked about even less than death itself. I take great pride in committing this crime as often as I can, and strongly recommend that all readers commit this unforgivable sin as often as may be convenient. It pays handsomely, and I can promise you that no official person will dare to object to it. Priests or parsons, rabbis or ayatollahs, politicians or pressure groups and their like will never forgive you even though they simply dare not do anything about it.

What is this unmentionable sin?

It is called 'Checking out the Facts'.

Any questions?

Smokeboxes

I had written an article on cladding and prepared many of the drawings therefore before I realised that it was useless without this article. It is rather tricky assembling cladding without having the smokebox attached, therefore let us proceed.

It seems a surprising fact that a smokebox made

of steel will rust rapidly, whereas door and door rings seem far less susceptible. Perhaps it is due to one being steel whilst the other two are cast iron. Anyway, boxes are best made of brass, gunmetal or brass rings and doors being applied at pleasure.

I shew the development of the boxes as accurately as I can, note that the decimal places are to be taken as your own desires dictate, computers being computers! In making these boxes, it is as well to omit the big hole for the chimmock until after rolling. If you don't, any tiny distortion in the roller during the act of rolling will leave it distorted and, since being on the outside, it is very visible it will be a bit dicey to bash it out. This also applies to a different extent to the big rectangular cut-outs (or cuts-out?) at the bottom of the box; however this is easy to cover-up.

Full-size smokeboxes had the joint at the top dead-centre, although of course few photographs will shew it. It is possible that some were made in two halves, but I don't know, and doubt it anyway. Bethink you that our boxes are thicker than scale, and our rollers are certainly weaker; it is easiest to compensate by putting our joints at the bottom.

Note the double row of rivets along the top; engrave or scribe a distinct groove along the cen-

tre-line to make it look posh. Use an internal butt-strip along the bottom of the box; the joint may be caulked with soft-solder. In theory, the big hole for the chimmock should be elliptical rather than circular, but the difference is so slight that it is unimportant.

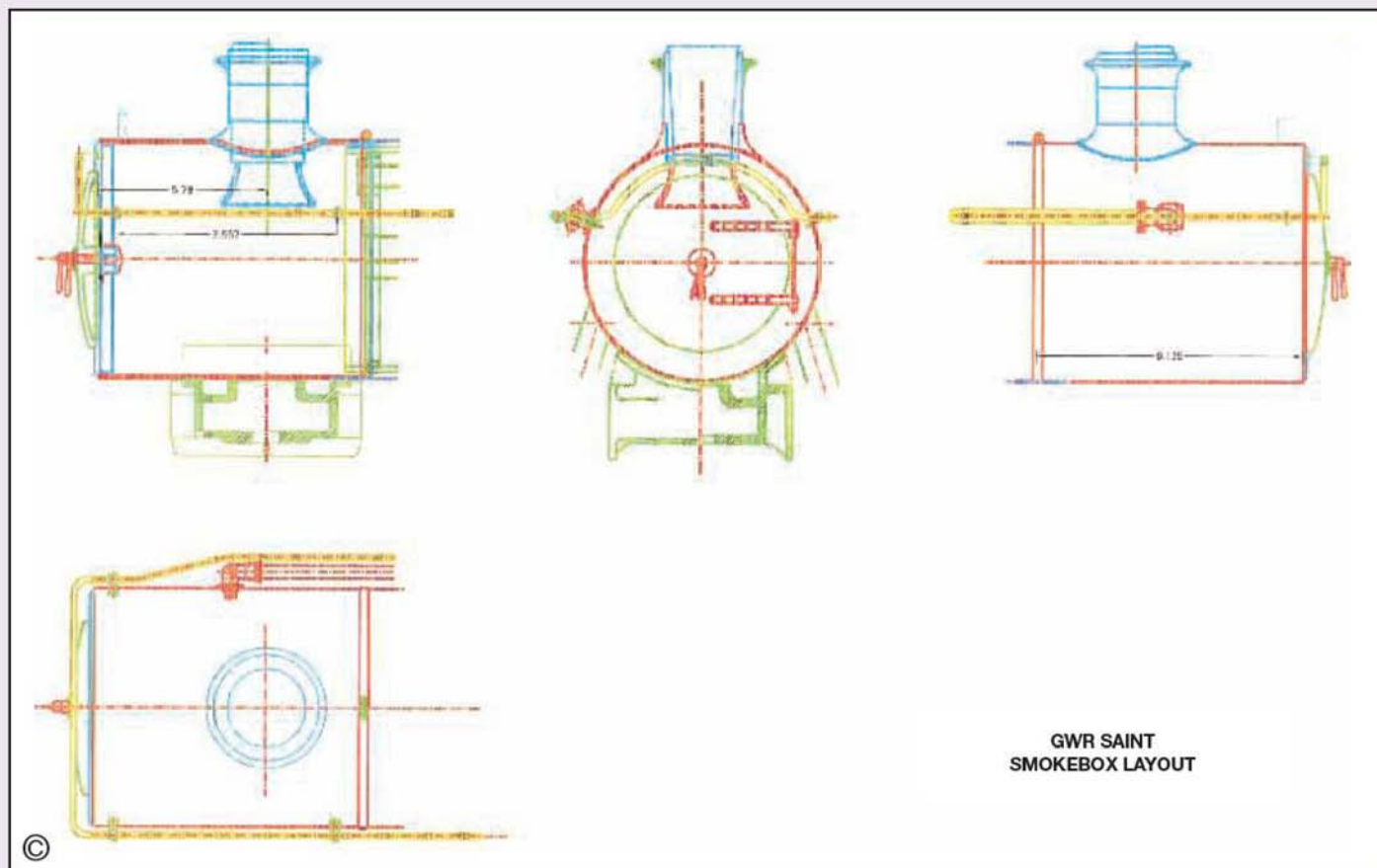
The two holes for the steam pipes are double-ellipses and, although once again there is no need to be too fussy, stick fairly close to my dimensions. The holes for three handrail supports are shewn plus a 1/2in. aperture for the ejector exhaust. Incidentally, it is best to have the handrail knob holes drilled clearance rather than tapped 2BA, nuts being used inside the box.

Chimmock assembly

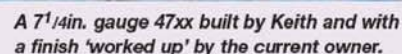
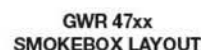
A fact that will be self-evident once you have tried it: to have the chimmock assembly removable as a unit will be a terrific advantage during any internal smokebox repairs. A scale petticoat pipe is unfortunately larger than the chimmock base, but no adverse effect will arise from reducing the petticoat diameter. It is not practicable to use nuts and bolts to hold this item down, for no way can you get to the underside to apply nuts. Steel, or indeed any material, bolts will set in solid due to

SAINT CHRISTOPHER

A GWR LOCOMOTIVE for 7¹/₄in. gauge

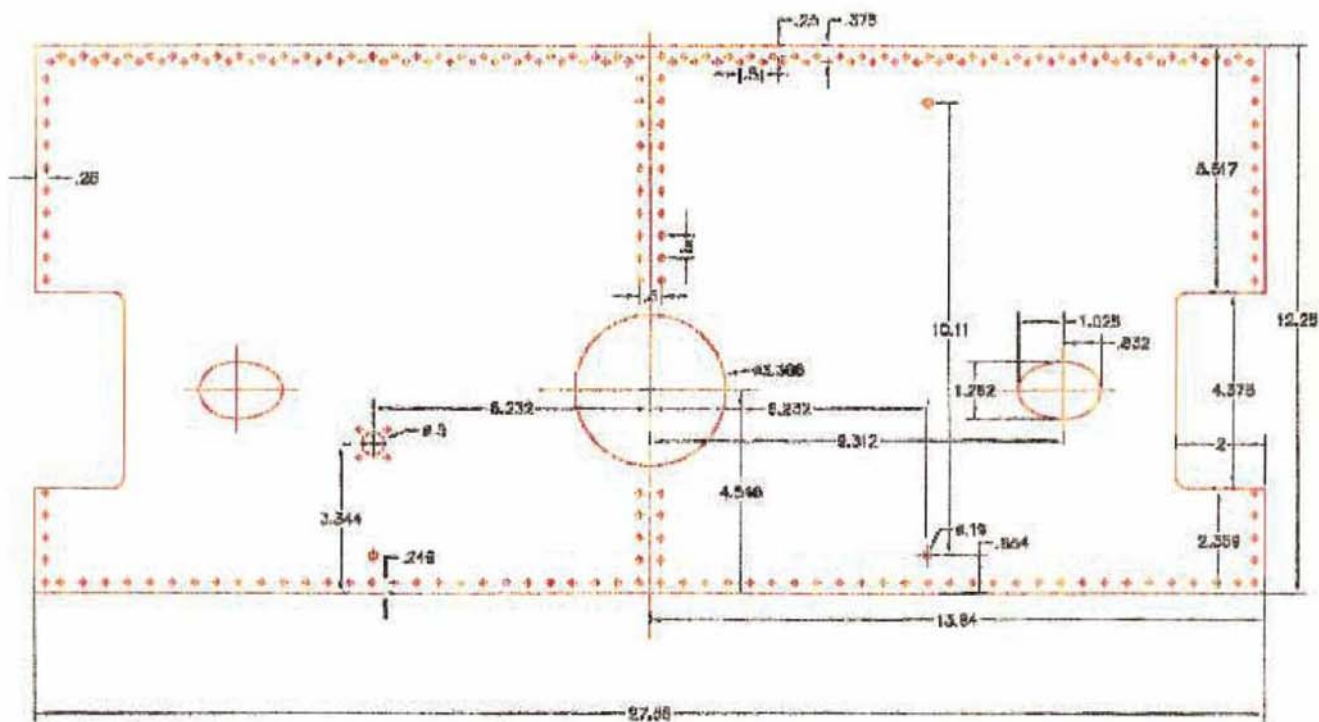


GWR SAINT
SMOKEBOX LAYOUT



For machining the top, if you are okay with hand tools as in wood-turning then no problems, otherwise use a round-nosed tool and juggle the





GWR 47xx - SMOKEBOX DEVELOPMENT - Material 2mm brass



An 'overbridge view' of the 47xx smokebox reveals the longitudinal joint at the top (see text).

©

except for machining the base, but copper electroplating the cap is a waste of time, for it won't take long to polish it off. Literally. I've had some!

It is no great problem to screw-cut the threads on the body and petticoat, after all they won't need undoing once assembled. Alternatively, tap three or four bolts from the outside in, preferably flush on the inside. The chimmock assembly is a job for Loctite 601.

Furniture

The door and door ring are routine lathe jobs. Cut a steel template to the correct door profile, clamp this across the lathe bed and then use the cross-slide to turn the outer portion of the door. A small pointer or cam-follower on the cross-slide will bear against this template and force the saddle

away from the chuck as the cross-slide moves across. If a round-nosed tool is used and a fine feed set for the last cut, you will be rewarded by a nice spherical door. If your lathe has power cross-feed, you can sit and watch it make itself.

Hinges are best chewed from solid, it isn't possible to fold the pivot end into the correct shape. Most if not all Swindon locomotives had flush-riveted hinges on the doors.

The door ring is best made a snug fit in the box proper, note that it is recessed for the door itself which helps in seating the said door.

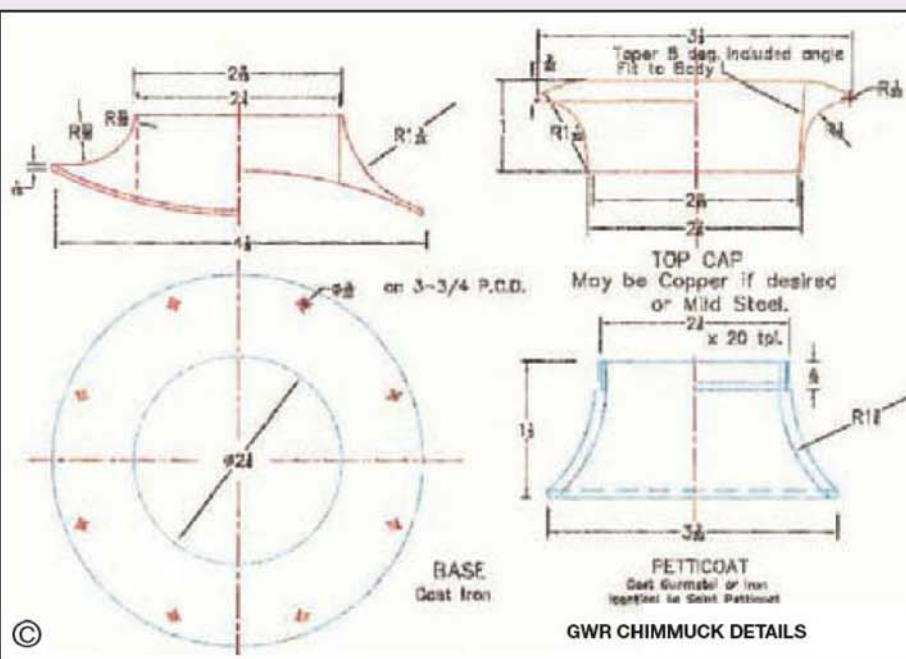
At the rear end of the box, there are two packing rings, one to match-up to the boiler barrel, and a smaller one to space-out the lagging. It is important that the outside of the cleating is flush with the outside of the smokebox, otherwise it will be the

top- and cross-slide. Alternatively, you could step out the job on graph paper and smooth off with files afterwards.

When smoothing out the marks left by turning, remember that the only way to remove round-and-round marks is with up-and-down marks; this means that the *second* smoothing with emery-cloth/paper is the most elbow-greasing operation of all. The subsequent up-and-down operation (there need only be one more) is far less stressful on the muscles. Polish off with Brasso or Bluebell or whatever, for which kitchen paper towels are recommended. Incidentally, these latter are very useful in the workhouse anyway. I suggest the first operation with 60-80 grit, second 100-120 grit, then 180-200, 350-400, then Brasso or Bluebell to finish.

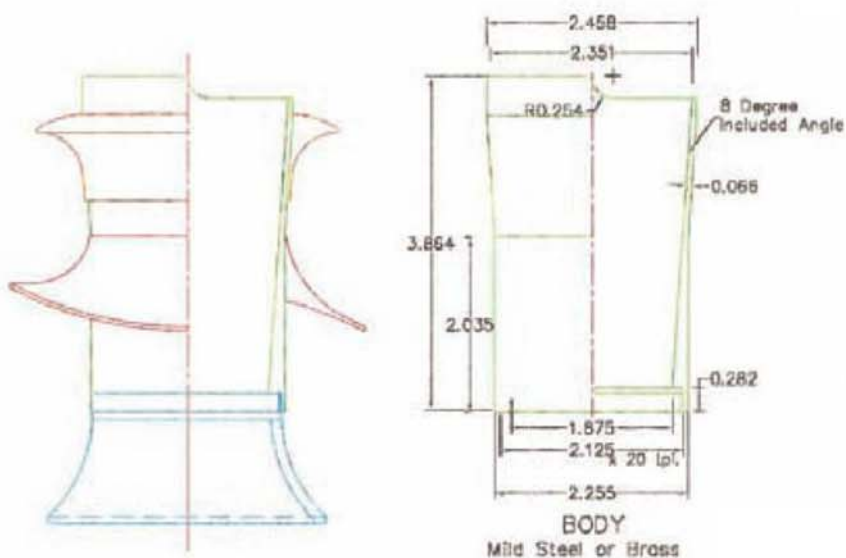
I will mention that the copper cap I shew is not exactly right, for the copper part only extends about halfway across the curved portion at the top. However this isn't too well known, for the number of published photographs illustrating this could well be counted on the fingers of one hand.

You could use a casting for the whole chimmock,

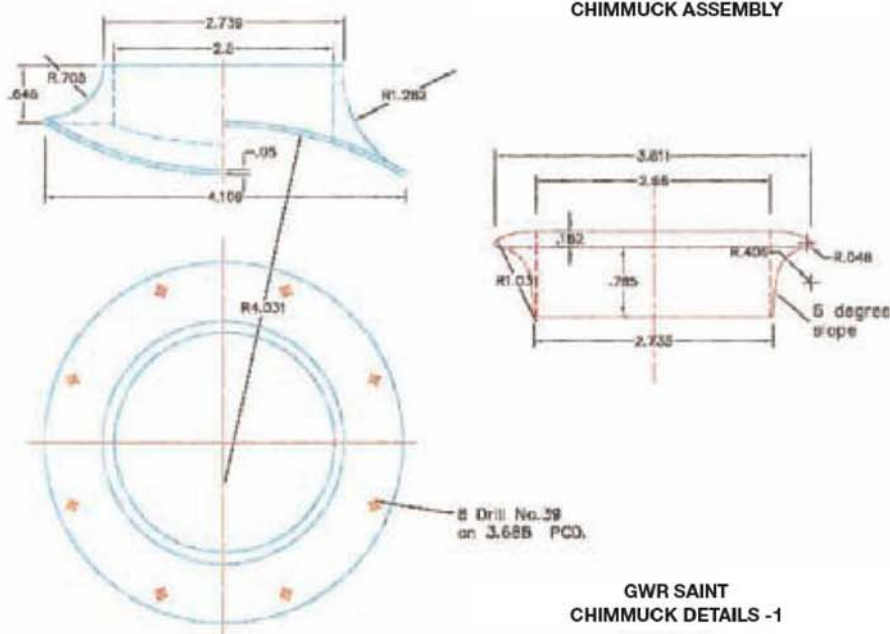


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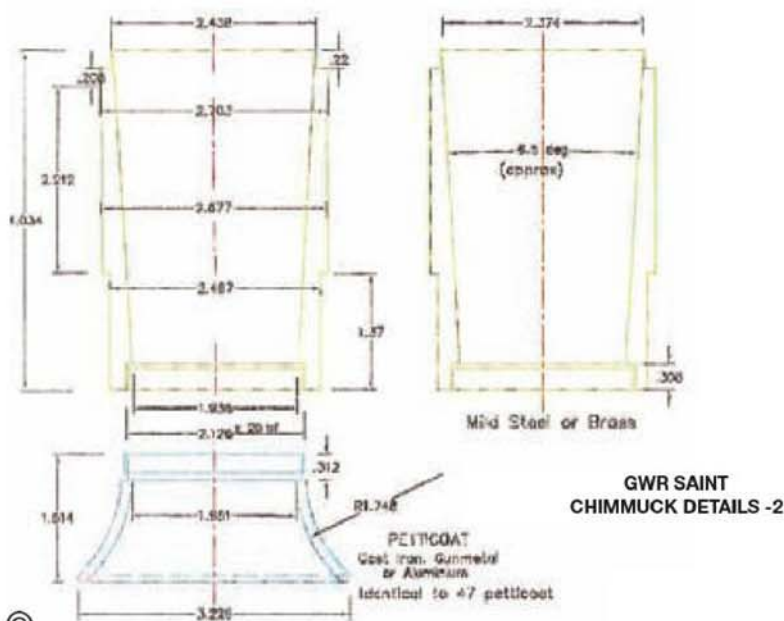
GWR CHIMMOCK DETAILS



GWR 47xx
CHIMMUCK ASSEMBLY



GWR SAINT
CHIMMUCK DETAILS - 1



GWR SAINT
CHIMMUCK DETAILS - 2



An impressive head-on view of the 47xx shows the door furniture and chimmuck profile.

deuce-and-all to pay to get the front cleating band in place.

Full-size smokeboxes were riveted to the barrel, but for us it is better to have a reasonably tight push fit. If desired, it may be easily fixed using four countersunk 2BA screws nutted on the inside. The countersinks are in the inner one of the two 'packing' rings, and are therefore completely hidden.

Darts, crossbars, door handles and the like are plain jobs and should need no explanation. Some engines had up-and down crossbars, others were set crossways. Take your pick. Lamp brackets were originally on top of smokeboxes; later they were moved to the door itself and needed a different type of bracket.

Handrail knobs or supports are tricky, for they are a bit on the small side for a form tool, however they are not too difficult to turn by hand. If the first part be rounded off with tools or files then the taper portion behind the head is a simple operation for tool or top slide setting, and a file will round off the rest of the head. Part off, and when you have enough 'semi-blanks' they can be re-chucked and the threaded part dealt with. Full size supports had a centre-drilled hole in the end of the head so were obviously turned between centres, or at least the outer part was supported by the tailstock centre. In such a case a form tool could be used. Whether or not this would pay off for us is a matter of personal choice.

The above remarks also apply to the 47s, but strictly speaking, they did not have a copper cap to the chimmuck. However, of the four I have built, the appearance of the 10¹/₄in. gauge ones at least was immensely improved by the use of copper caps. They are the crowning glory of the larger GWR locomotives, and to blazes with strict accuracy!

About the only difference between 29 and 47 smokeboxes is their diameter and length. The saddle for the 47, however, is much taller than that for the Saint; it might well be possible for the patternmaker to combine the two somewhat, for the lower portions are identical.

●To be continued.

PETE'S PAGE

Peter Spenlove-Spenlove describes a machine vice which can be made easily and cheaply in the home workshop.

When you bought your bench or pillar drill, the salesman probably sold you a drilling machine vice (photo 1). Most of us use drilling machines with a table about 6 or 9in. dia. or square and which can accept drills up to $\frac{3}{8}$ or $\frac{1}{2}$ in. diameter. The usual type of vice has jaws that are 3in. to 4in. wide and will open a similar amount. While this size of vice is adequate for most of the work we do, we sometimes wish it would open much more, say to 6 or 7 inches. We visit our tool supplier only to find that a vice capable of such an opening is both heavy and costly, having been designed for heavy work such as tool room milling and drilling.

One day, I was able to collect some mild steel bar-ends. One end of each had been literally chopped off the continuously rolled and drawn bar in the steel works where they chop the bar into lengths for despatch and these were what remained after the order quantity had been met. Having a far eastern bandsaw, it was easy to cut off the distorted ends which left me with a collection of rectangular lumps of various sizes.

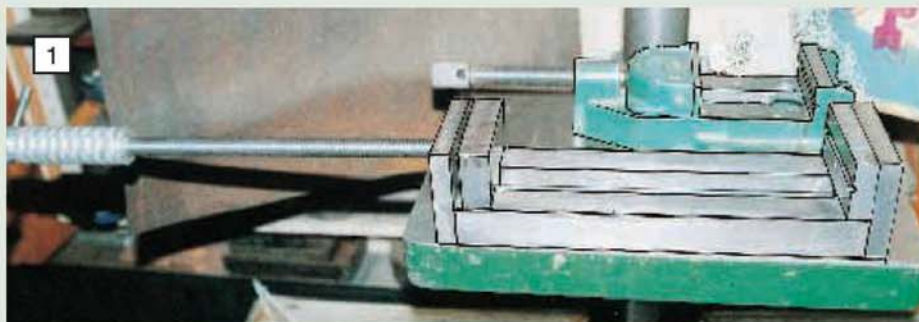
By the way, I can recommend these bandsaws, of the horizontal/vertical type. I bought mine in 1980 since when I have been able to accept unwanted, large steel stock and hang up my hacksaw, well — almost. I don't leave the workshop while the saw is cutting, since an occasional squirt of cutting fluid helps prolong blade life, but I can be doing other things while it gets on with the job.

Among my off-cuts was a piece of 1in. square bright mild steel, undamaged and straight for approximately 19 inches. When we acquire something, most of us ask ourselves "What can I use that for?" My thoughts immediately turned to a large capacity vice for my drill press (photo 1). At the time, I was making some timber plank parts, short shelf pieces, using 6in. wide timber. The 1in. square mild steel was cut into two pieces each 9in. long. Two pieces of $\frac{1}{2}$ in. thick bright mild steel flat stock (more off-cuts) were screwed onto the ends of the 1in. bars using four cap head screws into each bar end (photo 2).

One end piece was drilled and tapped for a long piece of $\frac{1}{2}$ in. BSW rolled thread studding onto which a knurled, aluminium alloy handle was fitted. Studding is standard stock stuff. It is relatively inexpensive and comes in various lengths and sizes. Your local hardware store will probably supply metric stock now; $\frac{1}{2}$ in. is roughly 12mm. Don't use anything smaller, it will bend too easily. 14mm dia. would be fine but is considerably heavier and I didn't want a heavy vice.

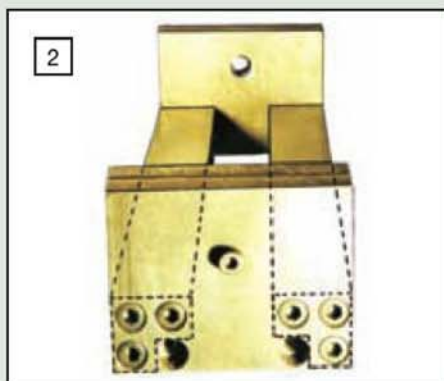
At the other end of my vice I fitted a hardened jaw with a Vee groove for round rod. The sliding jaw had a dimple for the tightening screw (photo 5) and a tenon which slid between the bars. The tenon was circular to allow the sliding jaw to swivel.

Unfortunately, my new vice did not work! The sliding jaw lifted and didn't grip the workpiece

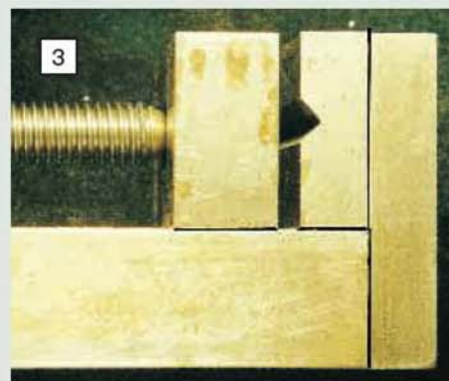


The Author's fabricated large capacity vice on the table of his drilling machine with a standard commercial vice behind it for comparison.

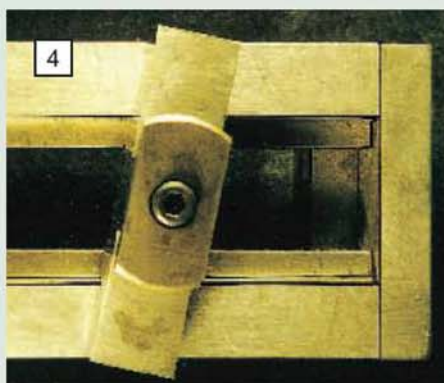
A LARGE CAPACITY DRILLING VICE



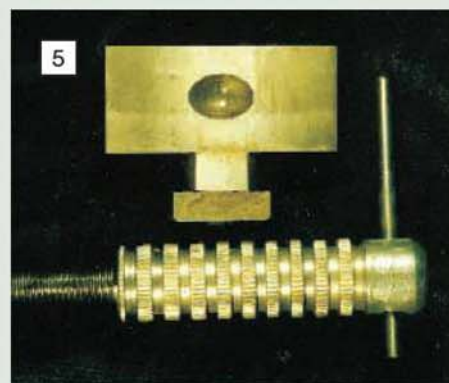
The vice seen from the fixed jaw end, the moving jaw and screw have been removed for clarity.



Vee grooved fixed jaw, sliding jaw and end of screw showing how these parts are assembled.



Underside view with sliding jaw removed from vice. Note the circular form of the keep plate to permit the jaw to swivel.



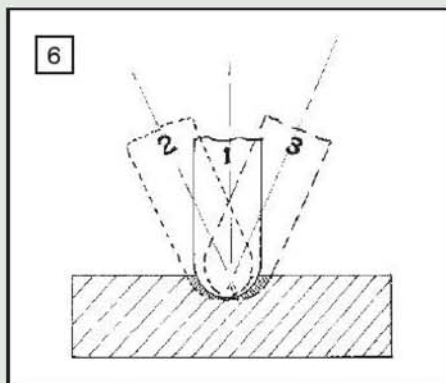
Sliding jaw and aluminium alloy handle with tommy bar. Note the elongated dimple in the jaw to facilitate the swivelling action.

safely, so it was back to the drawing board. The solution was simple; using my milling machine, I cut two 'ways' under the vice (photo 4). A new jaw was made with a shorter tenon but with a very thick 'washer' or keep plate underneath to run in the ways (photo 4). When milled, the ways meant that one of each group of four cap head screws originally used to assemble the vice could no longer be used. Photograph 2 shows how the ways were milled into each bar.

The vice now works well. It isn't perfect since, if the vice is done up too tightly, the bars bow slightly. However, it is very useful for light metalwork and when drilling wood or plastic. Both the jaws fitted to the vice are hard and smooth. If I need to drill plastic, which is slippery stuff, I face the jaws with fine emery cloth stuck

on with double-sided adhesive tape, or even emery cloth folded with the abrasive on the outside. This is just placed between the work and the jaw and need not be stuck in position.

One safety aspect should be emphasised. Experienced workers know that the drilling machine vice must be clamped to the machine table to avoid the drill snatching and spinning the light vice. If this happens, it can cause injury to the hand as well as probably breaking the drill. Because many small vices have a knurled handle, many beginners assume it is there to hold the vice in position under the drill. However, the vice should always be bolted down using the lugs usually provided on commercial vices. My home-made vice has no clamping lugs but can be clamped using long reach G-clamps, one at each end.

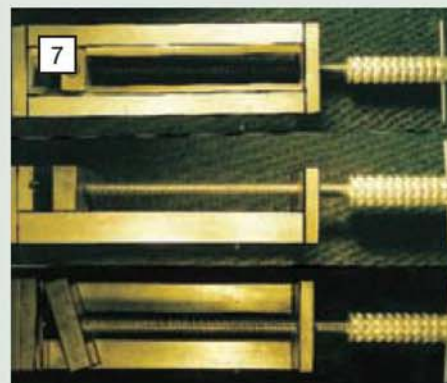


The dimple in the sliding jaw is cut using three settings of a ball nosed slot drill. Either the work or the cutter can be tilted for cuts 2 and 3.

The aluminium alloy handle (photo 5) is 1in. dia. and tapped 1in. deep for the screw which I

fitted and secured using epoxy resin and an $\frac{1}{8}$ in. cross pin. The other end is drilled $\frac{3}{4}$ in. dia. to reduce weight. A $\frac{1}{4}$ in. dia. tommy bar is held in place with a light coil spring in the central hole. Thus the tommy bar can be pushed to one side if the table prevents normal rotation.

If you want to allow the sliding jaw to swivel (for gripping tapered work) the end of the screw must be rounded to hemispherical form and seated in a dimple in the back of the sliding jaw. For a $\frac{1}{2}$ in. dia. screw make the dimple with a $\frac{1}{2}$ in. dia. ball nosed slot drill and machine it some $\frac{3}{16}$ to $\frac{1}{4}$ in. deep. When swivelling the jaw, the screw will work better if, after cutting the circular dimple, the jaw is tilted at an angle, first one way and



Three views of the Author's vice to show its design and construction using bright mild steel bar ends and stock $\frac{1}{2}$ in. BSW studding.

then the other, to elongate the depression as shown in photo 5 and figure 6.



SWINDON REMEMBERED

David Hawkins

brings his personal recollections of life at Swindon works to an end by singing the praises of one I.K.B.

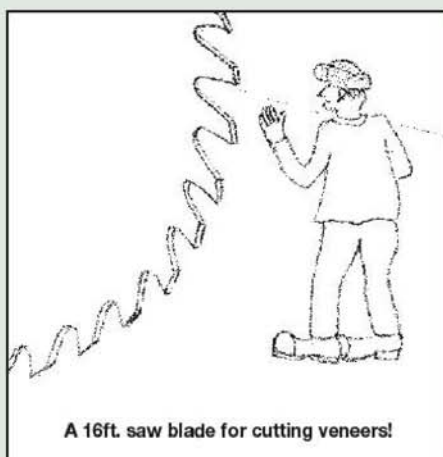
●Part VI continued from page 415 (M.E. 4170, 31 May 2002)

I am particularly grateful to our Editor for asking me to put these memories together. As I write this last piece in September 2001 it is 61 years since I suffered the injury which stopped me in my tracks. My working life has been an extraordinary one and during the 50 years that I ran my own small business, I have always worked on things from the past where I have had the privilege of seeing how tradesmen from the 17th, 18th and 19th centuries overcame the problems with which they were presented, and I have had to learn how to work as they did.

You must remember that when you repair (or in today's rather posh terminology 'restore') something, it would be wrong to use 20th or 21st century techniques and materials. So I try to work as they worked and is an aspect of my work which is rarely, if ever, considered. I must confess to some pride that they used to say about me "If you can see where Dave has been, he has failed." I made a point of learning how my predecessors worked and used their ideas and methods. It was a fascinating job, and happily nearly always a challenge, which is so important.

It is likely that it was at Swindon that my preference for working with the past was fostered and, when I was putting this brief series together, I came to realise that I had been working in an environment which, to all intents and purposes, was straight out of the 19th century. Nearly all the engines I worked on were from the very beginning of the 20th century but without doubt, a couple were from the previous era.

It is also a shock to realise that only 60-70 years before my time in the the works, broad gauge was still in operation; broad gauge seems so sensible to me! Much as the French have double deck railway carriages, I interpret broad gauge as being two for the price of one. Sadly this country of ours is a small one and had we adopted broad



A 16ft. saw blade for cutting veneers!

gauge, at least $2\frac{1}{2}$ times more land than the railways have gobbled up in the gauge adopted, would have gone. So, the gauge we now have was exported to all corners of the world.

I have to confess that I haven't read any books about Swindon and what went on there; I decided not to but to just rely on what memory banks I have left! I can remember A and B shops, but no others and, as each shop had a letter it would not have been right to have looked them up. I'll leave that to you; I expect there are many of you who will know all the letters anyway!

Having put these few words together about some abiding memories from my short time there, and it was a time for which I am more than grateful for it taught me how to think, I recall that it also taught me about safety, mainly because the accidents were many and often. One particularly unpleasant recollection is of being shown a matchbox in which were the tops of two fingers lost by some poor soul. I saw some pretty horrific things during the war years but nothing has stayed with me like the sight of that matchbox!

On the whole, the place was fairly primitive, but we must face up to the fact that industry generally was pretty primitive, to the extent that if it came back today it would be shut down almost immediately! Yet our own safety was demonstrated and explained; for example, I never bolt anything down onto my milling machine

table without a piece of newspaper or similar underneath it. Many such tips have stayed with me all my working life, and my hands are still in one piece each, and complete. It took a war to cause me any problems. If asked what I owe to Swindon, it is experience of the wisdom of generations of people working in an industry that was totally unforgiving if you made a mistake.

There is no doubt that Brunel was a genius; forget all the other names, they would not have had much prominence without Brunel. In the world in which I worked, he invented a circular saw in the 1830s that was capable of sawing veneers. Some 16ft. diameter, I will say here that you wouldn't have got me near it for a small fortune; but it worked, and I have seen and handled veneers produced by such a machine. The operation of such a machine today day is unthinkable.

Similarly, Brunel's railway arrived at Swindon and was then extended to Bristol, so he said to his Directors, or whatever they were called in those days: "Right Gentlemen, we are in Bristol; the next stop has to be New York." So without so much as a 'by your leave' or 'shall we?' he constructed a paddle steamer. From laying the keel to launch took him just over a year! Remarkable! He achieved what he set out to do and his vessel plied its trade for 30 years. It was possible to buy a ticket from London to New York — Richard Branson you were preceded by at least 165 years. Quite a man was our Mr. Brunel!

So having put the little down that my grey cells have left to offer, it is a surprise to realise just what I do owe to Swindon. Not getting the job that I went after in the carriage works was a tremendous piece of luck because the Swindon I finished up in taught me how to think and, without that ability, I would not have survived; and Swindon gave me an ability to work in metal.

I explored most of the amazing complex that was Swindon, the roundhouses and huge sidings into which coal was constantly arriving. The continuous smoke and soot that will never be forgotten. It's ironic that during my 18 months or so there, I never once got to see the carriage works that were the reason for my going to Swindon in the first place.

It really can be a funny old world!



CLUB CHAT

With Stan Bray

UK News

We doubt that many societies can match the turnout of members for working parties achieved by **Cardiff MES**. An average of 32 take part on Saturdays and 18 on Thursdays while, not to be left out, a group of their ladies arrived one Saturday afternoon just before the first open event of the year in order to give the kitchen area a good spring clean. As a result of all this activity the kitchen is spic and span, regular track maintenance has been completed, some of the older riding cars have been upgraded and new ones built. It is interesting to note that members are re-laying their ground level track using plastic sleepers, while **Frimley & Ascot LS** were forced to abandon those which they bought when they found they tended to catch fire and burn.

From **Birmingham SME** comes a most interesting idea; members are being asked to donate any spare Meccano parts they may have laying around. The society already has quite a good collection which they use to encourage youngsters who visit the site and are allowed to use it. Apparently, it is a real hit with them — and with some of the grown ups, as well. We know that many model engineers started by building with Meccano, so perhaps this could be a way to get youngsters to join the hobby. It is rarely practicable to be able to encourage them to make projects in the workshop, but much can be learned from Meccano. It sounds like an excellent way to plan for the future. Even further efforts are being introduced to encourage them with reduced junior subscriptions and the positive encouragement of the operation of toy steam including Mamod models. While thinking of the future, this year being its 65th Anniversary, the society is also looking back at the past; the latest newsletter has several photographs of the first ever public Open Day in November 1938. It is fascinating to see the difference between then and now; there is no sign of even a single 5in. gauge locomotive, and nearly all the men present were wearing suits and sporting ties — how different from today's casual approach to attire. The annual Club Competition has been revived and judging took place in February. The *Sherborne Cup* was won by John Budd with a *Vega* 2-cylinder 4-stroke aero engine; John also won the *Jubilee Cup* for a

1 1/2in. scale Allchin traction engine. Arnold Simkiss won the *Picknell Cup* with a

GWR pannier tank locomotive and John Walker the *Lehman Cup* for his efforts in organising the annual National Locomotive Rally. Another annual award made was that of the *Rose Bowl* which went to Brian Hesketh for his work in many areas of maintenance at the track.

Something of a challenge from the **Chesterfield DMES** comes in the form of a brief article in the club newsletter pointing out that their club track at Butterley Park has appeared on the latest Ordnance Survey map. The author believes it to be the only society so recorded and it will be interesting to discover if any other clubs have received the same recognition. The map may have to be amended when the large ground level extension has been built. Several embankments are needed for this project, for which some 400 tonnes of soil has been donated; it will be a major effort to shift it all. There is some help in the form of a group of young autistic people who attend with their carers on Wednesdays and take on a variety of tasks. The club's traction engine enthusiasts have been improving the terrain that they use, work which includes filling a number of hollows in the centre of the raised track to allow them access to the water supply at the steaming bays.

The early part of the year has been very busy for **Friends of Beamish ME Group** but the effort appears to have been worthwhile. They are particularly pleased with a new system for loading and unloading locomotives, now so easy that there have been a number of unscheduled running days. A cover, dubbed the 'Dog Kennel' has been built for the ash pit, and a station canopy completed. Tiles were donated by the museum, allowing the canopy to blend with other buildings in the area. The main project has been their rack railway, progress on which has been such that an Official Opening will be held on 15 September. Both normal adhesion and rack locomotives will be welcome, subject of course to production of a suitable boiler certificate. The opening ceremony is to be performed by Richard Gibbon of the **National Railway Museum** at York who, not satisfied with just cutting the tape, has declared his intention to bring his own model of *Wren* and to attempt to run it up the rack railway. Unofficial bets are being taken on how far he will get. Further

information about the opening can be had from Ken Swan at 'Liddesdale', 5 Dipwood Way, Rowlands Gill NE39 1DH, tel: 01207-542560. Like most model engineering societies, the fuel in greatest demand is tea, which goes down by the gallon. The signal that tea is ready is sounded on a ship's bell. It is unfortunate that an almost identical bell is used by the adjacent golf club to warn that someone is starting on the first tee. As a result, members turn up for tea in time to see someone start their round, while golfers at the first hole duck, believing that someone is about to fire off a golf ball in their direction when in fact it is just the model engineers having yet another cup of tea. The whisper is that the model engineers' bell sounds rather more frequently than the one at the golf club.

From 16-18 August, **Bristol SMEE** is staging a Model Engineering and Hobbies Exhibition at the Leisure Centre, Thornbury in South Gloucestershire which has plenty of free parking, is close to the Almondsbury interchange of the M4 and M5, and is near the Severn Bridge. With plenty of support from the trade and other societies, the content of the exhibition is broad enough to ensure that there will be something of interest for all the family. While not a competitive event, the society would welcome models for display from non-members. Further information can be had from Geoff Sheppard, call him on 0117-956-0869 or e-mail him at gsandg.sheppard@btinternet.com

Despite a heavy commitment to the recent Harrogate event, work has continued at Northcliffe, home of **Bradford MES**, with the completion of a new veranda on the clubhouse. During this work, the opportunity has been taken to utilise the space beneath the new veranda to construct a store to house the club rolling stock. Work on this remains to be completed so that best use can be made of it. It has been agreed to re-model the club exhibition stand to make it easier to build, dismantle and store. So far no firm decision has been taken as to how this will be done, but various ideas are being considered.

The **Stamford MES** track is in the grounds of a school a few miles from their home town and therefore escapes the vandalism problems suffered by many other societies. However, this does not mean that the members can just pop along and run on a nice clean, stable track any time they wish, because it also happens to be largely in a well

wooded area which means that it has to be more or less dug out from under the fallen debris of leaves, mud washed down by the rain and other accumulated rubbish at the end of winter. So, every spring sees a grand clear-up session with folk working away with strimmers and shovels until they eventually manage to find the track itself. Fortunately, a good number of members attend armed with shovels, and this year one even had the foresight to bring a wheelbarrow. Another made good use of the tow bar on his car to haul away fallen branches and to remove the stump of a tree which had been in the way of operations for a long time. The group split into teams, one working clockwise, the other anticlockwise, the parties eventually meeting somewhere near the middle. Apart from a few sleepers which showed signs of having succumbed to the adverse conditions, the track has been declared perfectly useable and all that now remains is to organise running dates.

With several long-serving members wishing to stand down, some changes to the **Southern Federation MES** committee were approved at the recent AGM. The position of newsletter editor is now in the hands of Norman Rogers, and that of Secretary, Mr. M. Bennett who can be contacted at 40 Suckling Green Road, Codshall, South Staffordshire MV8 2BT, tel: 01902-842829. During the meeting, Chairman Brian Thompson presented Stan Bishop with a Commemorative Certificate to mark his retirement from the position of Newsletter Editor after 16 years. The Federation Autumn Rally will be hosted this year by Hereford SME on Saturday 21 September but we do not yet know if this will be followed by the traditional Open Day on the Sunday.

Contractors delivered five new 7 1/4in. gauge carriage frames to **Rugby MES** in March since when work has gone on to fit bogies, so the vehicles should be in operation this running season. The work is facilitated by the fact that the club now has a special workshop just for dealing with rolling stock. Also recently constructed are three new signals for the approach roads to the ground level station. Although the point work will still be supervised and manually operated, their operation will trigger the electrically operated signals. Another completed task is the re-laying of 85 metres of track which involved the removal of several tonnes of earth and replacing it with two 15 tonne loads of ballast to improve drainage. The problem

In Memoriam

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

Michael Alford
Dr. John Farrington
David Greensmith
Dr Ian McGilvray
Peter Mason
Barrie Mills
Bob Smallwood
Peter Smallwood
Cannon Walker

Birmingham SME
Rugby MES
Cardiff MES
Wigan DMES
Isle of Wight MES
Wigan DMES
Mashonaland SME
GL5MLA
Cardiff MES

of getting the ballast down into the cutting was resolved by the use of a chute which allowed the ballast to run into wheelbarrows for distribution along the cutting.

Members of *Isle of Wight MES* have come to the conclusion that the cost of building a new club house renders the project impractical and so will probably settle for improving the old one. There is also a slight possibility of a move to another site at some time and a few suggestions have been made regarding possible new venues. Any such move will entail a great deal of thought, for the existing set-up is very nice and any move would involve a lot of work. The club will be staging an exhibition on 7/8 September and is busy twisting the arms of members for all possible exhibits; we hope to be able to supply more information nearer the date.

This year, *North London SME* has to re-negotiate the lease on its headquarters building at Finchley, and it is anticipated that some repair work will be necessary prior to this. The building involves the club in considerable expense in maintenance and the cost of the lease,

but members consider themselves fortunate since any sort of building in London is very costly. The slot car group is popular; over the years its members have been very successful in various competitions, and to increase the usage of their fine slot car racing track, the section is now open for running on an additional night every week.

Most societies these days run charity events and so it comes as no surprise to hear that some members of *Stockholes Farm MRS* have decided to do something a little extra. For example, members are urged to turn out their sheds and workshops and pass on any unwanted tools which will then be renovated and sent to third world countries. Used postage stamps are also collected and donated to the *Royal National Institute for the Blind*. When the

railway was first planned, one of the stations was named *Orchard Halt* with the intention of running the railway through an orchard in that area. Over the years, fruit trees have been planted in an effort to create the orchard, none of which have grown. There is to be one last try to get some to grow, if these fail the station may have to be renamed!

On 31 August and 1 September, the *Gas Turbine Builders Association* will celebrate 30 years of existence with a special meeting at Rolls Royce, Hacknall. Although sufficiently numerous as to make most other societies green with envy, attendance at the AGM and seminar held in late March was slightly down. Atrocious weather made the downturn hardly surprising, but those who braved the elements were able to participate in a lively debate which

covered a wide range of topics.

With new locomotives appearing on a regular basis, the popularity of the *National 2 1/2in. Gauge Ass'n.* rallies is steadily increasing. The Southern Area Spring Event held at the *Romney Marsh MES* track was no exception, a new addition being a model of one of the old *NER Bo-Bo* electric locomotives. The society's quarterly journal *Steam Chest*, which is supplemented by a monthly newsletter, is rapidly becoming a constructional journal, members being supplied with separate drawings of the latest project to be described, which in the case of the current issue is a *GNR Stirling Single*.

Some years ago the *Old Locomotive Committee* published a book which gave the history of the locomotive *Lion*, and an extremely interesting little publication it was. There is now discussion on the possibility that a new updated volume might be published. As well as the history of the engine, it would contain details of its preservation and who knows, possibly additional information about *OLCO* itself.

Turnout, the newsletter of the *Ground Level Sin. Gauge Mainline*

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.

JUNE

To 14 July Talylyn Railway, Talylyn Vintage Train. Enquiries: 01654-710472.
28 Steam LS of Victoria. Working Bee & Barbecue. Contact Graham Plaskett: (03) 9750-5022.
29 Chichester DSME. Summer Barbecue. Contact Brian Bird: 01243-542266.
29 Frimley & Ascot LC. Fish & Chip Run. Contact Bob Dowman: 01252-835042.
29 National 2 1/2in. Gauge Ass'n. Summer Rally at Worthing DSME. Contact Clive Young: 01233-626455.
29 Reading SME. Open Day. Contact Graham Bustin: 01189-615450.
29 STEAM - Museum of the Great Western Railway. Meet the Railway Workers. Information: 01793-466646.
29/30 Amberley Museum. Fire Show. Contact Derek Kilburn: 01798-831370.
30 Ascot LS. Members' Steam-Up. Contact Tony Alderman: 01932-854393.
30 Birmingham SME. Heartlands Leukaemia Charity Day. Contact John Walker: 01789-266065.
30 Chichester DSME. Steam on Sunday. Contact Brian Bird: 01243-542266.
30 Durban SME. Members' Running Day. Bring & Braai. Contact David Martin: 031-5635755.
30 Great Western Soc. (Didcot Railway Centre) Steamday. Contact Jeanette Howse: 01235-817200.
30 Guildford MES. Running Day. Contact Dave Longhurst: 01428-605424.
30 Leighton Buzzard NG Rly. Vintage Vehicle Rally. Enquiries: 01525-373888.
30 MELSA. Sunday in the Park. Contact Graham Chadbone: 07-4121-4341.
30 Oxford (City of) SME. Running. Contact Chris Kelland: 01235-770836.
30 Ryedale SME. Passenger Day. Contact Michael Burch: 01439-788033.
30 St. Albans DMES. Outing to the Bluebell Line. Contact Roy Verden: 01923-220590.
30 Urnston DSME. Electric/Diesel Outline Day. Contact Bryan Cartwell: 0161-485-5174.
30 Woking MRS. Open Day. Contact Ronald Dewar: 01932-343331.

JULY

1 Peterborough SME. Bits & Pieces. Contact Tony Meek: 01778-345142.
1 Romney Marsh MES. Track Meeting. Contact John Wimble: 01797-362295.
2 South Durham SME. Meeting. Contact B. Owens: 01325-721503.
2 Taunton ME. Barbecue. Contact Don Martin: 01460-63162.
3 Bradford MES. Steam-Up. Contact Gordon Eddison: 01943-864217.
3 Bristol SME. Bring & Buy. Contact Trevor Chambers: 01454-415085.
3 Chingford DMEC. Club Evening. Contact Martin Masterson: 0208-989-5552.
3 Hutt Valley MES. Mark Waterland: Harvesting Sunlight. Contact Gavin McCabe: 567-4487.
3 West Wiltshire SME. Steam-Up. Contact R. Nev. Boulton: 01380-828101.
4 Leyland SME. Sam Bates Vol. II: Railway Reminiscences. Contact Alan Wilson: 01942-715072.

4 South Lakeland MES. Meeting. Contact Adrian Dixon: 01229-869915.
4 Sutton MEC. Bits & Pieces. Contact Mike Dean: 0208-657-5401.
5 Vale of Aylesbury MES. Track Night. Contact Clive Ellam: 01296-623433.
5 Maidstone MES. Evening Run & Pizzas. Contact Martin Parham: 01622-630298.
5 Portsmouth MES. Fish & Chips Evening. Contact Bob Aldred: 023-92-523366.
5 Rochdale SME. Annual Models Running Night. Contact Mike Foster: 01706-360849.
5 Romford MEC. Competition Night. Contact Colin Hunt: 01708-709302.
6 Dockland & E. London MES. Track Meet. Contact P. M. Jonas: 01708-228510.
6 Isle of Wight MES. Track & Pond. Contact Ken Stratton: 01983-760762.
6 Peterborough SME. Visit to National Railway Museum. Contact Tony Meek: 01778-345142.
6 Romney Marsh MES. Visit to Great Wealden Railway. Contact John Wimble: 01797-362295.
6 Society of Ornamental Turners. Meeting. Contact N. S. Edwards: 01234-358392.
6 York City & DSME. Summer Barbecue & Steaming. Contact Ken Bateman: 01904-421445.
6/7 Amnerfield Miniature Railway. Steam Open Day. Contact David Jerome: 0118-9700274.
6/7 Ascot LS. GL5MLA Rally. Contact Tony Alderman: 01932-854393.
6/7 British Columbia SME. Annual Meet. Contact Sean Laurence: (604) 931-1547.
6/7 Lancaster & Morecambe MES. Open Days and Exhibition at Cinderbarrow Track. Contact Harry Carr: 01524-411956.
6/7 Leeds SME. THE INTERNATIONAL MODEL LOCOMOTIVE EFFICIENCY COMPETITION. Contact Edwin Hughes: 01757-707454.
6/7 Museum of Power, Langford. Little Engine Rally and Model Show. Contact Janet Hobart: 01245-473359.
6/7 Stockholes Farm MR. Non-Steam Rally Weekend. Contact Ivan Smith: 01427-872723.
6/7 Guild of Model Wheelwrights at Fire Rail 2002, St. Peters Collegiate School, Woverhampton. Contact Biddy Hepper: 01492-623274.
7 Bedford MES. Road Vehicles Day. Contact Ted Jolliffe: 01234-327791.
7 Cardiff MES. Steam-Up & Family Day. Contact Trevor Jenkins: 029-20755568.
7 Great Western Soc. (Didcot Railway Centre) Steam & Railcar Day. Contact Jeanette Howse: 01235-817200.
7 Guildford MES. Disability Challenge. Contact Dave Longhurst: 01428-605424.
7 Kinner & West Midlands SME. Kinner Diesel Day. Contact John Campbell: 01384-891244.
7 Leighton Buzzard NG Rly. Model Railway Mania. Enquiries: 01525-373888.
7 Malden DMEC. Open Day. Contact J. Mottram: 01483-473786.
7 Ottawa Valley Live Steamers. Steaming Day. Contact John Bryant: 761-1109.
7 Oxford (City of) SME. Running. Contact Chris Kelland: 01235-770836.
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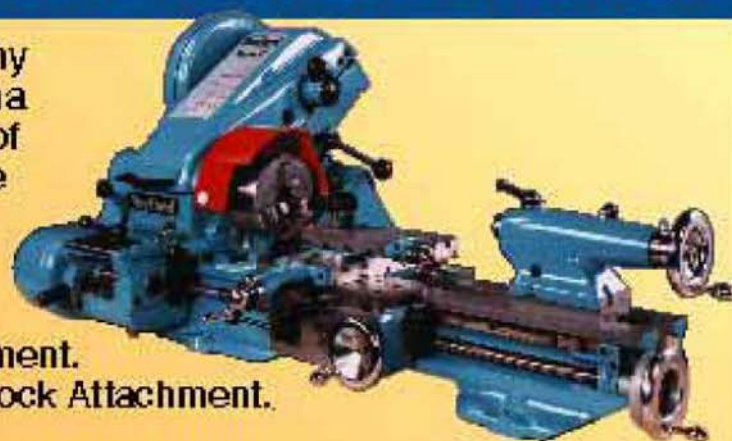
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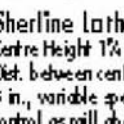
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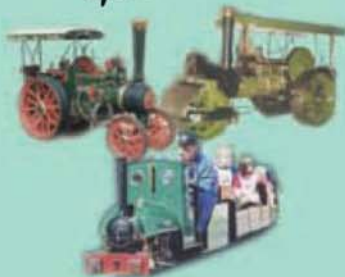
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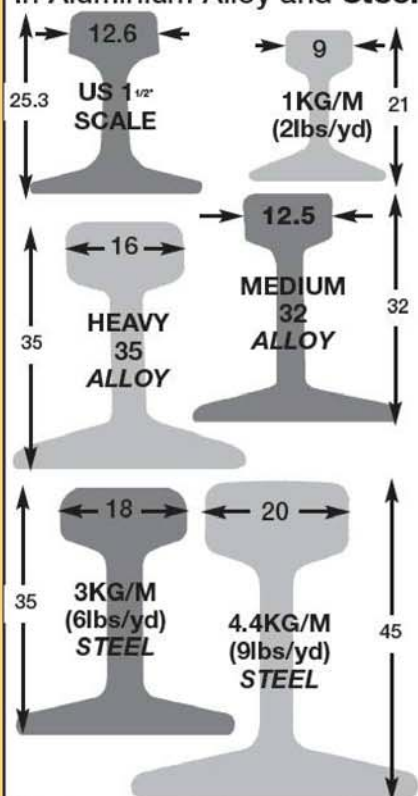
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- 100-2500mm
- Range of threads (mm) 1.5-4mm (metric) 0.41-1.25mm
- Headstock 350mm
- Headstock 350mm
- Headstock 350mm
- Headstock 350mm
- Headstock 350mm



£850

Price include VAT
& Delivery UK

Model B-Super

- Swing over bed 4000mm
- Bed length 5000mm
- Headstock 500mm
- Tailstock 500mm
- 3rd hand 500mm
- 100-2500mm
- Range of threads (mm) 1.5-4mm (metric) 0.41-1.25mm
- Headstock 500mm
- Headstock 500mm
- Headstock 500mm
- Headstock 500mm
- Headstock 500mm

£725

Price include VAT
& Delivery UK



Comet Lathe

- Swing over bed 2500mm
- Bed length 3000mm
- Headstock 300mm
- Tailstock 300mm
- 3rd hand 300mm
- 100-2500mm
- Range of threads (mm) 1.5-4mm (metric) 0.41-1.25mm
- Headstock 300mm
- Headstock 300mm
- Headstock 300mm
- Headstock 300mm
- Headstock 300mm

£1155

Price include VAT
& Delivery UK



Centurion

- Swing over bed 4000mm
- Bed length 5000mm
- Headstock 500mm
- Tailstock 500mm
- 3rd hand 500mm
- 100-2500mm
- Range of threads (mm) 1.5-4mm (metric) 0.41-1.25mm
- Headstock 500mm
- Headstock 500mm
- Headstock 500mm
- Headstock 500mm
- Headstock 500mm

£1395

Price include VAT
& Delivery UK



Craftsman Precision Belt Drive

- Swing over bed 3000mm
- Bed length 3500mm
- Headstock 350mm
- Tailstock 350mm
- 3rd hand 350mm
- 100-2500mm
- Range of threads (mm) 1.5-4mm (metric) 0.41-1.25mm
- Headstock 350mm
- Headstock 350mm
- Headstock 350mm
- Headstock 350mm
- Headstock 350mm

STANDARD EQUIPMENT

- 6" 3-jaw chuck with 2 sets of jaws
- 6" 4-jaw chuck
- Steady rest - follow rest
- 3rd - 1st hand
- 3rd - 1st hand
- 4-jaw tool rest
- 1st hand rest
- 1st hand rest

£1725

Price include VAT
& Delivery UK



Cub 620/630

- Swing over bed 3000mm
- Bed length 3500mm
- Headstock 350mm
- Tailstock 350mm
- 3rd hand 350mm
- 100-2500mm
- Range of threads (mm) 1.5-4mm (metric) 0.41-1.25mm
- Headstock 350mm
- Headstock 350mm
- Headstock 350mm
- Headstock 350mm
- Headstock 350mm

STANDARD EQUIPMENT

- Headstock and 1st hand rest
- 3rd hand - 1st hand
- 3rd hand - 1st hand
- 3rd hand - 1st hand
- 3rd hand - 1st hand
- 3rd hand - 1st hand
- 3rd hand - 1st hand
- 3rd hand - 1st hand
- 3rd hand - 1st hand

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