

MODEL ENGINEER

Vol. 192 No. 4217

19 March - 1 April 2004

**WORTHING
DSME
BIENNIAL
EXHIBITION**

17/18 April 2004

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332 PAGE**

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Mart**

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BV-20 LATHE

SPECIFICATION:

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- DISTANCE BETWEEN CENTRES 14"
- SWING OVER CROSS SLIDE 5"
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- RANGE OF METRIC THREADS 0.4MM - 3MM
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Cross Travel	145mm
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Spindle Taper	3MT
Diameter of Spindle	63.5mm
Diameter of Column	66.65mm
Throat	165mm
Max distance spindle to table	320mm
Height with head at top of column	1067mm
Width	775mm
Depth	559mm
Spindle speeds	400-1640
Motor	1 phase 1/2hp with F/R switch
Weight	295lb
Head tilting	90-0-90 worm gear tilt mechanism

General dimensions may be subject to minor variations.



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An intriguing design which avoids the
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BRISTOL HYDRA THE NEXT TWELVE MONTHS

The series continues with more trials
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WELLAND FINE FEED QUADRANT

Concluding this short series with further
 details of an inexpensive alternative to
 the quick change gearbox. Part II.
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A SOUTHERN RAILWAY MERCHANT NAVY CLASS LOCOMOTIVE IN GAUGE 1

Attention is turned to the smokebox
 and cab. Part XIII.
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FOWLER STEAM WAGON

Machining the cylinders, cylinder covers,
 piston valves and liners. Part III.
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FINE TUNING A WARCO BH600G LATHE

A description of the George Thomas
 style dividing head designed for use
 with this popular lathe. Part XIV.
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WORTHING EXHIBITION

Looking forward to this year's event with a
 glimpse at a previous WDSME Exhibition.
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KEITH'S COLUMN: LOGGER & SLOGGER AMERICAN TYPE 2-8-2 LOCOMOTIVES

for 5in. and 7 1/4in. gauges.
 An acknowledgement of a small error in
 the boiler design is followed by details
 of the throttle valve. Part XXVIII.
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On the cover ...

*Representative of the second batch
 of King Arthur Class locomotives
 built in 1925 by the North British
 Locomotive Company for the
 Southern Railway to a design developed
 by R. Maunsell from a LSWR Urie design,
 this fine 5in. gauge model of
 SR N15 No. 763, Sir Bors de Ganis
 was built by Peter Fagg
 and was his entry in Class B1 of
 the 73rd Model Engineer Exhibition.
 A superb example of the
 model engineer's art, it was awarded
 a Gold Medal, the Bradbury-Winter
 Memorial Challenge Cup, and the
 Charles Kennion Memorial Trophy.
 A full report on the working steam
 locomotives, plus the scale model aircraft
 entered in competition at the recent
 Model Engineer Exhibition
 begins on page 312 of this issue.*

(Photograph by Mike Chrisp)

LETTERS TO A GRANDSON

Following a discussion of the behaviour
 of steam and water in a live steam injector,
 work begins on the cones for the flap
 valve injector. Part LXI.
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TRADE TOPICS

A must-have book, oxy/gas precision
 torch, and a leakproof oil gun — more
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Recent activities and forthcoming events.
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CENTRE SPREAD PULL-OUT: SAFE OPERATION OF PRESSURE SYSTEMS FOR THE MODEL ENGINEER

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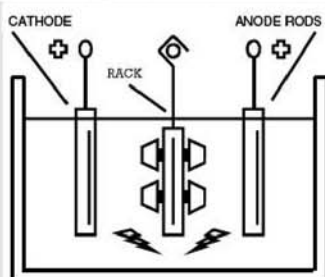
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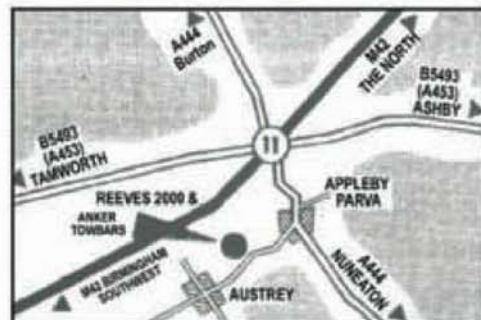


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Lorch AVIK Lathe, Collets, Comp Slide, Paint stripped off Cabinet for repaint, cheap machine for restoration		£ 1000.00	Jones and Shipman 540 Surface Grinder, Mag Chuck, 3ph	£ 21650.00	Clarkson 40INT Autolock Chuck (large) with 2 collets	£ 100.00	Gudal 8 Station Lathe	
Boxford AUD 4 1/2" x 18" Lathe, Tooling, New single Phase Motor Fitted		£ 1250.00	BJH Trim Tool Grinder, 3ph	£ 200.00	Clarkson 40INT Autolock Chuck (small) with 4 collets	£ 80.00	Swiss Hydraulic Mill S101	
Boxford AUD 5 1/2" x 22" Lathe, 3 & 4 Jaw, DCTP, Catchplate, Manual, 240 Volt 1ph, VGC		£ 1850.00	Eluxit 8" Pedestal Grinder, 3ph	£ 75.00	Clarkson 50INT Autolock Chuck (lg) 2 Imp. Collets	£ 85.00		
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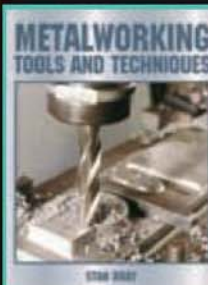
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The Tesla Disc Turbine • Cairns • £ 6.90

Nikola Tesla was granted a British Patent for his Disc Turbine, in 1910. Unlike a conventional turbine, in which the rotor consists of bladed segments, in Tesla's machine these were replaced by discs, working on the concept of flowing media being converted to rotary motion by friction working on the discs. The early twentieth century prototypes were way ahead of the metallurgy of the time, but interest is growing again in this simple machine. In this book the basic concept is explained and various possible uses are given, and there are also drawings and instructions for building a small Tesla Turbine. 34 A4 format pages. Numerous drawings and sketches, including 6 pages of drawings specifically for a Tesla turbine you can build. Paperback.



Building the Maltese Falcon • Shelley • £20.45

The Maltese Falcon is a 260cc Flat Four, Side Valve engine which turns a (scale) 34" x 18" propeller at 2500 rpm, and measures 8" x 8" x 13". Essentially designed to be built from solid, certain parts, notably a magneto kit, and standard Honda pistons can be used if you want to get your Maltese Falcon running as quickly as possible - parts suppliers are listed. Whilst not a beginner's project, this engine can be built by any competent model engineer and, of course, having built the engine, you can then build a giant model aircraft for it to power! What really intrigues us about the Maltese Falcon is what else you could drive with it, in some cases with modifications to the cooling arrangements; large scale model road vehicles, 7/4" gauge railway motive power, an outboard motor, a GT lawn mower and a motor bike would also all seem possible. In this book you get the full drawing set of 11 sheets, reduced in size to fit A3 format, and 36 A4 pages of notes, hints and tips on building the engine, plus numerous photos of parts and set-ups for making them; this isn't a construction manual in the conventional sense, but it is all good solid information aimed at helping the builder to make a 'model' LC engine which really will make people's jaws drop! Wirebound with card covers.



Building Stirling I • Warbrooke • £ 7.20

This book describes how to build a unique form of Stirling Engine which does not have a displacer. The theoretical possibility of such an engine has been long considered, but as far as we are aware, this is the first design that actually works. Because the only moving parts are the piston, crankshaft, crank and flywheel this is a very simple engine to build, and an ideal project for the beginner. It will also have considerable appeal to Stirling Engine enthusiasts as the basis for further experimentation. This book contains full drawings for this engine, plus hints and tips on building it, assembly photos etc. Stirling I requires no castings, and can largely be made from bits in the scrap box. Simple but accurate turning, some hand work and some soldering are all that is required to build this fascinating engine. High quality 32 page A4 paperback.



Model and Miniature Locomotive Construction • Bray • £33.30

Written by well known author Stan Bray, this book covers the construction of model and miniature locomotives from Gauge 1 to 7/4" gauge, with the accent on the passenger hauling gauges. The bulk of the book is Stan passing on hints, tips, ideas and practices he has picked up over fifty years as a model engineer, and he covers the subject with chapters on each major part, such as frames, axle-boxes, valve gear, cylinders, boiler, platemwork etc; he also covers electric and LC powered locomotives, and each chapter is heavily illustrated with drawings and photographs of the relevant parts. There are also photographs of model and miniature locomotives from around the world, reflecting Stan's involvement with the rapid growth of the model engineering hobby world wide. Written in Stan's inimitable style, this book is a good read, as well as containing a huge amount of practical and useful information and ideas. Whilst especially useful for the beginner, the ideas, hints and tips in this book make it one every model or miniature locomotive builder should have on their bookshelves. Quality hardbound A4 format book. 208 pages including 8 pages of useful charts. 158 drawings. 300 B & W, and 32 colour photographs. 12 charts.



Early Flying Machines • {1909} • £ 9.60

As our small contribution to the celebrations of the Centenary of the first authenticated powered flight in 2003 we published this book, the contents of which originally appeared in a four volume work entitled "Engineering Wonders of the World" published in 1909, when flying was still very much in its infancy. The contents have been rescaned, improved where possible and we have followed the layout of the original as far as we could. Five of the chapters - Mechanical Flight and Aerial Navigation, The Theory and Principles of the Aeroplane, Flying Machines of To-day, Aeronautical Engines, and The Construction of Aeroplanes and Aerial Propellers give a very detailed over-view of all facets of aircraft development and building at this time, and cover not just the Wright Brothers machines, but those of Blériot, Cody and many of the other pioneers. The sixth chapter is on Dirigible Balloons, and covers powered airships of the time, of all types up to and including the early Zeppelins. The book is illustrated with a considerable number of photographs and drawings which complement the good text whose author is, sadly, unknown. A fascinating look at the days when the aviation pioneers were literally launching themselves into the unknown. High quality, 64 page A4 format and Softcover.



'LBSC' His Life and Locomotives • Hollingsworth • £26.50

Few model engineers can not have come across 'LBSC's' designs or writings: 112 designs published over 44 years, over 3000 articles published in *Model Engineer* and other magazines, the last only a month before his death at the age of 84. And he built 55 small steam locomotives himself. But what made him famous was his style of writing - informative, opinionated and down to earth, they gave the ordinary man the confidence to realise that he could build models if he wanted to, and told him how to do this. When one considers just how many model locomotives have or are being built to an 'LBSC's' life, writings and designs in some detail, warts and all. A fascinating and highly readable book on a fascinating and highly readable man, and is one every model engineer should have on his bookshelf. 112 pages. Over 220 B & W photos and drawings. Hardbound.

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SMOKE RINGS

With the Editors

Saving time

When he was still a relatively young man, Neil recalls a friendship with a fellow restorer of old motor cycles who has long since passed away. This gentleman was quite elderly and very experienced. He was much respected by amateur restorers and professionals alike and had been on first name terms with a number of key figures in the trade. Yet he always had time for youngsters who shared his interests — something we could all try to emulate when approached by a young man or woman interested in our hobbies. One day, Neil and he were discussing a particular restoration task and disagreed over the approach. Neil said "Well, I do it this way to save time." The old gentleman looked at him severely and said: "... and what do you do with the time you save?"

Saving time is not a bad thing in itself, particularly if we are able to use 'the saving' to good purpose. However, how often does saving time really equate to cutting corners. We think this is what Neil's old friend was driving at. It is no use saving time if you end up rushing the task and possibly having to repeat it. It is much better to take your time and get it right first time. The Romans had a phrase for it: *festina lente* — hasten slowly!

Neil has often had occasion to reflect on the words of his old friend. Most recently he was carrying out a slotting operation on his milling machine. A large pulley had been bushed to suit a new electric motor shaft and the keyway was being machined in. However, anxious to finish the job that evening, he failed to pause and lock the machine table. He went to the rear of the machine to check that the cutter was passing through the bush and inadvertently caught the table feed screw hand wheel with his smock. Without going into all the messy details, the result was that the newly bushed pulley had to be rebushed, a job which took far longer than it would have done to have checked whether the table had been locked.

We are sure that most readers have had similar experiences and have learned hard lessons from them. Some engineering companies issue check lists to their machine setters so that each individual operation has to be 'ticked off' on the sheet to ensure, at least in theory, that all key operations have been carried out and nothing has been forgotten. Pilots follow a similar procedure before being allowed to take off with an aeroplane. Maybe that is going too far for a hobby, but it does no harm to pause and reflect before starting any particularly important operation.

In one of his series of three books entitled *Workshop Technology*, W. A. J. Chapman mentions that two of the fastest, most effective tool room workers he knew were both large, slow moving individuals. Their speed came from economy of movement and making each action count. They did not rush things and thought before they acted. Perhaps, in the past, they had forgotten to lock a machine table and the painful memory was still fresh in their minds.

Colchester Bantam lathe

Mr. Robert Dean has written to tell us that he is rebuilding an elderly Colchester Bantam lathe dating from circa 1930 and requires information on the correct method of reassembling the

headstock and drive arrangements. If any reader has a similar lathe or literature on this type machine and would be prepared to help Mr. Dean with his rebuild then we would be pleased to pass on their details by way of the Editorial office.

Fifth Stirling Engine Rally at Kew Bridge Steam Museum

In association with The Stirling Engine Society Kew Bridge Steam Museum is pleased to announce details of its fifth popular Stirling Hot Air Engine Rally and Competition which will take place on Sunday 4 April 2004 11am - 5pm.

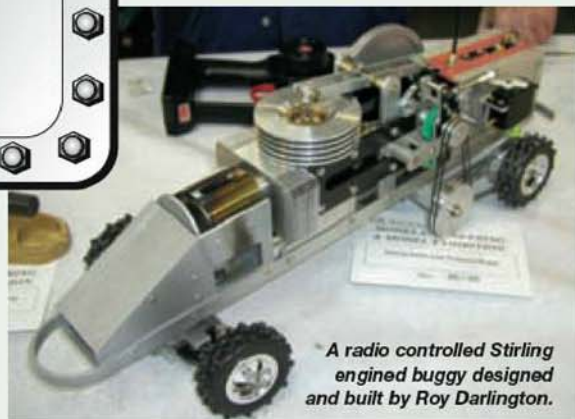
The Stirling Engine Rally will include 80 or more Stirling and hot air engines, most of which will be working. There will be model and full size engines, some coal fired and others solar powered, on show in the museum's Steam Hall, Mezzanine floor and around the Water for Life Gallery.

The rally will once more bring together arguably the most diverse collection of Stirling and hot air engines ever assembled under one roof. Visitors will have the opportunity to meet the experts and find out more about these fascinating engines.

The Competition is divided into two sections:

Section 1: As in previous years, there will be separate classes for collectors of vintage hot air engines (Class A), modern commercial Stirling engines (Class B), and self-built Stirling and hot air engines (Class C).

Section 2: For the second year running, there will be a competition for Stirling powered vehicles. This competition has been inspired by the Stirling Techno Rally now held annually in Japan where it attracts many entries from technical schools. The forthcoming competition has been widely publicised in UK educational circles with the aim and intention of attracting entries from technical schools here. Section 2 involves four classes:



A radio controlled Stirling engine powered buggy designed and built by Roy Darlington.

Class 1: A model Stirling powered vehicle with three or more wheels, to be test run in a self-guiding track 300mm wide fitted with 50mm high side/guide walls (the length of the track has yet to be determined). Vehicles to have a maximum length of 460mm with maximum width of 280mm. Note that the term 'vehicle' is used loosely to mean a Stirling engine mounted on some form of chassis and driving a set of wheels by gearing or belt drive. Self-steering is not important since the vehicle will be guided by the track's guide walls

Class 2: Radio-controlled model Stirling powered vehicles with three or more wheels.

Class 3: Large manned Stirling powered vehicles with two or more wheels to carry driver seated in vehicle.

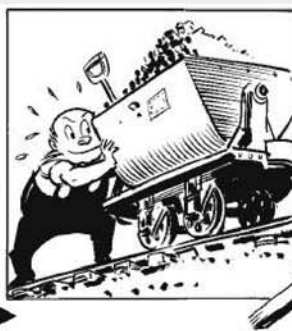
Class 4: To encourage the participation of young people, there will be an extra class for vehicles using compressed air motors supplied from air-filled plastic fizzy drink type bottles (overall dimensions as in Class 1).

The museum's giant beam and rotative engines will be in steam all day, and the narrow gauge railway will be giving free rides around the site. The *Water for Life* Gallery telling the story of London's water supply from Roman times to the present day will be open too. There is a free car park, a café serving hot and cold food and snacks, and a souvenir/book shop.

Further information can be had by contacting the museum, tel: 020-8568-4757; fax: 020-8569-9978 or by visiting the museum website at www.kbsm.org

CHUCK the MUDDLE ENGINEER

by B. TERRY ASPIN



POST BAG

The late Martin Evans

SIRS, - The following caught my eye from a letter published in M.E. 3670, 4 December 1981.

"... I would also like to thank Martin Evans for a very interesting locomotive design, even if I do get a divorce ..."

Isn't it extraordinary how one individual can have such a powerful effect?

George Winspur, by e-mail.

SIRS, - It was with much sadness that I read of Martin Evans' passing.

I never met Martin Evans, but we corresponded on a few occasions on matters concerning his 'O' gauge designs for *Royal Scot* and *Evening Star*. His books and articles on locomotives both large and small have given me enormous pleasure over many years, as has his personal kindness to me.

I recall one occasion when building my 3 1/2 in. gauge *Evening Star*, I wrote to Martin Evans for advice on the driver's brake valve for this locomotive. He replied most promptly with a letter explaining the details, and sent me one of his own drawings of the valve; it was much appreciated.

He will be sadly missed but I am sure his memory will live on and never be forgotten for as long as model engineering is practised throughout the world.

I express my condolences to his family and friends.

A. Bibby, Clwyd.

SIRS, - I never actually spoke to Martin face to face though we duelled often on paper with 'typewriters at dawn' so to speak.

I hope many readers will still remember me from my thirty years and three months wonderfully enjoyable employment with A. J. Reeves & Co. Ltd., first at Moseley Road, and later at the Marston Green works until closure in December 2000. Working there was more like being part of a family. Martin was already Editor of *Model Engineer* when I joined the firm in late 1970 though I knew him by sight from when I was a steaming bay assistant at the very first IMLEC at the Birmingham SME track the previous year.

Martin was fiercely protective of his job and his magazine. An example of Martin's attitude was when he wrote to the Directors along the lines: "I continually get enquiries for a source of castings

for Westbury's Shand Mason fire engine and have tried most

other suppliers without success. Would Reeves seriously consider putting this design in their range?" Well, Reeves did. Alec Farmer and I studied the drawings and decided to have a go; I made all the patterns except one.

Castings were put into stock and Martin was contacted with a request for an editorial mention that this design was now available. Martin's reply was short and to the point: "You will have to advertise like everyone else." That was not well received, but then he was never really a friend to the castings suppliers.

As far as I am aware, none of his designs were ever to fine scale standards. For example, each of the numerous 5 in. gauge 6-coupled locomotives he designed had a slightly different main axlebox and horn block, sometimes by only a 1/32 in., an apparently insignificant difference which could lead to insufficient machining allowance on a previously almost identical casting. Protests on such matters prompted some of the duels mentioned above.

However, Martin ably continued the LBSC tradition of designing miniature steam locomotives that looked like the prototype, worked well and would get the builder on the track and enjoying the fruits of the labour involved. For those who did not aspire to the design of their own locomotive, Martin's drawings could, and often were successfully used as a basis for much closer to scale miniatures. To produce a working design without actually building a prototype is exceedingly difficult as I have learned from experience. To continue to produce such designs year after year after year requires someone of huge ability, stamina, and historical background knowledge.

Martin was also considerably helped by a talented and artistic wife who did most of the tracing of original pencil work by all contributors for the magazine prior to publication. At a rally a decade and more ago, again at the Birmingham track, Yvonne was making pencil sketches of personalities at the event. I wish now that I had asked for the one she did of me which really was a good likeness.

After Reeves closed I received a personal letter from Martin which was much appreciated.

To Martin's wife and family, I wish to record sincerest condolences on the loss of a man who I will



Mr. Derek Winks' device for honing indexable inserts with below, much enlarged views of a tip before (left) and after (right) attention.



always regard as a giant of the great model engineering hobby.

David Piddington, Birmingham.

Carbide tooling

SIRS, - I was extremely interested in the letter from Dennis Randall concerning his doubts and lack of success with indexable tips. The reply from Mike Chrisp was correct and informative.

The subject of modern tooling and its effective application is a complex subject which ranges from cobalt coatings to negative rake angles.

I well remember our machine shop switching to indexable carbides in 1960. The advantages of sintered carbide indexable tooling over high speed steel in industrial applications is well proven and without doubt. However, to encourage Mr. Randall, when it comes to model engineering on my Myford Super 7, I also use HSS turning tools to excellent effect on steels; only when cast iron is machined (e.g. locomotive wheels) do I revert to tungsten carbide tips.

Cutting tools are only effective and efficient if the machining speeds, rake angle, tip grade and geometry are correct. Even some of the so-called 'free-cutting' mild steels are suspect. Whatever happened to EN3?

It is interesting to calculate the speeds required to machine 25mm diameter mild steel using the well known formula $rpm = (1000 \times S) \div (\pi \times d)$ where S is the tooling manufacturer's recommended surface cutting speed in metres per minute and d is the work diameter in millimetres.

For HSS tooling, a typical figure for S of 25m/min. gives $rpm = (1000 \times 25) \div (\pi \times 25)$, which is about 300rpm.

Depending on a variety of factors, a figure for S of about 150m/min may be suitable for sintered carbide indexable tip tooling, giving $rpm = (1000 \times 150) \div (\pi \times 25)$ which is about 1900rpm.

My references are *Workshop Technology* Vol. 3 by W. A. J. Chapman and *Modern Tooling*

published by Sandvik Coromant.

Who wants their small lathe whizzing around at these speeds, especially when HSS tooling is effective?

J. Downs, Wrexham.

Improved performance

SIRS, - I have read with interest the comments of Messrs. Randall, Jeffree, Willson and others on the subject of indexable lathe tools.

Some years ago I bought a set of these from a stand at the Model Engineer Exhibition. The set consisted of five tools with triangular tips in a wooden box. There was no manufacturer's mark, so it is anybody's guess as to where they came from, but the low price suggests a Far Eastern origin. First trials were disappointing, the tools seemed reluctant to cut and the surface finish was poor, so I thought at first that I had wasted my money. Examination of the cutting edge with a magnifying glass showed that they were far from sharp.

I thought sharpening would improve performance, so I made a simple jig which could be used with a diamond hone to sharpen the tips without changing the original cutting angles. This jig was described in *Model Engineers' Workshop* 69, November 2000. This resulted in a very marked improvement in performance, giving a surface finish at least as good as that produced by high speed steel tools.

This set is now used more frequently than any other turning tools in my kit, as the shapes are suitable for a wide variety of turning operations, and the common height enables them to be interchanged quickly without adjustment. I think they were a good bargain, even allowing for the cost of the diamond hone, which is useful for other purposes. The edges can be quickly restored using the jig when they become blunt.

My photographs show the jig and magnified views of the cutting edges before and after honing.

Derek P. Winks, London.



Mr. Roger Castle-Smith's successful pop-pop boat.

Kit-Q-Cut parting off tool

SIRS, - I have been following the recent letters concerning indexable tools and can only say that I am totally satisfied with the large selection of tool holders and inserts purchased from Greenwood Tools who advertise frequently in these pages; they are a real boon.

However, there was a somewhat irritating problem with the Kit-Q-Cut parting off tool. I was getting a pip left on the parted off item or, in the case of parting off into a hole, a very thin sleeve despite the use of cutting oil, a slow feed and dead centre tool height. When using a HSS blade I always avoid this situation by grinding the leading edge at a very slight angle so that the pip or sleeve, if any, is left on the parent material.

The standard insert supplied with Kit-Q-Cut has the end formed at right angles to the insert holder. On raising this issue with Mr. Peter Cook, who is always most helpful, he said that Greenwood can now supply inserts with the cutting edge angled at 5 degrees. I purchased two of these and ... problem solved.

There is nothing more annoying than being left with a pip or sleeve on the workpiece, especially if it is difficult to turn it around after parting off, for example thin washers. **Roger Castle-Smith, Buckinghamshire.**

King of Showmen

SIRS, - In *M.E.* 4212, 9 January 2004, your correspondent D. N. Wellings enquires about a history of the Pat Collins fairground concern.

I would refer him to *Pat Collins, King of Showmen* written by Freda Allen and Ned Williams and published in 1991 by Uralia Press, Wolverhampton. This fascinating book gives a very detailed history of Patrick Collins and his family, descriptions of the rides and other amusements, records of fairs they attended in many parts of the country and details of all the engines they used. There are a great many photographs of the rides, engines and personalities which augment a most absorbing narrative.

My own recollections of 'Pat. Collins Amusements on Tour' as the engine canopies often displayed are of the funfairs they ran to accompany the Handsworth Flower Show in Birmingham in the thirties. It was these childhood memories

which many years later prompted me to embark on constructing 2in. *Thetford Town*, which sadly is still a long way from completion.

Graham Madeley, W. Midlands.

Probity and integrity

SIRS, - Having been a reader of *Model Engineer* since its cover price was 9d., I am delighted that your advertisers will still accept a subscribers' probity without question. Several times recently I have placed orders, some of considerable value, with businesses such as Chronos (usual disclaimer). My cheque has been accepted without guarantee and goods despatched before the cheque could have been cleared.

I conclude from this that the general integrity of the readership is beyond reproach and that mention of *Model Engineer* when ordering is sufficient guarantee of good faith. Long may it continue.

Don Jardine, France.

Destiny

SIRS, - I am a recently returned reader of *Model Engineer* from a dim and distant time when Cherry Hinds won the Duke of Edinburgh trophy and Myford were undisputed leaders in small lathe manufacture.

I am pleased to see that the content is still wide ranging and the colour pictures are a great improvement over the old days.

However, what really caught my eye was *Destiny* described in *M.E.* 4215, 20 February 2004. I trained at W. H. Allen in Bedford and wonder if Len Walker ever worked there. Some of the turners and apprentices made similar pieces to Len's but with a twist! Instead of boring right through, go in to a set depth with a tool a bit like a circlip cutting tool and then wind out the tool to leave a blind bore with a rebate at the bottom. Repeat on six faces and if you have your settings right you will get a cube within a cube.

Of course, this trick can be taken further to leave a cube within a cube within a cube. Or you can go for ultra miniaturisation. One wag even figured out the settings and holding jigs to produce a dodecahedron within a dodecahedron.

It seems strange now that these little tricks were made in great secrecy (from colleagues and the foreman) to be produced from a grubby overall pocket like a

conjurer producing a rabbit from a hat. It shows what skill and pride those guys had in their work; nearly all gone now of course.

Still reminiscing about the 'old firm', the mortal remains of a Foden steam wagon were still being used to ferry parts between two crane bays during the 1970s. It had lost its boiler and motion work which were replaced by a battery electric drive. Even so, the chassis, steering and Y-spoked wheels were unmistakable. I guess this was the same vehicle that is mentioned in Michael Lane's book on Queens Engineering Works. Happy days! **Martin Johnson, Inverness-shire.**

Pop-pop engines

SIRS, - I was fascinated by the article in *M.E.* 4214, 6 February 2004 on pop-pop engines which brought back a flood of childhood memories from some 55 years ago. Two-tube engines are well covered but I thought readers would be interested in the accompanying photograph (above) of my single tube boat which is 9in. long.

The boiler is very shallow with a flexible top, generally as described in Jeff's article, about 3in. long and 1in. wide. The tube diameter is $5/16$ in. with a $1/32$ in. wall thickness. It will be noted that there is a distinct kick-up at the outlet end of the tube for about $3/4$ in. and it struck me that it was not sensible to have a vertical component in the driving force! So I made as near an identical boat as I could without this kick-up but it wouldn't pop a single pop!

I then used the same boiler but with a kick-up at the tube end and the boat roared along my bath! I thought about this for some while with no positive conclusion. I therefore challenge Jeff or others to offer a plausible explanation as to why the kick-up is apparently essential for a single large tube engine.

I entered *pop pop boat* on the Google internet search engine expecting to get nothing, but found 664,000 hits! For anyone interested, I recommend as a starting point www.nmia.com/~vrbass/pop-pop/. This website has pictures and some details of many colourful boats with

all sorts of engine configurations, and has many useful links.

In particular, I noted two boats. Near the start of the page is one with a kicked-up outlet just like mine. Then there are several boats whose engines do not include a boiler such as that described by Jeff, but rather just a couple of turns of small copper tube under the flame with the ends leading to the stem of the boat. I made several of these as a youngster and they work well but without a nice noise! I noted that pop-pop boat competitions are held in the USA; well, how about one at Sandown next year with entries for speed and duration with a fixed amount of fuel? **Roger Castle-Smith, Buckinghamshire.**

Display domes

SIRS, - In *M.E.* 4213, 23 January 2004, Ian Beilby comments on the unavailability of glass domes for clocks. It may interest readers to know that these are available in glass or acrylic in sizes up to 142mm dia. and 260mm high at prices up to €25 from a German clock parts supplier: Selva Technik, Christian-Messner-Str. 29, 78647 Trossingen, Germany; www.selva.de a company with which I have no connection other than as a satisfied customer.

Patrick Williams, Germany.

Real joy

SIRS, - I recently had occasion to replace several lathes and drilling machines in the college workshops. Warco Ltd. of Surrey were our chosen suppliers. The three GH1322 lathes are of good quality and well equipped. However it is the Warco service that totally wins the day. Any problem, however slight, is treated seriously and promptly.

The 3-year old lathes that were replaced had major problems from the outset. The supplier made many promises but kept none of them! I visited their stand at the Harrogate Show and made my complaints, only to be asked to leave the stand. After this treatment it is a joy to deal with a company that takes customer service seriously.

D. M. Dunstan, East Yorkshire.

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Bruce Davey and Judge Dennis Monk compare opinions concerning a detail of Peter Fagg's magnificent 5in. gauge SR King Arthur class locomotive.



A member of Brighton & Hove SMLE and a model engineer for some 45 years, Peter Fagg has named his locomotive Sir Bors de Ganis.

COMPETITION MODELS AT THE 73RD MODEL ENGINEER EXHIBITION

CLASSES B1-B9: RAILWAY SECTION Reported by Dennis Monk

The number of entries in Class B this year was disappointing, totalling six in all. However, this was offset by the very high standard of all the exhibits. In addition, all had comprehensive Judges' notes, for which the Judges were extremely grateful.

CLASS B1: WORKING STEAM LOCOMOTIVES 1in. to 1ft. SCALE AND OVER

There were four models in this category. Peter Fagg of Storrington entered a 5in. gauge model of a Southern Railway N15 King Arthur Class locomotive No. 763, *Sir Bors de Ganis*. This locomotive represented the first of the second batch of King Arthurs built in 1925 by the North British Locomotive Company for the Southern Railway, to a design developed by R. E. L. Maunsell from a LSWR Urie design. Peter set out to fit as much detail as possible on a locomotive built for hard use on club tracks.

Drawings were prepared from full size works drawings of the main frames, front bogie, valve gear, cylinders, tender and tender bogie frames. Most other information was obtained from the general arrangement drawing and photographs. The scale for the comprehensive backhead fittings was set from the 1/4in. dia. gauge glasses, these being considered to be the smallest size that will give a true reading.

The boiler was based on Martin Evans' *Springbok* design. It is fed by two injectors to D. E. Lawrence's design and the crosshead vacuum pump was designed as a boiler feed pump. A tender hand pump is also fitted. The safety valves are to Holmes' design. Patterns were made for the spring hangers, which were cast in high tensile brass. Leaf springs are fitted throughout.

Two displacement lubricators supplied with oil from a large tank under the footplate provide cylinder lubrication. The outside motion was well executed with strapped and cottored big ends and cotters or lock nuts fitted as required. The crosshead cotters looked strange fitted as they were inside top to outside bottom, but photographs confirm that this is correct. I suppose it is as

difficult to drive them in from the inside as it is to drive them out from the inside.

It was noted that the connecting and eccentric rods were not fluted on the inside. It is difficult to understand why someone capable of producing work to this standard cannot face the challenge of fluting the backs of the rods. The root of the fluting was also left square, whereas it should be radiused to avoid stress raisers. I understand these faults will be corrected in the future.

Draw hooks, couplings, vacuum and carriage warming pipes, lamp irons and other external fittings were faithfully reproduced and the model was extremely well finished in Southern Railway livery of the period.

The model gained a well-deserved Gold Medal together with the Bradbury-Winter Memorial Challenge Cup and the Charles Kennion Memorial Trophy.

There was one 7 1/4in. gauge locomotive in competition this year, entered by Peter Gardner of Farnborough. It was a model of a North Eastern Railway T1 Class 0-8-0 tender, mineral locomotive built by Wilson Wordell in 1902. Based on the first batch of engines of the class



Peter Fagg designed the backhead fittings for Sir Bors de Ganis to a common scale determined by the availability of suitable gauge glass tubing.



Finished in 1910 livery, Peter Gardner's NER T1 0-8-0 was the only 7 1/4in. gauge locomotive entered in competition this year, it won a Silver Medal.



Tony Meek, of Peterborough SME, entered his beautiful 5in. gauge Midland Single wheeler The Princess of Wales. The original locomotive was winner of the Grand Prix at the 1900 Paris Exhibition.



The fine backhead of Tony Meek's locomotive faithfully represents prototypical practice.

built at Gateshead, ultimately reaching a total of 90, it was numbered 1002 and appropriately named by the builder *Titan*.

Peter's intention was to produce a locomotive with a reasonable degree of fidelity to prototype, with the emphasis on making a good working miniature steam locomotive. If the engine performs as well as it looks, this objective has been achieved.

The professionally built boiler designed by the builder has two radiant superheaters and is fed by an axle pump, two injectors and a tender hand pump. Semi-pop safety valves are fitted in place of the Ramsbottom valves of the original. The connecting rods have strapped and cotted big ends, but neither these nor the coupling rods are fluted at the back. The engine has inside, Stephenson link valve gear and the piston rods carry tail rods, which should prove a distinct advantage. Cylinder lubrication is by a single ram pump.

Both engine and tender axles have needle roller bearings and the driving wheels were cast from home made patterns. The locomotive was very well finished in the North Eastern Railway livery of 1910. It was awarded a Silver Medal.

The third entry in this Class was a 5in. gauge model of S. W. Johnson's Midland Railway 4-2-2 locomotive No. 2601, *Princess of Wales* by Tony Meek of Peterborough. Built in 1899, the prototype of this model was the locomotive that won the

Grand Prix at the Paris Exposition of 1900 and was the second of only two Midland Railway locomotives to carry a name. The model depicts the locomotive as it appeared in Paris with its bogie tender. This was soon to be replaced by a six-wheeled tender as water troughs spread throughout the Midland system. The bogie tenders were then converted to six-wheel tenders for use behind a build of Somerset and Dorset Railway engines.

Based on Martin Evans' design, a considerable amount of detail had been added. This included lubricators to axleboxes, tender bogie slides and axlebox slides, together with slide bar oilers.

Other details included sand traps to the driving wheel sanding gear, the link and shackle fitted to the bogie tender screw couplings, simulated vacuum brake ejectors at the side of the smokebox and a neatly made tender tool box. A prototypical backhead is fitted, the steam supply being obtained from inside the dome as in full size practice, instead of from the turret of the Evans' design. The firehole door is typical Midland of the period with a top-air flap. A mechanical lubricator concealed behind the front buffer beam provides cylinder lubrication in place of the hydrostatic lubricator of the original locomotive. An addition not on the original locomotive is an externally operated rocking grate and ash door, to aid disposal after running.

The buffer bolts have their heads outside. Tony

believes that they would have been fitted this way round on this particular engine. However, there is photographic evidence showing that the nuts were in fact on the outside, no doubt because of the practical difficulty of fitting them inside, owing to the proximity of the beam angles. It would have needed two men and a crane to fit each buffer, with a box key and bar to tighten the inside nuts, compared with one man, a crane and an open ended spanner to tighten outside nuts.

Before its trip to Paris via Grimsby and Antwerp, the original locomotive was given Robert Weatherburn's Kentish Town Paintshop treatment. Apart from the embellished Midland livery, a considerable amount of burnishing was carried out on the metalwork, including sandbox lids, axlebox top rubbing plates, the tops of the frame plates and of course the handrails. The underside of the boiler lagging was painted white to reflect light on to the motion. Oil turned this yellow in time, earning the engines the nickname 'yellow bellies'. All are faithfully reproduced on the model.

While it was disappointing to find the well-applied livery did not have the famous Midland gleam, which would have enhanced the model further, it was nevertheless awarded a Gold Medal and the J. N. Maskeline Memorial Trophy.

Richard Castle of Oxhey entered a 5in. gauge 0-6-0 dock tank shunting engine, LMS No. 16379. The fourth and final entry in this Class, the model was based on Kennion Brothers' *Butch*



This 5in. gauge 0-6-0 dock shunter by Richard Castle is based on the Kennion Butch design worked up to represent a 1917 NB locomotive.



David Hudson's 5in. gauge BR Class 2 2-6-0 has been used as a vehicle for experimental purposes relating to draughting, superheating, etc.



This 1923 Metropolitan Railway 'Dreadnought' brake 3rd coach doubles as a 5in. gauge riding car, the ventilators having first been removed!

drawings. It was detailed to represent one of three locomotives ordered by Peter Drummond and built in 1917 by the North British Locomotive Company for the Glasgow and South Western Railway. One of these locomotives was scrapped in 1932, the other two being sold out of service in 1934. No. 16379 was withdrawn in 1962 from a North Wales colliery and is now preserved in Glasgow Transport Museum as the only remaining locomotive from the G&SW Railway in existence.

The model has balanced slide valves and vacuum brakes operated from an ejector. Needle roller bearings are fitted to the coupled axleboxes. Cylinder lubrication is by a twin cylinder lubricator supplying oil by separate lines to each cylinder. An oil separator is fitted to the blast nozzle, which minimises oil loss to the chimney. A sight glass in the cab indicates the water level in the side tanks. The buffer heads appeared to be over-thick and the coupling and connecting rods again were not fluted at the back.

The engine was nicely finished in LMS post-1927 black livery and was awarded a Silver Medal.

CLASS B3: LOCOMOTIVES OF ANY SCALE, EXPERIMENTAL, FREELANCE OR BASED ON ANY PUBLISHED DESIGN AND NOT NECESSARILY REPLICAS OF FULL SIZE PROTOTYPES, INTENDED FOR TRACK DUTIES

The only entry in this Class was that of David Hudson's 5in. gauge BR Standard Class 2, 2-6-0 tender engine No. 78030. This locomotive was built as a test bed to investigate ideas with a view to improving the operation of miniature locomotives. The investigations included combustion control by reduction in agitation of the fire coals, draughting improvement using Dr. Giesel's principles and improved cylinder breathing by lowering the piston back pressure, this latter being accomplished by the use of an expansion chamber fitted with an exhaust steam extractor.

Other experiments incorporated are re-entrant superheater tubes to improve superheater heat absorption and heat recovery in the smokebox by the use of extended steam pipe work to yield a 70% increase in superheater length. This was combined with a cylinder steam reservoir to maintain steam chest pressure, thus compensating for increased superheater pressure drop.

Increased smokebox accessibility is obtained by the easy removal and replacement of all manifolds and pipes. The use of Heumann wheel

in as used condition. It was awarded a Silver Medal and the Crebbin Memorial Cup.

CLASS B9: PASSENGER OR GOODS ROLLING STOCK ABOVE 11IN. SCALE

There was also a single entry in this Class. This was a scratch built 5in. gauge model of a Metropolitan Railway 'Dreadnought' brake third coach. No. 495, built in 1923 and entered by Guy Adrian Harding of Basingstoke.

This coach was primarily built as a riding car for a Metropolitan Railway electric locomotive. I mentioned in an earlier report how a Metropolitan Railway 'Growler' brought back memories of early mornings at St. Pancras underground station in the 1950s. This time it was the coach that triggered memories of waiting for a train to Whitechapel *en route* to Devons Road Motive Power Depot. A train of this stock would arrive, drawn by a 'Growler'; the doors would be flung open to allow a train load of commuters to disgorge in seconds. The station staff would slam the doors shut and the train would be taken away to be stabled for use later in the day.

The carriage bogies, which were fabricated, represent the original Fox bogies. Leaf springs provide primary suspension for light running and coil springs fitted to the swing links give a secondary suspension to carry the extra load when used as a driving car.

The bodywork was built up from birch plywood to provide strength with flexibility to produce the tumblehome and to give the desired varnished timber finish. Interior seating is neatly upholstered and interior lighting is provided, which is normally supplied by the locomotive batteries via flexible connections.

Simulated battery and voltage regulator boxes, a coach lighting generator and vacuum reservoirs are carried in the underframe. The removable roof is padded for the comfort of the passengers and covered in fabric coloured to represent weathered white lead roof paint. Roof ventilators are removable when the vehicle is used as a

profiles, together with increased axial and axlebox/horn clearance are incorporated, which are intended to obtain single point wheel to rail contacts and thus improve wheel-to-rail adhesion and reduce flange wear.

Yet again, all of the motion rods were only fluted on the outside. The model was finished in BR lined black livery,

driving car. The softness of the padding tends to spoil the line of the rain strips and ventilators. It might have been better to have a plain soft roof with a second of hard wood with rain strips and ventilators for show purposes.

In addition to the roof ventilators the coach is detailed both internally and externally. Third rail pick-ups are carried and safety side chain couplings of the period fitted each side of the screw couplings. The coach ends carry footsteps, hand rails, lamp irons with working lamps and vacuum pipes. The sides have scratch made door handles, handrails, door ventilators and destination board brackets.

With Metropolitan Railway lettering, the crest having been downloaded from the Internet, the coach is finished to represent varnished teak. It is possible that the grain on the coach ends would have run vertically instead of horizontally. It was well made, nicely finished and was awarded a Bronze Medal.

CLASS A7: GENERAL ENGINEERING EXHIBITS NOT COVERED BY CLASSES A1-A6 Reported by Mike Chrisp

Most entries in Class A have been discussed in our previous report, but David Hudson's lone entry in Class A7 was held over for inclusion with other railway subjects.

Regular readers will be aware that David's series on wheel profiles and suspension systems was published not long ago (*M.E.* 4189, 21 February 2003, *et seq.*). In a postscript, David discussed the design and construction of a passenger vehicle developed from the principles described and using self-steering wheelsets and swing-link suspension; it was one such vehicle that he entered for competition this year.

For 5in. gauge, compared with the original design the vehicle features a new, much simplified pivotless bogie arrangement with swing-link rubber suspension and self-steering wheelsets involving wheels machined with the Heumann profile. While not checked at the exhibition, those who have ridden on these carriages all praise them for affording an exceptionally comfortable ride.

The passenger cars are fabricated, all parts being cut from stock materials. The bulkheads and



David Hudson's pivotless bogies with wheels to the Heumann profile and swing-link rubber suspension provide an exceptionally comfortable ride.



Ian Redshaw's Airco (de Havilland) DH2 has a 9ft. 6in. wingspan and is powered with a 62cc petrol engine driving a 30in. propeller.



This 1:4 scale model of a Fokker EV Flying Razor is also by Ian Redshaw and features a wingspan of 6ft. 10in. and hand painted lozenge camouflage.

bearing housings were commercially laser cut to eliminate much unnecessary hand work with a hacksaw and files. The eye catching, bright red finish is a durable resin powder coating, applied by a local company specialising in such finishes.

The Judges were much impressed by the innovative nature of the development work involved in this project and this together with the very high standard of the final result brought David Hudson a Gold Medal for his efforts. It is hoped that a series describing the design and construction will soon be ready for publication in these pages.



Colin Hammond's 1:6 scale WW2 B25 Mitchell bomber represents the prototype as Big Bad Bonnie and is powered by two 38cc petrol engines.

CLASS D1: SCALE RADIO CONTROL FLYING MODELS

Reported by Ron Moulton

Few in number, though high in quality and large in size, just four model aircraft were entered. Quite why this should be when the general standard of precise scale radio controlled models is exceptional at this time raises the question of whether adequate promotion was given to the class in its specialist press. Of the four entries, three were well known in the flying scale display circuit and one as yet untried. Proven flight performance is not a requisite for entry in the Model Engineer Exhibition, which makes it all the more surprising that more of the highly detailed and exquisitely finished 'wallflowers' that do exist could not be exposed as in earlier years. Admittedly there was little room for more than the big four, but an embarrassment of riches would have been welcome.

Dominated by Ian Redshaw's huge Airco (de Havilland) 2 with its internally mounted 62cc petrol engine driving a massive 30in. propeller at

the end of a long shaft extension, the models made up for their low numbers with a firm impression that 'big is best'. The DH2 was still awaiting flight tests, possibly now concluded successfully. Though it weighs 41lb., the large biplane has generous wing area in its 9ft. 6in. wingspan, all wire rigged as on the original. It was awarded a Bronze Medal.

Also from Ian Redshaw, a well proven and hand-painted Fokker DVIII parasol winged German fighter of WWI was appropriately lighter at 14lb. The complicated pattern of the 'lozenge' camouflage had been applied, colour by colour with latex masks, in itself a worthy achievement giving a striking impression for which this earned Ian another Bronze Medal.

In striking contrast, Colin Hammond's North American B-25 Mitchell bomber of WWII bore the markings on one used in a postwar film. Powered by a pair of 38cc petrol engines, this model is familiar to many from visits to the model air shows and has never failed to impress. Sleek lines, well finished in realistic camouflage, it

showing few, if any, scars from its long career in the field.

CLASS D3: SCALE NON-FLYING MODELS INCLUDING KIT AND SCRATCH BUILT

Reported by Mike Chrisp

Stephen Atkinson provided the sole entry in this class in the form of a beautifully crafted 1:24 scale Mk. V Spitfire. Carved from walnut grown locally to Stephen in Northern Ireland, it was felt that the colour and grain of the timber are sympathetic to the camouflage used on the original aircraft.

The propeller could be made to rotate at the press of a button on the green baize covered baseboard thus supplying current to a small electric motor housed in the fuselage nose. Roundels and other markings were computer generated and printed onto thin self-adhesive paper.

Regrettably, the model arrived damaged in transit but was displayed and was Commended.

●To be continued.



Unbelievably, Dave Horton's Nieuport 21/22b is 20 years old with over 3000 flights logged. Its 9ft. wingspan is powered by a 35cc OS BGX engine.



With a 16in wingspan and carved from locally grown walnut, Stephen Atkinson's Mk V Spitfire was modelled in 1:24 scale.

John Wilding FBHI

describes the construction of an interesting 'new' clock.

●Part I

In the horological context, the term 'gearless' implies a clock without any 'meshing' gears, in other words gears with teeth which would normally mesh with other gears or pinions. Pin wheels or those with ratchet teeth are allowed.

The challenge of making such a clock has attracted several eminent clockmakers over the years. Perhaps the best known is the 'Le Roy one-wheel' clock which is housed in the student's room at the British Museum and can be seen by appointment. This clock is well described in Royer Collard's book *Skeleton Clocks* and in Paul Chamberlain's *It's About Time* and again more recently by Dr. Philip Woodward in his book *My Own Right Time*. However, the Le Roy clock is not truly gearless as conventional gearing is employed in the motion work. Dr. Woodward abides by the definition literally and uses a ratchet drive in the motion work. In this construction of the Woodward gearless clock I have used the Aaron Dodd Crane 'daisy wheel' motion work which Dr. Woodward mentions in his book saying that he would have used it himself had he known about it at the time.

The reader may well ask: apart from the challenge in making a gearless clock, is there any advantage to be gained by so doing? There is a practical advantage, particularly for the amateur constructor. Conventional gear wheels require to be cut with an accurate form cutter, an expensive item today. The wheel needs to be accurately divided if the gears are to mesh sweetly, and this requires the use of a division plate or dividing head. After the gears have been made, it is necessary to fit them into a depthing tool in order to obtain the best meshing distance for planting in the clock plates. It can be seen that some expensive and specialised tools are necessary for this work.

The teeth of ratchet wheels, however seldom require to be accurately formed as their use is normally in winding mechanisms. They don't have to mesh with other wheels and accurate dividing is usually not necessary. Even in a precision clock such as the Synchronome master clock, the 15 tooth count wheel can perfectly well be formed using a piercing saw and files. The object of this wheel is simply to count 15 double swings of the pendulum, in other words one rotation of the wheel; what happens in the other 14 gatherings is of little importance. Although it is true that a pin wheel needs to be accurately divided, the machining necessary is a simple drilling operation and, of course, no subsequent depthing is required. In the Woodward clock, a ratchet wheel and a pin wheel are employed; if the daisy wheel motion work is used then a second pin wheel together with the actual daisy wheel will also be required.

Dr. Woodward's original clock was described initially in the *Horological Journal* in three issues, November, December 1991 and January 1992. The clock is also described in his book *My Own Right Time*. The reader who plans to make this clock is advised to obtain one or other of these sources as, although I will be giving



WOODWARD'S GEARLESS MECHANICAL CLOCK

full instructions on the making of the clock, Dr. Woodward describes the development of the design which makes very interesting reading. There are five different clock designs in Dr. Woodward's book culminating in a 'free pendulum' clock. The designs are all most stimulating and I am grateful to Dr. Woodward for allowing me to write up the construction of this gearless clock.

The clock is shown in photos 1 and 2 from which it can be seen that it is weight driven. The duration of running can be either 30 hours or 8 days. There is no difference in the construction for either running period. The only requirement for an 8-day run is that the clock is mounted high enough on the wall to allow a 5ft. weight fall. The clock has no key for winding, or ratchet mechanism as most mechanical clocks do. It is driven on the 'bollard' principle where a line or rope is given a few turns round a drum and sufficient grip is obtained by this method to enable a ship for example to be controlled by a single man on the quayside. If he needs more friction at the bollard he simply adds another turn of the rope, and to allow the line to pay out he relaxes his hold on the free end so reducing the friction round the drum.

In this clock I have employed $7/8$ of a turn of line round the drive pulley and this, in conjunction with a jockey weight not shown here, gives a secure grip. To wind the clock you simply grasp the weight with your hand and raise it 8in. for a day's run or 56in. after a week's running. I needed to carry out trials with different lines because

some were more slippery than others. In order to relieve the constructor from this procedure I shall be specifying the line I used together with the weights, and this line will be available from RiteTime Publishing, together with the dial and the five ball races required in the design. The small amount of brass and steel can be obtained from College Engineering. The whole of the machining can be accomplished in one of the small lathes available today and I used the Unimat 4 which is ideal for drilling the pin wheel. I actually demonstrated cutting the count wheel up at the Model Engineer Exhibition at Sandown Park in 2002.

The movement is mounted on a $1/8$ in. thick brass backplate which in turn is fixed to a $3/4$ in. wooden backboard. A Perspex cover which is open at the bottom is fitted over the movement.

Operation

This can be understood from fig 1. On the left of the movement is the pendulum which supports two brackets. The upper one carries a wire gathering pawl and the lower one a wire impulse hook. This latter is tail heavy so that as the pendulum swings, the hook is clear of the escape wheel pins. The escape wheel is mounted on the centre arbor which is driven by the clock weight on a pulley some $5/32$ in. diameter. The escape wheel is prevented from rotating by the 'gated detent' 'D'. This ingenious component required a name and this term was suggested by Martin Burgess.

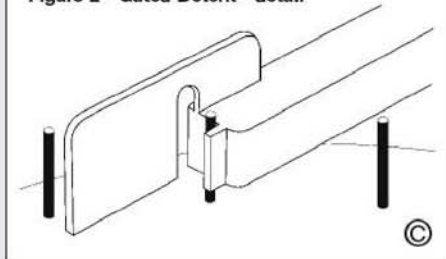


General view of the movement.



Movement with the dial and motion work removed.

Figure 2 - Gated Detent - detail



In action, the pendulum gathers a tooth of the count wheel at each swing. There are 48 teeth in the wheel and the pendulum is of such a length that the wheel turns in one minute. A seconds indication could be fitted here. It will be noticed that one tooth is made deeper. When the gathering wire drops in this, it engages the top of the vertical wire L on the deflector piece. This is then tilted anti-clockwise causing the second wire L1 to bear down on the impulse pawl M which then engages a tooth in the escape wheel and pulls it backwards slightly. This movement

releases a pin from the gated detent which, being tail heavy lifts out of engagement and allows the pin wheel to impulse the pendulum via the impulse hook. The impulse is terminated by the next pin in line on the escape wheel running along the upper shelf of the gated detent falling through the slot and locking on the lower shelf. The impulse hook then pops up out of engagement with its pin. The gated detent is shown in more detail in fig 2. It carries two shelves, an upper one which is some 1/2in. long and is provided with a slot. The lower shelf is short, just long enough to accommodate a pin of the wheel.

We see, therefore, that the pendulum swings freely for a whole minute without impulse until the deep tooth comes into play. It is essential that all moving parts involved with the count wheel are light. Woodward made his count wheel from Perspex and filed the 48 teeth. However, he has advised me not to use this material as there have been lubrication problems. He also jewelled the count wheel bearings. In recent correspondence with Dr. Woodward he has informed me that Anthony Randall who has custody of one of Dr. Woodward's clocks has found that a soft

lead pencil is an excellent lubricant on Perspex. My wheel is cut from 18 gauge brass generously crossed out, and the pivots some 0.040in. diameter are highly burnished and run in plain holes. During the 48 swings of the pendulum each minute the deterioration of the arc is barely discernible.

The clock is most ingenious. It is always fascinating to see what happens when a fresh mind ventures into this field with a completely new approach to the subject.

The clock is not difficult to make but the clockmaker with a traditional background will have to think differently. The wire pawls are not what we usually see in quality clockwork, but they are very light and function perfectly.

Maintaining work is necessary, otherwise when the weight is raised the pressure of the pin on the gated detent will be removed and the escape wheel will advance one pin thereby gaining a minute. Woodward designed an automatic maintaining system. I was so anxious to get the clock up and running that I fitted a manual device which can be seen on the right in photo 2, but an automatic arrangement would be better.

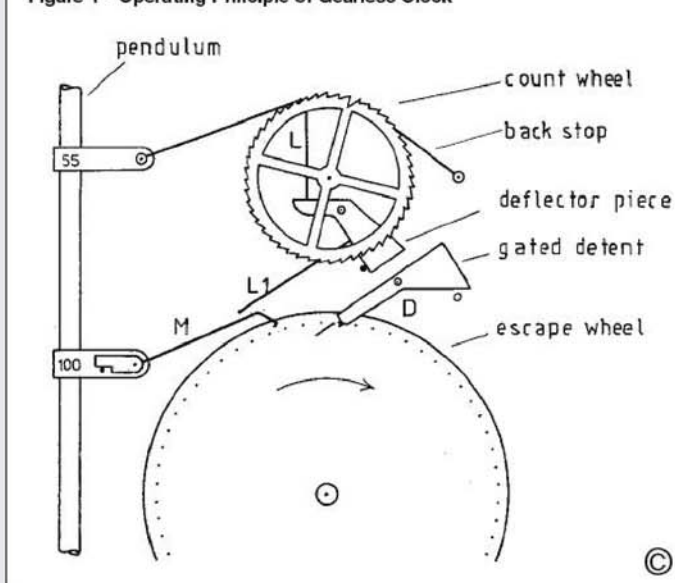
I have provided a material list, all of which can be obtained from College Engineering (ref 1) at a modest cost. The special parts such as the dial, ball races Paxolin rod and the nylon monofilament line can be obtained from RiteTime Publishing (ref 2).

Supplies

- 1: College Engineering Supply, 2 Sandy Lane, Codsall, Wolverhampton WV8 1EJ; tel: 0845-1662184; mobile: 07860-493689; fax: 01902-842284; email: sales@collegeengineering.co.uk website: www.colegeengineering.co.uk
- 2: RiteTime Publishing Ltd., 18 Woolmer Way, Bordon, Hampshire GU35 9QF; tel: 01420-487747; fax: 01420-474647; email: sales@ritetimepublishing.com website: www.ritetimepublishing.com

●To be continued.

Figure 1 - Operating Principle of Gearless Clock



Materials

Mild Steel (round)

- 2in. dia. x 12in.
- 7/8in. dia. x 6in.
- 5/8in. dia. x 6in.
- 5/16in. dia. x 12in.
- 1/4in. dia. x 12in.
- 3/16in. dia. x 24in.

Silver Steel (round)

- 1/8in. x 12in.
- 3/32in. x 12in.
- 1/16in. x 12in.
- 1/32in. x 12in. (2 off)

Steel Studding

- 2BA x 12in.
- 5BA x 12in.

Spring Steel

- 1/2 x 0.006 x 6in.

Brass Sheet (CZ 120)

- 3 x 3 x 3/16in.
- 12 x 6 x 1/8in.
- 6 x 6 x 1/16in.
- 3 x 3in. x 18 gauge

Brass Square

- 1/2 x 1/2 x 12in.
- 1/4 x 1/4 x 12in.
- 1/8 x 1/8 x 12in.

Brass Round

- 3/4in. dia. x 6in.
- 5/16in. dia. x 12in.
- 1/4in. dia. x 12in.

Miscellaneous

- 0.4mm monofilament nylon fishing line
- Paxolin 1/2in. dia. x 6in.
- 5 ball races
- 3/8 O/D x 1/8 I/D x 7/64in.



Preliminary operations on the new set of cylinder head blanks involved the use of simple turning operations and some attention with the bandsaw.



Initial profiling operations on the cylinder heads in the milling machine required the use of the rotary table again.

BRISTOL HYDRA THE NEXT TWELVE MONTHS

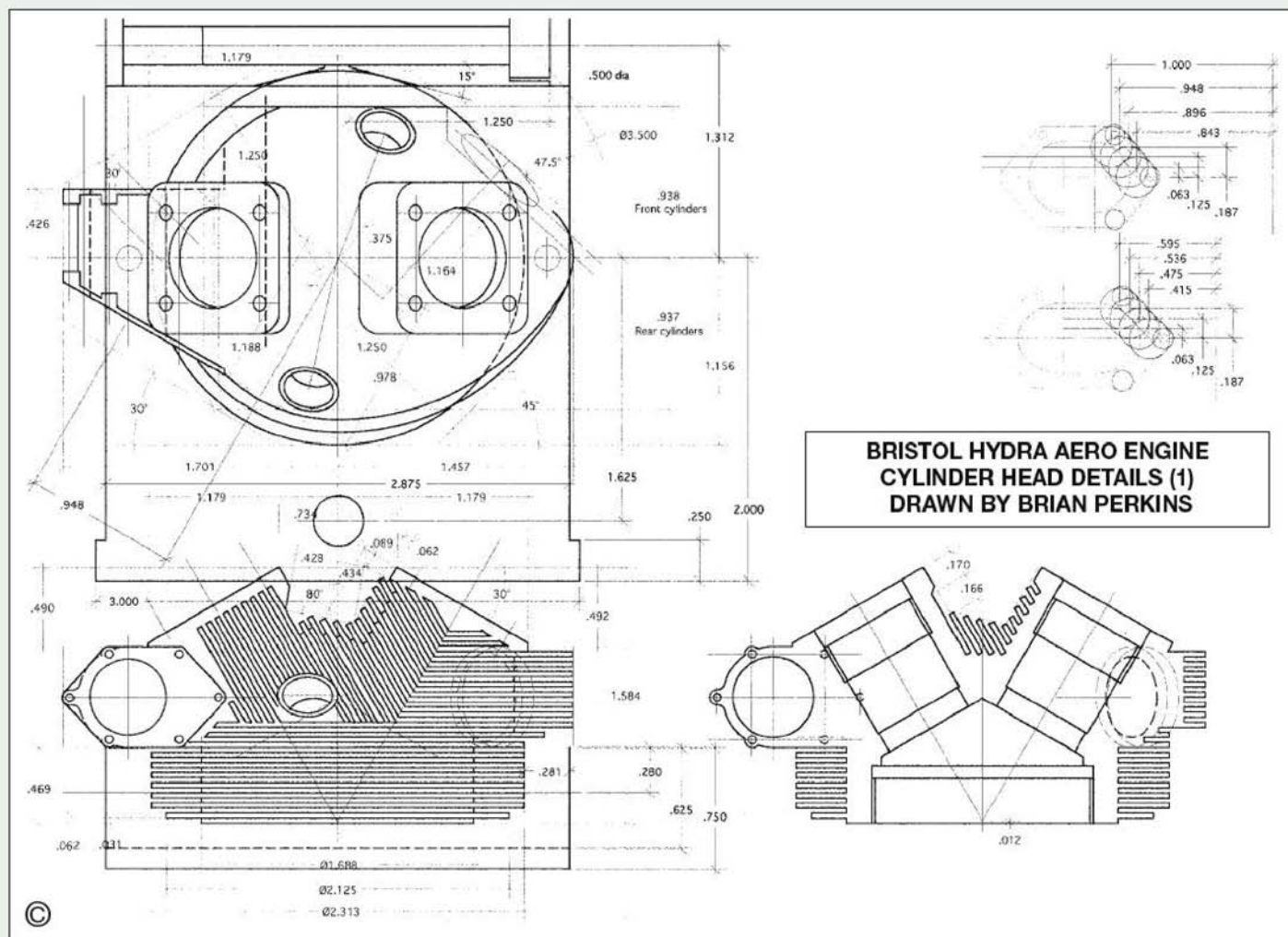
Brian Perkins

brings us up-to-date with his triumphs and disasters.

●Part VIII continued from page 205
(M.E. 4215, 20 February 2004)

The new cylinder head blanks arrived and the drawing was modified to accommodate the downward sloping exhaust port mentioned previously. I decided to make a spare of each hand. Eight each right and left hand are required which later become modified by milling a flat to make four each left and right hand front and four each left and right hand rear cylinder heads.

I soon realised that a certain amount of concentration was necessary to ensure that I ended up with the correct items, and being able to check each setup on the spare heads as work progressed was a great advantage. As with the heads for the *Aquila*, I set up for one operation at a time and then worked through all 18 blanks for each operation. I kept a record of the various operations, which eventually totalled 47. Some





With the milling machine head set over to the required angle, the 30deg. facets for the valve inserts could be machined.



The valve seats were bored using an offset boring head. The rotary table enabled the work to be rotated to present the other valve seat.

were obviously fairly straightforward but others were rather more time consuming.

Not surprisingly, cutting the fins was the longest operation, absorbing 30.5 hours of the total of 252, but there were quite a few other steps before I got to that point.

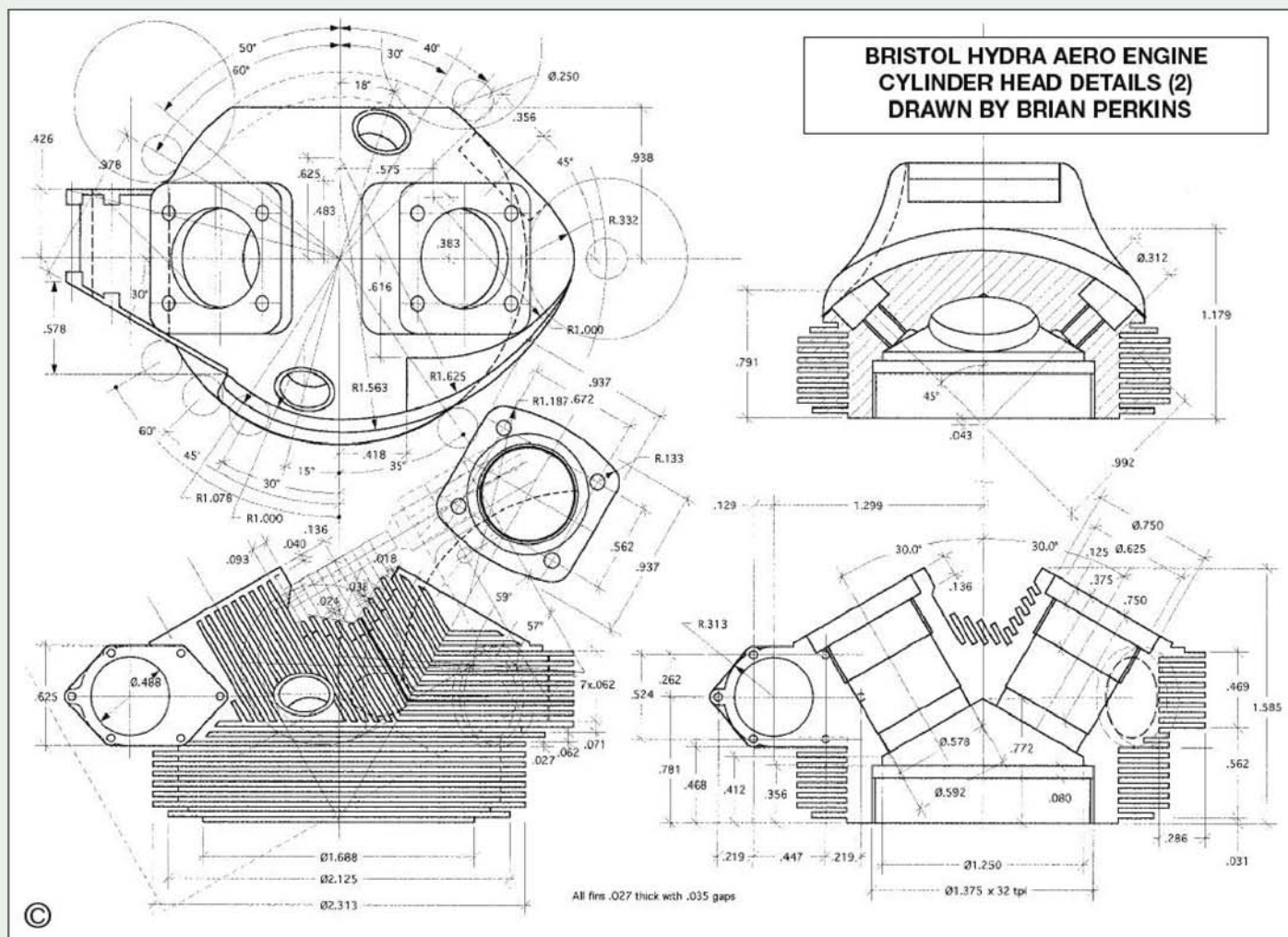
I began by doing as much straightforward turning as possible: facing the blanks to length, boring and screwcutting for the cylinder fixing thread and then machining the internal profile of the conical combustion chamber. The blanks were then marked out using the preliminary machining drawing and rough profiled on the bandsaw. A central slot was then milled through the head and the two 30deg. cam box seatings machined which were then bored and tapped for the valve seatings.

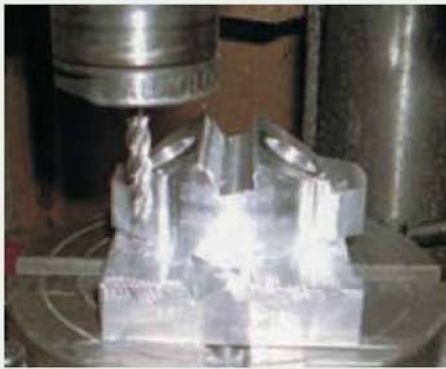
Some profile milling on the rotary table to produce the basic shape and I was ready to think about the fins. By mounting the blanks in a tilting vice attached to the rotary table I was able to produce a series of steps using the faithful 1in. dia. x 1/16in. thick slitting saw type cutter which had served me so well throughout the job, but it was now time to actually cut the fins. A similar slitting saw was required, but only 0.035in. thick, and my diary reminds me that I had considerable trouble in producing this cutter. As far as I can see I made ten cutters. At the first try they were too thin, the second one broke, the third one distorted in heat treatment and the fourth and fifth ones sheared off due to the centre being too thin. However, then I tried to be a little more

scientific with a minimum of (controlled) side clearance, hardening between clamp plates to keep them flat and tempering them at the highest setting in our bottom electric oven, making sure I was alone in the house at the time!

Each fin had to be machined separately as the starting and finishing points vary and this could only be done by eye. I suppose it would be possible to calculate them, but I took the easy way out. The blending in to the fins on the front and rear faces of the exhaust turret involved a certain amount of juggling with the hand wheels, but once I got into a rhythm it was quite satisfying.

There are two fins on the full size engine which appeared impossible to machine because they are beneath an overhanging flange. However,





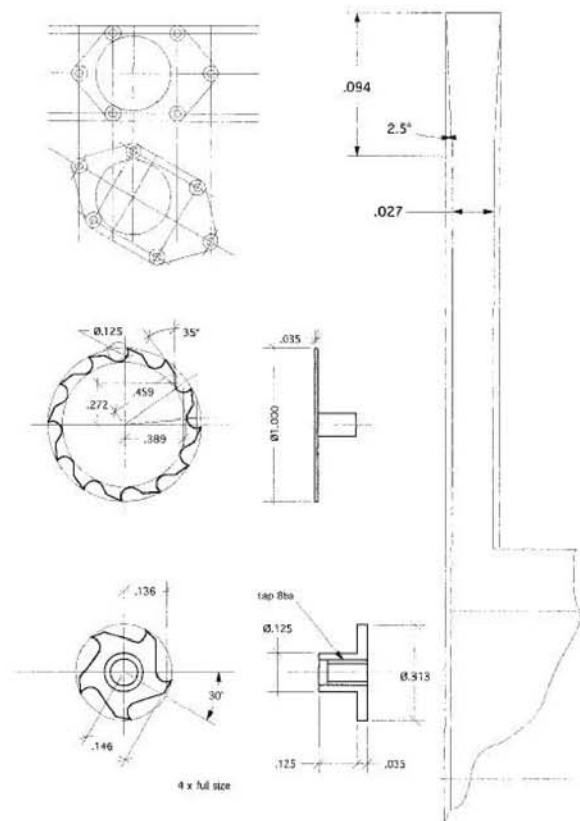
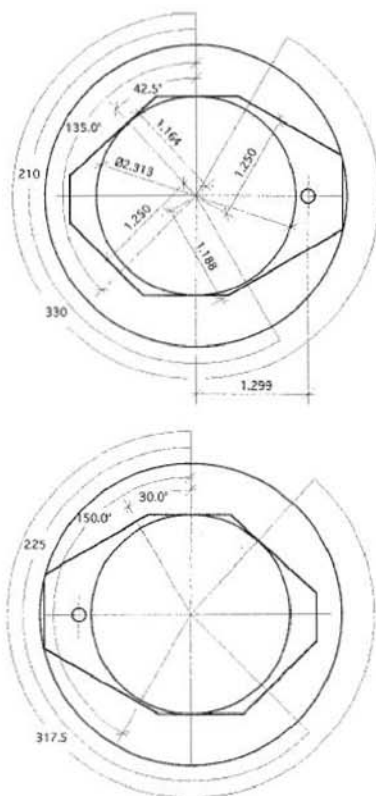
a close study of the photographs I had taken revealed some machining marks which appeared to be formed by a small diameter saw which seemed to make it possible. So, I made up a $5/16$ in. dia. saw with a very slender shank and was able to partially cut the grooves which I then

finished off with a junior hacksaw blade. I am sure that a number of fins on the full size engine were also finished by hand.

Drilling and tapping for the inlet and exhaust ports and the twin plug holes left only the cutting of the fins around the base of the head which

were done with a conventional slitting saw with the head mounted on the rotary table. The work took 252 hours between 7 January to 12 May 2003 and you can imagine my heartfelt sigh of relief when it was complete!

●*To be continued.*





The Welland gear quadrant fitted to the author's Myford ML7 lathe.



Large head thumb screws are made using 2BA countersunk screws.



The lead screw thumb screw is furnished with a recess for improved location.

David Dew

describes how to make a useful accessory designed to facilitate screwcutting and auto-feed settings

●Part II continued from page 213
(M.E. 4215, 20 February 2004)

The gear studs were made as a 2-piece job, which saves silver-steel and expensive swarf! One is three gears long. There are five large-headed short screws to make for the studs (photo 7) and the screwed cap that fits onto the lead screw end (photo 8). There is also the separable nut and tommy bar (photo 9).

Minor modifications to the lathe

We need to add one 1/4in. BSF hole in the end of the lead screw (using a hand-held drill and a jig), and a clearance keyway in the original quadrant.

The gadget is further enhanced by arranging for the new quadrant to swing using just one *in situ* removable tommy bar. This allows the input gear to be changed without using any loose tools. It has been found from experience that whatever loads I have imposed on it, only the top thread is necessary to hold either quadrant firmly in place. This top nut is now a hand nut and a lever (in two parts), which are quickly reassembled each time a quadrant is changed.

Constructional details

Starting with the 'tiddly' bits, and trying to do all the knurling together — take no notice of the part numbers which are simply in the order that they came on the drawing.

Part 4: turn, face, centre-drill, drill and tap, knurl and part-off.

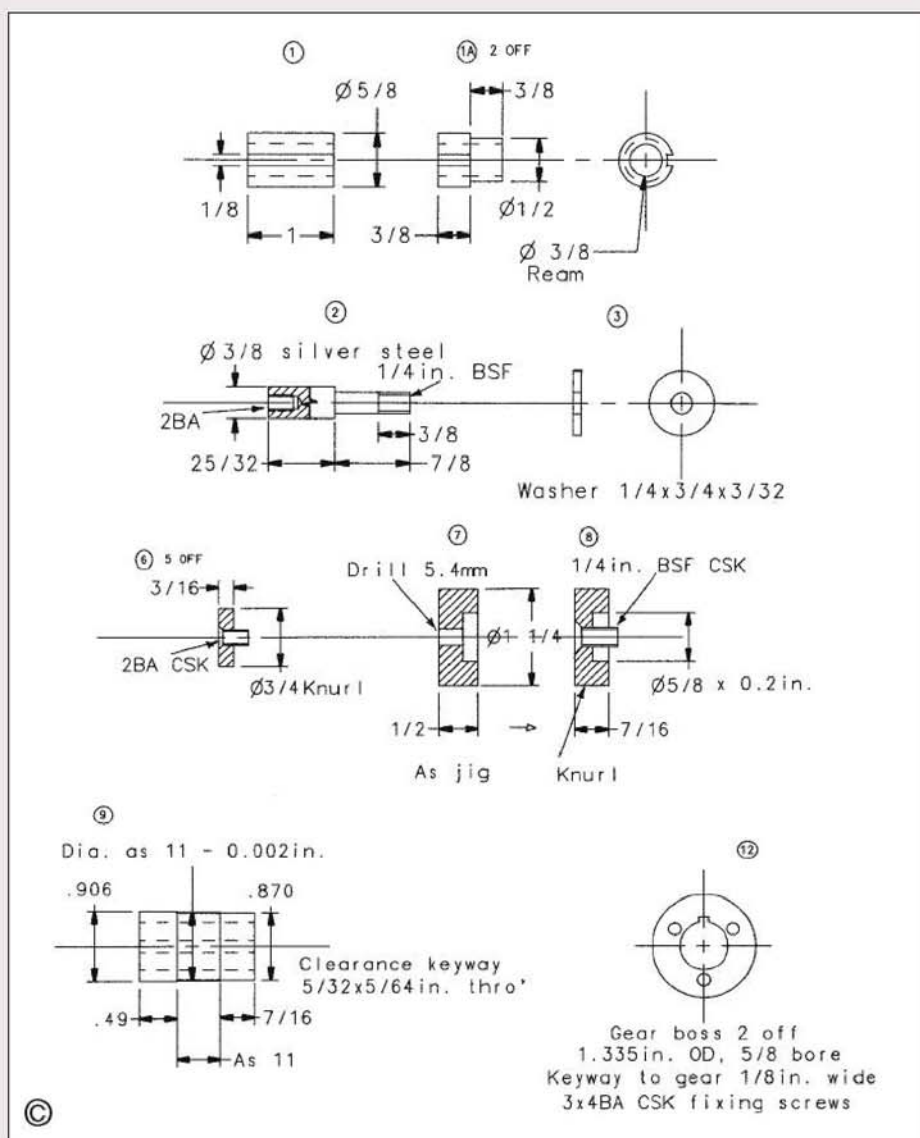
Part 7 begins its existence as the jig which guides the tapping drill into the end of the lead screw. Turn, face and knurl, then bore to suit the lead screw and drill 5.4mm. Place the jig over the end of the lead screw, ask your better half to hold it to stop it rotating, and drill with a pistol drill (the lead screw — not your wife!) and tap 1/4in. BSF x 1/2in. deep.

Now convert Part 7 into the retaining cap (Part 8) which provides an extra length to the lead screw. You may have to adjust the lengths to suit your lathe, facing to reduce the thickness. My lead screw protrudes only 0.180in. beyond the gears, which is insufficient for a collar. Trim the screw to enter easily and for just two turns,

then secure it in the cap using Loctite.

Make 5 (plus) off finger screws (Part 6), three for the new quadrant, two for the old one, and at least one spare. Chuck a length of 3/4in. bright mild steel with about 2 1/2in. protruding, face and centre drill. Apply the tailstock centre and skim

over the top, relieve 0.010in. deep near the chuck to allow the knurling tool to run partially into fresh air. Knurl to a fine diamond pattern, drill 2in. deep x 4.0mm for 2BA tapping, cut a 90deg. countersink to just suit the screw and tap 2BA for one component. Partially part one off, chamfer





The quadrant locking nut with its detachable handle.



A keyway is cut into an Oilite bush by racking the lathe saddle to and fro.



Blued steel $\frac{3}{8}$ in. bosses are attached to the 25 and 64 tooth gears.

both sides with file and complete the parting off at about 400rpm with a rear parting tool post. Repeat the sequence of countersinking, tapping and parting off for the batch. Trim the 2BA countersunk screws as described for Part 8 and secure to the head using Loctite.

I can still buy imperial size Oilite bushes from my local bearing stockist. Part 1 is $\frac{5}{8} \times \frac{3}{8} \times 1$ in. long. If you cannot find anything suitable, make them from a solid phosphor bronze bar (PB1) suitable for hard shafts which may also be obtainable from your local bearing distributor.

Turn a mandrel to a nice sliding fit in the bushes. Without disturbing the mandrel in the chuck, secure the bushes onto it. Using the mandrel for all turning and keyway cutting operations, modify the Oilite bushes to the drawings. Permanently secure the 20T iron or Tufnol pinions to the $\frac{1}{2}$ in. bushes using Loctite.

Make the 2 gear bosses (part 12), cutting the keyway as you go. Drill, tap and countersink for 3 off, 4BA screws. Transfer the holes to the 25T and the 64T gear wheels (photos 10 and 11).

If you are never going to use the new gears for anything else (worm threads, diametral pitches, etc.) you may prefer to omit the keyways and reach for the Loctite once again (*must* be 603 for Oilite) and glue the gear wheels to the bush as a permanent cluster gear to save the time and effort of cutting the external keyways.

Hardening and tempering

Make a 0.125in tool for the keyway with relief (clearance), etc. A carbon steel tool will suffice, and can be filed easily to dead size and provided with relief. Heat slowly to boiled-carrot red, quench in brine, then immediately temper lightly for around 10 minutes in a deep fat fryer set to 190deg. C. Stone the cutting edges lightly, clamp the tool sideways in the tool post at centre height and 'rack' the saddle to and fro applying a few thousandths of an inch feed each time and using the tailstock centre for support.

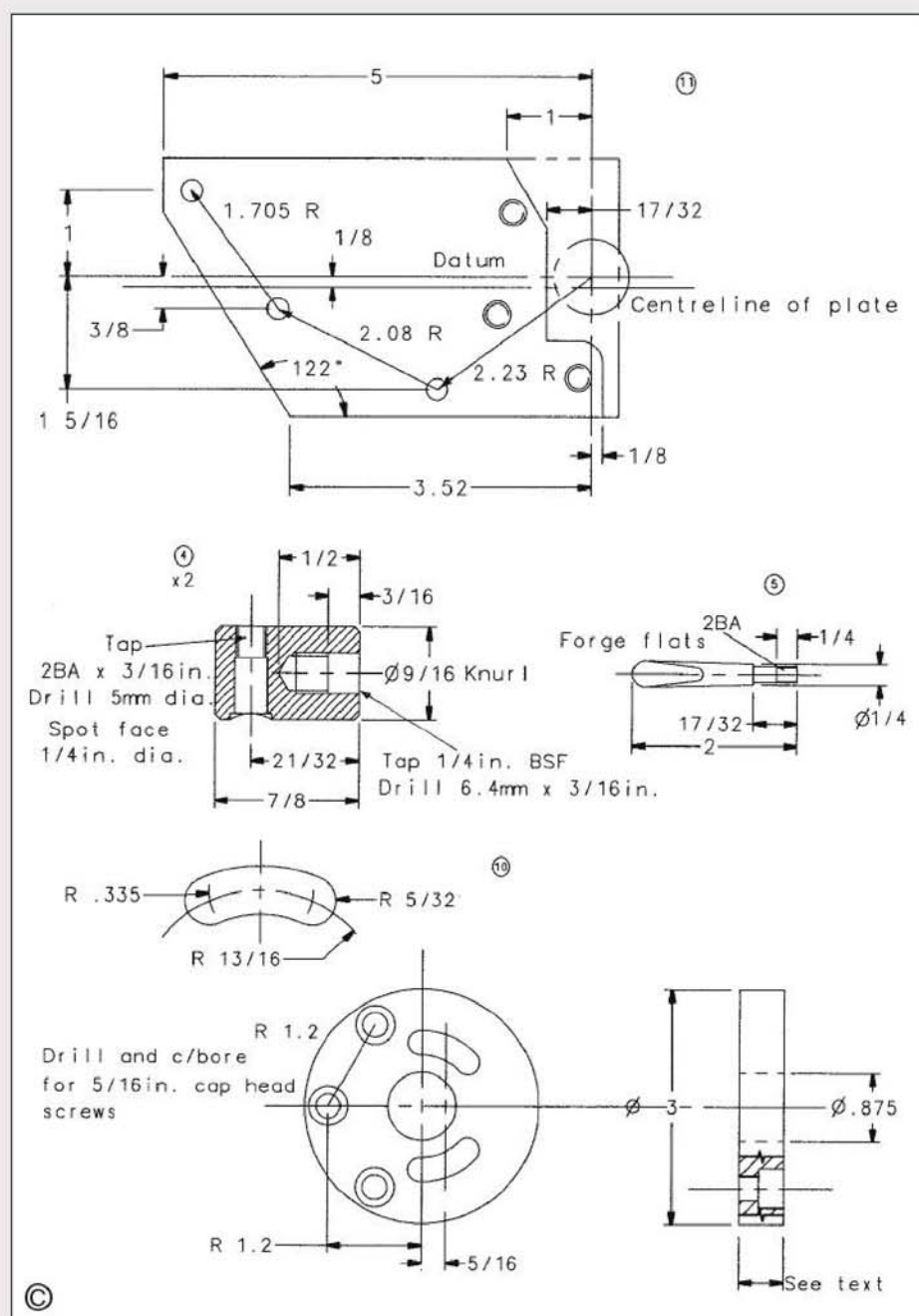
Turn and thread Part 2, then reverse and face, drill and tap the silver-steel studs. Use an old worn fine file to obtain a free running fit in the Oilite bushes.

Make the washers (Part 3). Fit some old screws in the stud holes to prevent trapping steam and suspend on a soft wire. Heat each slowly to carrot red and plunge vertically into a brine solution, and oscillate. Polish and temper for say 10 minutes in the deep-fat fryer at maximum setting. Remove one at a time and play a gentle flame over each stud, rolling it over on a firebrick, until it is a deep blue (pre-heating to a

fairly high temperature throughout should allow for more even thorough subsequent tempering). It should now be both hard and strong, ideal for running the Oilite or phosphor bronze on.

Laying out the quadrant

I had great difficulty dimensioning my quadrant on a drawing for this article. Then I remembered that I had laid it out partially by eye, the gears





12
The 64/25 cluster on the 1in. long bush; the 25T gear detaches for exchange with the 64T gear.



14
The change wheels are conveniently identified and stored on the left-hand hinged cabinet door.

having been laid out on the steel plate, meshed together and clamped, then used as drill bushes to 'spot' the holes. With adjustment on the spindle holes, I had not needed any drawings. Such a method is not a good one to try to describe here! The following method may not be perfect, but I trust the adjustment will cover my errors!

Having found, scrounged or purchased the two pieces of steel to suit the drawing, clean up the flat surfaces. A plate thickness of 6mm ($\frac{1}{4}$ in.) should be plenty strong enough; compensate for any variation by altering the disc thickness. Face up both sides of Part 10 to size. Coat the face with marking blue or rub with copper sulphate solution and prick the centre with a sharp centre drill. Use the lathe to scribe the 1.2in. and $\frac{13}{16}$ in. radii. Scribe centre-lines at 90deg. and, using a square and rule, scribe the $\frac{5}{16}$ in. offset line. Drill and ream a central $\frac{1}{4}$ in. tooling hole then remove from the chuck.

Use dividers to scribe the other two fixing hole centres and to mark the centres of the ends of the slots at 0.344in. radius. Drill the slot end holes 8.0mm and pilot the three fixing holes 6.0mm.

Nowadays I could use a rotary table on a



13
The Welland quadrant with its studs and bush shown with the standard Myford gear quadrant.

milling machine when cutting the slots, but when I made my *Welland* I relieved the back of the slots with a circular groove, leaving 0.150in., and then filed it out. It is probably just as quick to drill it out and finish full thickness with a suitable file.

With the plate (Part 11) long enough to include a $\frac{1}{4}$ in. datum hole, mark it out. I am told that Myford change gears have no backlash allowance, they are nominal size. Although you cannot set your dividers that accurately, the dimensions for gear centres do include 0.005in. for backlash. Drill and ream the $\frac{1}{4}$ in. datum hole and the three gear spindle centres 8mm.

Pivot the plates on a piece of $\frac{1}{4}$ in. silver-steel swivelling it until the plate edge is approximately 22deg. to the datum line of Part 10. Using toolmaker's clamps, drill 6mm through the pilot holes in Part 10. Open up, tap and counterbore to suit the screws you are using ($\frac{5}{16}$ in. BSF, UNF, Whitworth, M8 — you have a very wide choice). The photos show the heads on the other side.

Return Part 10 to the lathe and open out the bore to 0.875 inch.

Turn the centre boss (Part 9) to replicate the one on your lathe — I am not sure that they are all the same. Using the methods described above, make an oversize internal keyway tool. Rack a keyway in the bore so that it can easily clear the Woodruff key in the leadscrew. Now do the same in the original quadrant.

Fit the boss (Part 9) with the clearance keyway in rough position using (of course) Loctite. I always set the leadscrew key to TDC when changing quadrants. Now is the big moment; you can check the new quadrant on your lathe to see if it really does fit!

Hopefully you can make an assembly of the studs using the centres given, opening up the holes if required. Although a fair degree of backlash will do no harm in a feed train, if possible mesh the gears with a cigarette paper between the teeth.

The nut Part 4 can be screwed on and the round bar marked about 30deg. below horizontal before removal for drilling and tapping. Now enter the handle hard (by hand), mark its top and flatten here with a hammer. Clean it up so it is nice to use.

Loctite the Woodruff key into the leadscrew. It can be removed subsequently by means of a judicious tap with a hammer.

Final assembly

Any suitable steel parts can be 'blackened' in solution if you have it, or whatever else you normally do. The quadrant needs a coat of primer and paint, missing the studs and washers, and the faces of the disc. Until some years ago, I always used Tractol paint (photo 11) but this is now obsolete; can anyone enlighten us as to what is the currently 'in' equipment paint?

Only the top slot and stud is used for gripping the disc. This has been found entirely satisfactory.

If you have never done so before, just remove any burrs and tight spots in all the gear keyways and bores to make sure everything slips together really easily. Do have some organised method of storing your change gears, out of the swarf, but close to where you use them (photo 14). Label the hooks on which each gear hangs and prepare a table on the lathe showing the feeds set from each input wheel you use. Preferably keep this small selection of wheels really handy (see above). Put a drop of oil on all the spindles.

This gadget is used continuously on my ML7, which is my more precise 'technical' lathe. I hate to think how I would get on without this addition now. I hope you will make it and find it just as useful as I have. I am sure some will find better ways to make it and to use it; your comments are welcome! Reach me on DALMANC@aol.com

Retaining compounds

This entire article seems to be nothing but 'Loctite everything together.' Readers will know that several other brands of 'high strength anaerobic engineering retaining compounds' may also be used, and may even be cheaper. Advising the use of Loctite is like saying 'Hoover' even if a 'Dyson' is better! I have used Loctite since the early 1960s.

To make this job using all press fits would make it unnecessarily difficult. The strongest retaining compounds give a calculated strength of about 50% of that of a good, thin 60/40 soldered joint on steel. I use solder to fabricate steel sections for jigs and the like. All this helps to assess whether a Loctite joint might fail. But then, does it matter for the application in hand? As an example, the index gear on my ML7 headstock mandrel will shear off if it happens to be engaged and the lathe started in low speed! So you just re-glue it and stop for coffee for about half an hour.



A SOUTHERN RAILWAY MERCHANT NAVY CLASS LOCOMOTIVE IN GAUGE 1

Roger Thornber

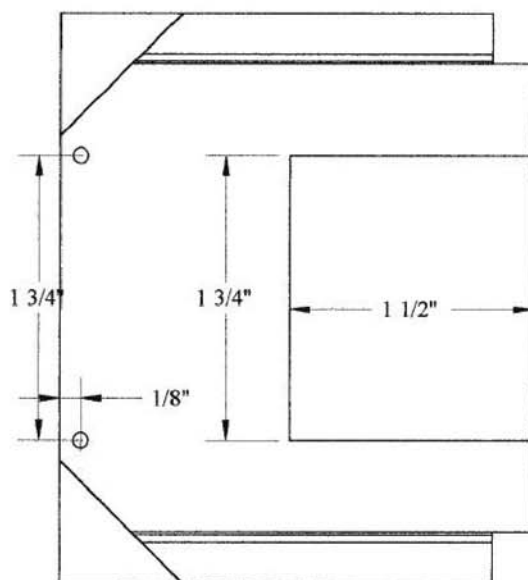
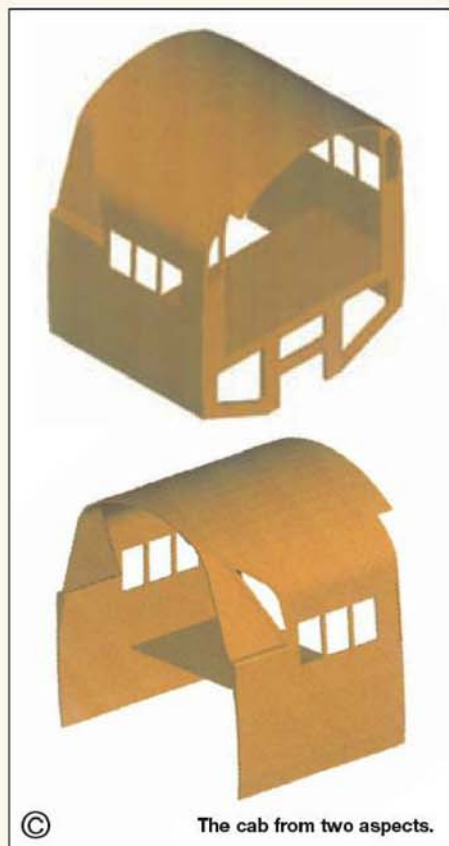
describes the smokebox, cab and location of the bypass valve.

●Part XIII continued from page 207
(M.E. 4215, 20 February 2004)

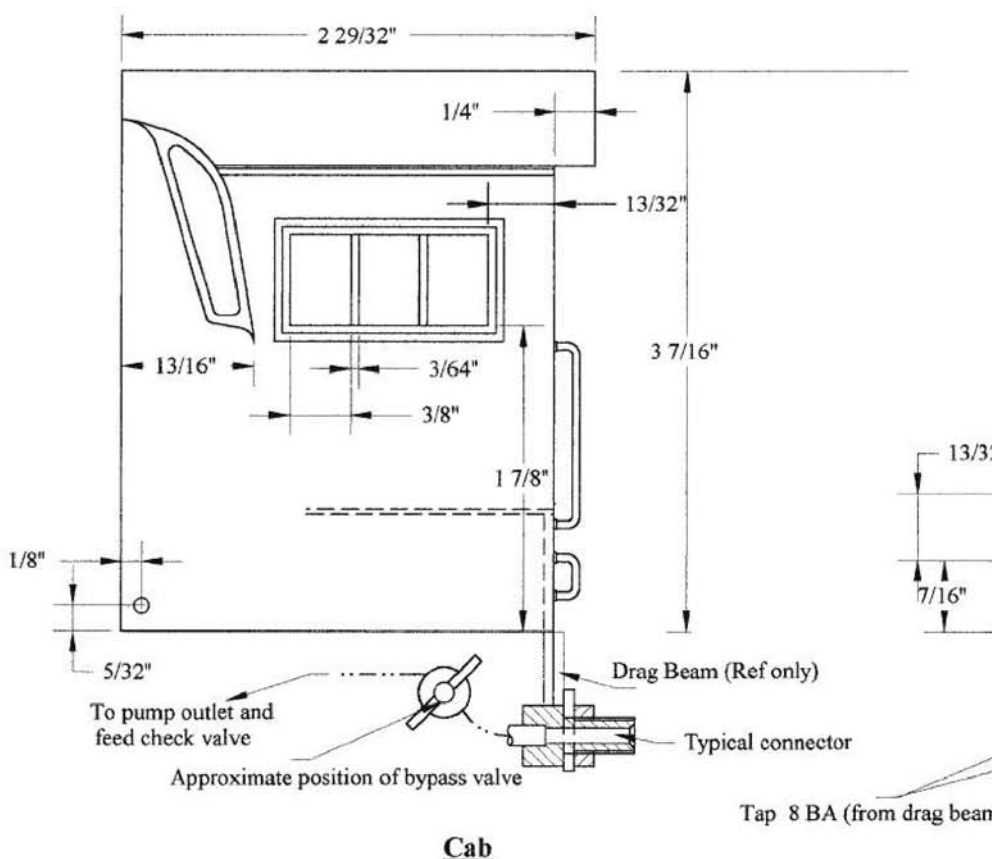
The smokebox is rather unusually shaped as it has to taper towards the front because of the 'ducting' around the chimney. This is part of the bodywork. I took a piece of $2\frac{1}{4}$ in. tube and cut a Vee out of it before squeezing one end. In retrospect, it would have been easier to take a slice off the top, and solder a flat piece across as shown in the drawing.

Note that there is a hole in the bottom for the main steam connection and the exhaust pipe. Since this is a closed flue system there is no need to seal the smokebox. Indeed there may be no need to have a smokebox at all! I have not tried this and would not really recommend it. Besides, the smokebox combines the front attachment.

The cab is shown here, as there was space on the sheet, but it is probably best left until the main bodywork is finished. The outside shape conforms to the contours of the backhead. As shown on the schematic, the sides and top could be formed in one piece, but I would suggest that it is easier to make it in three, the join would be covered with the rain strip. The roof may have a removable portion in it. This makes access easier.



The finished cab for the A



The front windows are difficult to get right - particularly as I am not sure of the exact shape! I think that, as drawn, they look about right. Probably the best way is to cut a piece out of the side and top as shown in the isometric. The window panel can now be fitted - the actual window should

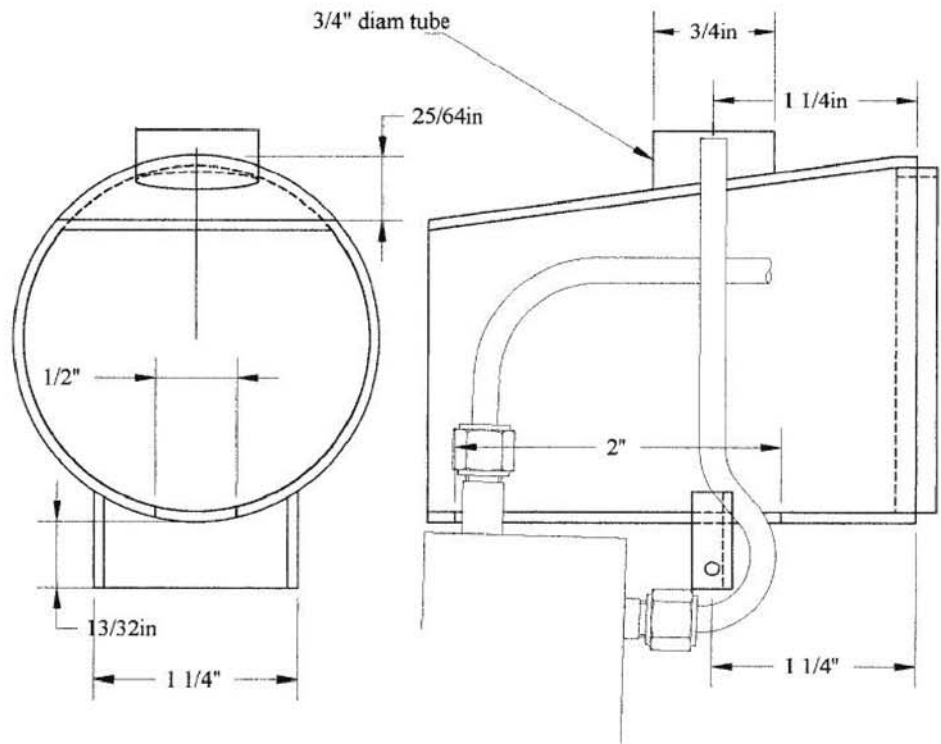
be left at this stage. Another triangular piece is bent to shape - again the top portion of this should match the backhead. Finally, another triangular piece completed the front.

The back of the cab has two small vertical pieces and a plate which goes down to the drag

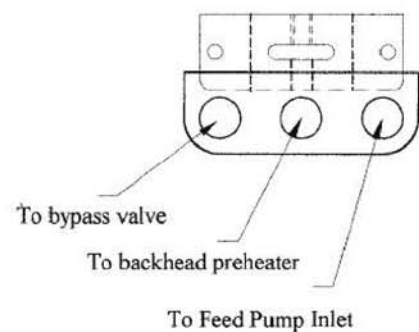
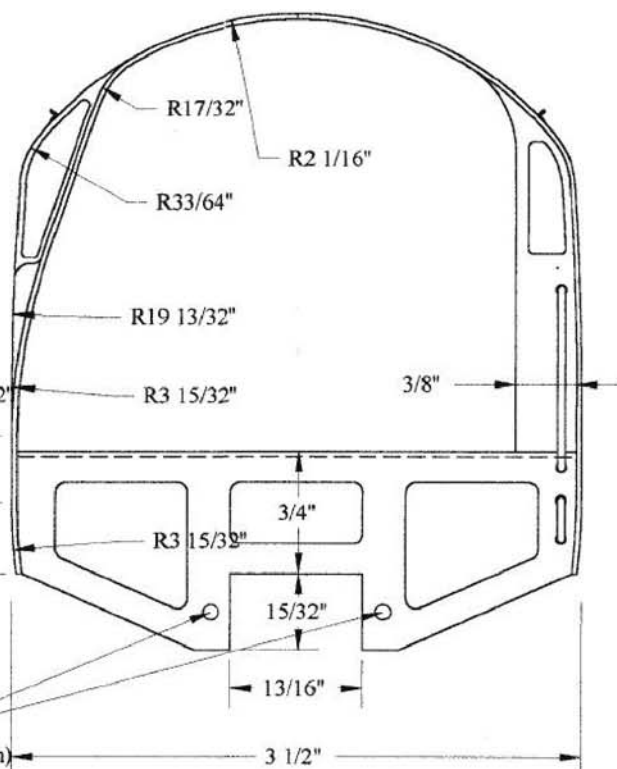
beam. This plate goes in front of the beam and is attached with two 8BA bolts. As you will see in the next instalment, the cab attaches to the main bodywork on a former, thus the bodywork and cab form a complete unit attached to the chassis with two bolts at the front on the buffer beam, ►



author's locomotive.

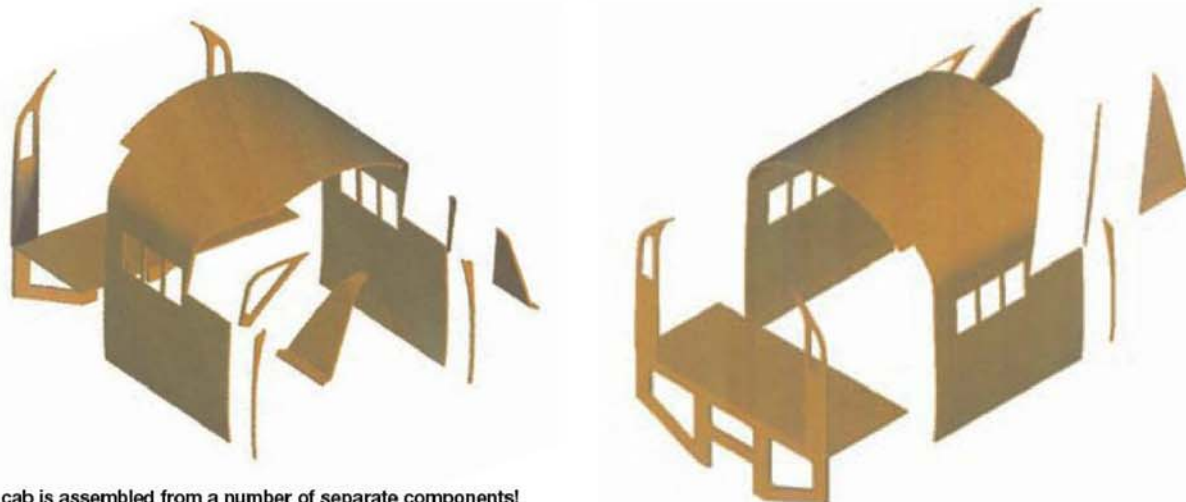


Smokebox



Loco Tender Connections

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



© The cab is assembled from a number of separate components!

and the two mentioned above. So, it might be best to fasten the rear end before the front - any small discrepancies could then be taken up.

The drawing shows a floor to the cab. This will obviously need to be cut out to clear the various

pipes within the cab.

The drawing also shows the connections to the tender. A bypass valve is shown just below the cab. This valve is similar to any of the other valves shown, but should be as short as possible as there

is not much space. Any valve like this should be arranged so that the pressure side is against the valve spindle, otherwise pressure is always acting on the gland and the packing.

● *To be continued.*



Tony Webster

describes how to machine the cylinders for this unusual vehicle.

● *Part III continued from page 199 (M.E. 4215, 20 February 2004)*

FOWLER STEAM WAGON

The cylinder castings (Parts Nos. 8646 and 8647) incorporate the main steam cylinder bore and the piston-valve bore. These are held together by the ports and flanges at each end. The piston valves run in cast iron liners and the main cylinder bore is also lined with a cast iron sleeve. This latter is the only extra work needed when using an aluminium alloy cylinder casting.

A steam passage runs from end to end of the casting with a flanged port mid-way. The original cored passage is difficult to reproduce in this size, so it is machined in the side of the casting and closed by a cover plate which incorporates the steam inlet flange. The piston valves are arranged for outside admission. The exhaust flange is part of the cylinder casting. The ports in both cylinders are arranged in the

same way. When the steam passage has been closed by the cover plate, which is secured by eight 6BA (M3) screws, the ends of the cylinder casting can be machined.

Working in the lathe, chuck the casting in the 4-jaw chuck, face and bore for the steam cylinder liner (photo 12). Turn the job round and create the other bore while the newly machined face is pressed against the chuck face. This operation may be more accurately done with the workpiece clamped to a faceplate (photo 13). The steam cylinder ports must communicate between the cylinders and the valve liners while sealing the steam from the steam passage to the *inside* of the valve liner.

Working in the milling machine, set up a Woodruff cutter, or similar, smaller than the bore for the valve liner. Enter this cutter into the bore



Operations on the cylinder barrels start with mounting the part in the 4-jaw chuck, facing off and then machining the cylinder bore to size for its liner.



The casting is then reversed and held on the faceplate for boring the piston valve bore and facing the other end.

without damaging it, and create the steam passage around the liner by milling to both sides and towards the steam cylinder. This operation must leave $\frac{3}{16}$ in. of undamaged bore to maintain the seal between steam into and out of the valve liner. This could be done in the lathe with the job offset and using a boring tool projecting a long way out from the boring bar but this is not a very satisfactory method!

The problem arises in extending this passage to the steam cylinder. It could be milled, as there is not now the problem of sealing at this point, and a $\frac{3}{16}$ in. thick piece of aluminium alloy screwed to the end cover would help keep the steam passage at the same cross-section for all of its length. The alternative is to drill four $\frac{3}{16}$ in. dia. holes from the other side of the steam cylinder and from the steam cylinder bore to the milled steam passage. The outer end of these holes would be plugged and the cast iron liner would cover the plugs. The whole of the cylinder could be machined on the milling machine and this would ensure that the two bores are parallel to each other.

The cylinder top end covers, Parts Nos. 8648 and 8649, are faced, leaving a spigot to fit the cylinder and a recess to take the valve liner. Repeat dial settings on the milling machine would help here. Both covers will need the gland

flanges removed by turning them away. The same pattern is used as for the lower cover where the gland is needed. Incidentally, the gland flanges have been turned through 90deg. to allow spanner access to the gland nuts. The high pressure cover is drilled and tapped for the cylinder oil feed on the valve centre line — this being for pump feed.

The bottom end covers, Parts Nos. 8644 and 8645, are treated in the same way as above plus the facing of the mounting flange which has a spigot to fit the trunk guide bore. The main face is machined and then bored through for the piston

rod. When turned around, the bore is centralised using a lathe centre and a dial test indicator (photo 14).

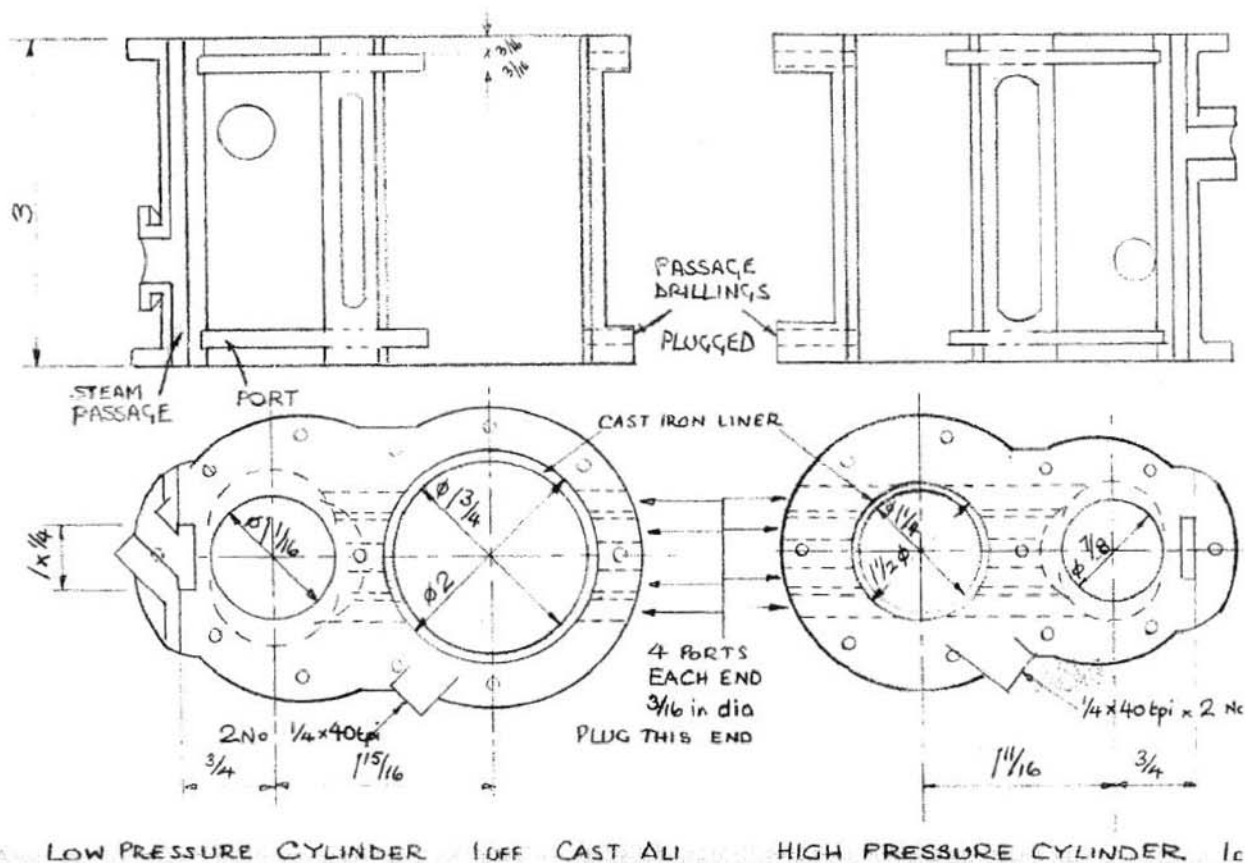
All of the above operations on the cylinders are the same for the high-pressure and the low-pressure cylinder sets, but note that the steam cylinder-to-valve centre distances differ.

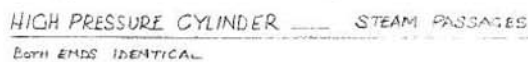
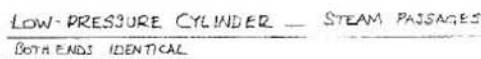
A further option, which is now incorporated in the revised patterns for these castings, is to make the end-to-end steam passage by drilling four $\frac{3}{16}$ in. dia. holes from each end to meet at a 7mm dia. cross hole drilled in from the side opposite the inlet flange. 7mm is the tapping size for a $\frac{5}{16} \times 32$ tpi plug. A 7mm dia. hole is also drilled 'square' to the inlet flange to connect to this cross hole. These holes should be drilled after the ends of the casting have been machined.

Another option for machining the passages between the valve liner ports and the main steam cylinder ports is to face the end of the cylinder back by $\frac{1}{8}$ in. (or the thickness of available aluminium alloy sheet, see later) and bore a circular recess which is offset from the valve centre line. This recess is then extended to the steam cylinder, as a parallel groove, by milling. The end of the cylinder is then covered by a piece of $\frac{1}{8}$ in. aluminium alloy sheet secured with four countersunk screws positioned between the cover stud holes. Both ends of both cylinders are treated in the same way. The valve liner bore and

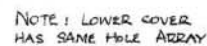
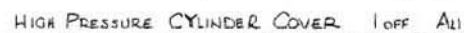


Setting one of the lower cylinder covers to run true in the 4-jaw chuck using a dial test indicator on a centre serving as a 'wobble bar'.





©

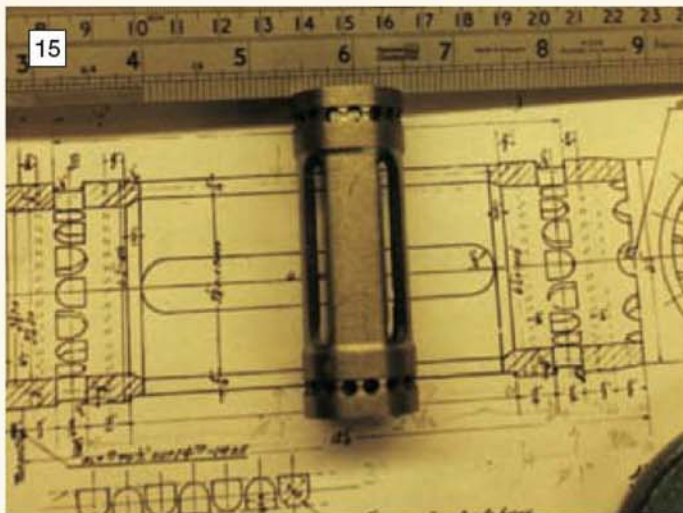


©

LOW PRESSURE CYLINDER COVER 1 OFF ALI



JOHN FOWLER & CO
(LONDON) LTD ENGINEERS
LONDON



A finished valve liner superimposed on a print of the valve liner for a full size engine.



Boring one of the valve liners from the headstock of the lathe. The part is held in a Dickson tool holder which provides convenient height adjustment.

the steam cylinder bores are now drilled and bored for their liners.

This method of making the steam passages gives clear open passages without obstruction, and the milled passage and cover plate would be the best way of getting steam from end to end of the cylinder.

The pattern has been modified to make the cover stud flanges thick enough to allow for the removal of this metal and also incorporates the steam inlet flange alongside the exhaust flange. This puts both flanges where they should be, as shown on the Fowler drawings.

This inlet flange could be used in conjunction with a drilling from the milled end to end

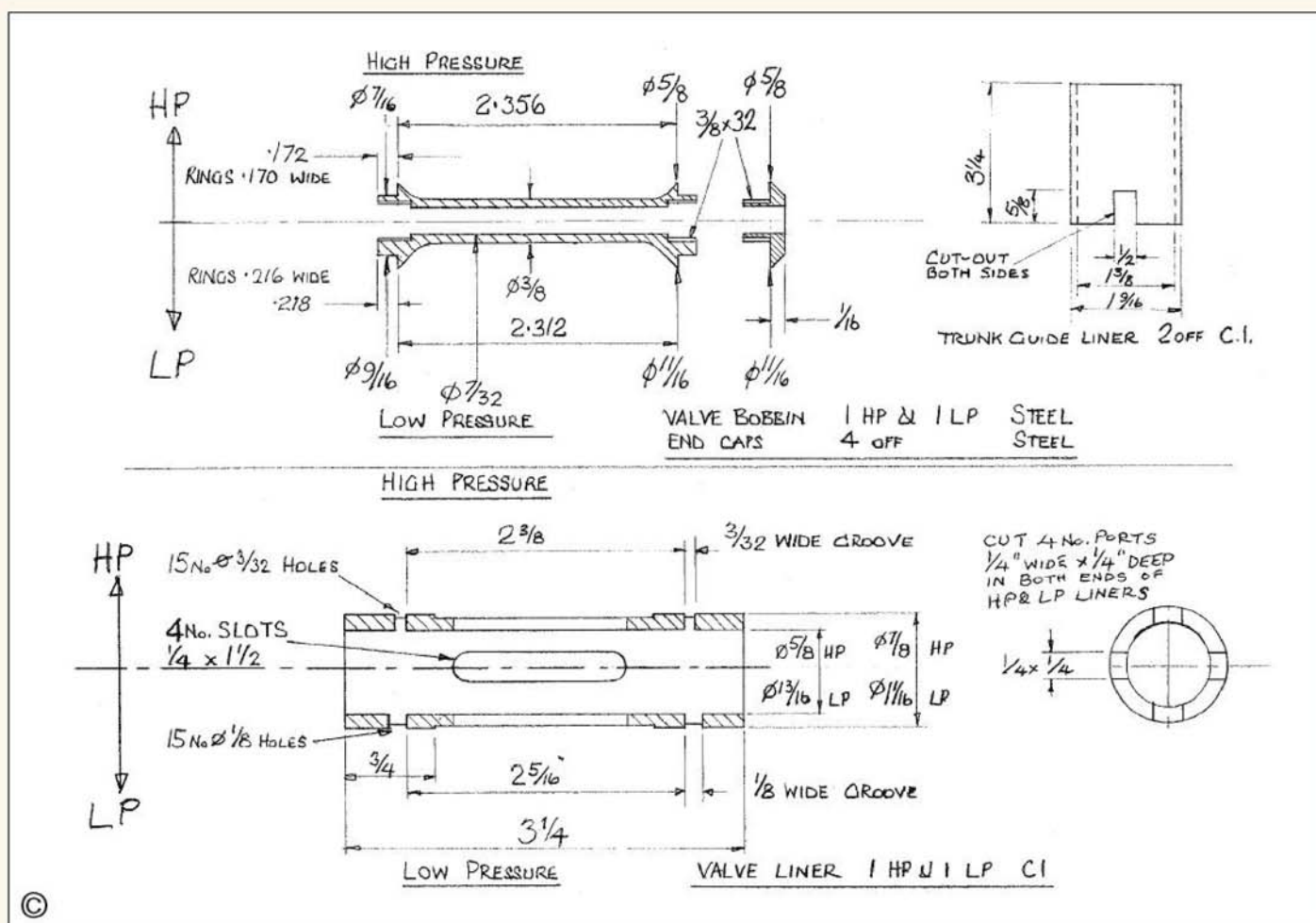
passage; the choice is yours. Cut off any unwanted steam flange — it will be covered by insulation and cladding.

Liners

The trunk guides are lined with a $\frac{3}{32}$ in. thick cast iron liner which is cut-away to allow the connecting rod to oscillate. The high pressure and low pressure cylinders are lined with $\frac{1}{8}$ in. thick cast iron, into which steam ports are cut at each end. The high-pressure liner has two ports, and the low-pressure liner has three ports at each end. The bridge pieces prevent the piston rings popping into the ports and breaking something.

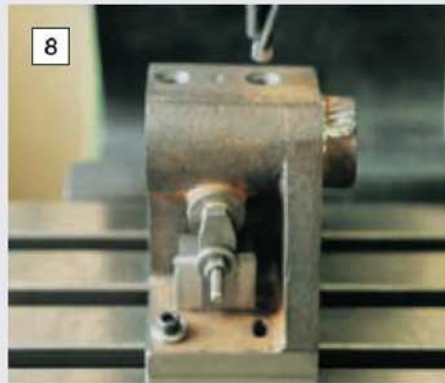
The valve liners, Parts Nos. 8712 and 8713, have ports that are drilled from the bottom of a groove which is turned on the outside. A further groove, made by a pointed tool, in the centre of the square groove, helps to locate the centre pops for the port holes in the centre of the groove. These liners are longer than the cylinders and, to prevent movement, they are held by the ends of the recesses in the end caps. The depth of these recesses is critical, and when calculating their depth, add the depth of both recesses to the length of the cylinder, and this should equal the liner length. Use the same gasket material for the ends of the liners and the cap joint.

●To be continued.

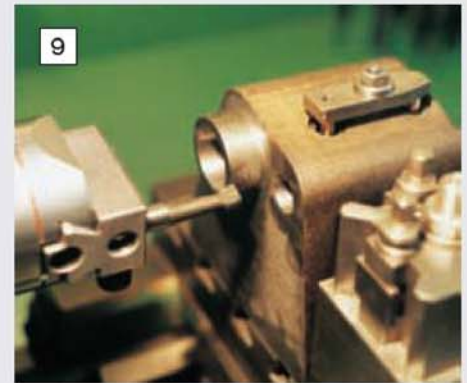




7
Machining the bottom surface of the dividing head casting.



8
Counterboring the holes for the over-arm locking pads in the dividing head casting.



9
Boring the overarm hole. Note the method of fixing the locking pads to prevent movement.

Anthony Mount

makes a start on the body casting for the GHT style dividing head.

●Part XIV continued from page 202
(M.E. 4215, 20 February 2004)

The GHT dividing head casting is similar to the simple head, but varies in some of the machining operations, so I will go through the sequence again. Clamp the casting down onto the milling machine table with the base upwards. This is not so straightforward as the casting is resting on a rounded top surface. A suitable cradle can be carved from a piece of hardwood and careful adjustment of the clamp screws should result in a level and firm setup. It can also be clamped to an angle plate.

Photograph 7 shows my setup with a piece of aluminium alloy sheet under the casting and clamps at the sides. The base can now be milled flat. Instead of using a large face mill that could impose large forces on the casting, a series of passes with an end mill is a gentler way of achieving the desired result. Remove from the table and file off the areas that were under the clamps.

Set up a large angle plate on the milling machine table once again; the casting can now be clamped with a machined face to the angle plate for milling the other faces. Face off the top of the back spindle spigot but skirt around the sides of the spigot as these will be dealt with later.

There are three clamping pads for this casting. Drill and counterbore (photo 8) the two holes for the over-arm pads, and drill and tap an M6 hole centrally between them. For the spindle locking pad, drill down and open out to 14mm diameter as a blind hole. About 15mm below the hole, drill and tap for an M6 screw.

Make up the brass clamp pads, including the threads, and drop them in place. A bridge piece can go across the overarm holes with a hole in the centre for a screw to pass into the tapped hole between them, this will clamp the pads in place.

A similar method can be used for the spindle locking pad, but some packing will be required under one

end of the bridge piece to bring it level. Photographs 8 and 9 show the bridge pieces in place. The screw holes can be filled in later and after painting you will forget they are there!

Drill the bolt holes in the base of the casting. Again notice that two of the holes are slots to allow for differences in the tee slot centres.

Mark the centre line of the spindle on the casting and set up on the lathe cross-slide with the back facing the lathe headstock. Check that it is square to the cross-slide. Use the tailstock centre to pick up the centre line marks on the casting and lock the cross-slide.

Centre and drill through, opening out to as large a diameter as you can. Finish the bore to size

with a between-centres boring bar. It is not critical to get the bore exactly to size as the spindle can be made to suit the bore. However it is satisfying if you can get it to the prescribed dimension. Machine to within approximately 0.5mm of size and take a measurement with internal calipers.

Using calipers needs a degree of 'touch', especially with the spring loaded type. The calipers need to slide in with just a merest hint of resistance. Not enough to spring them in of course, but not loose either.

Measure over the caliper with a vernier or micrometer. You might ask why not use the vernier direct in the bore, but personally I have never found this accurate except on large bores. Unless the vernier has knife-edges, which would not last long, I find it always measures undersize. Try it yourself and see.

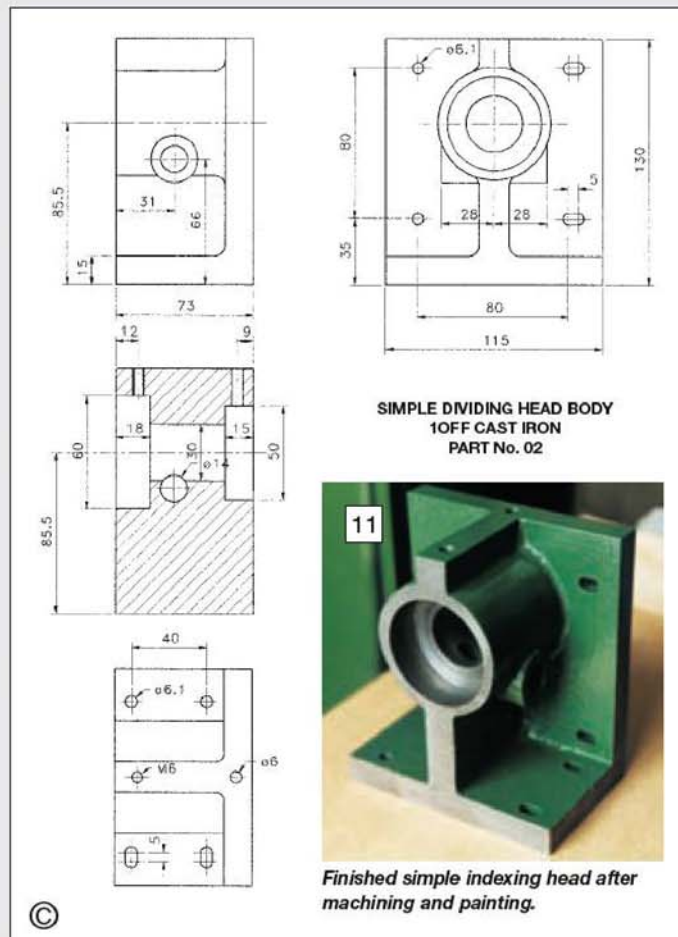
Subtract your measurement from the finished size and divide by two. That is how much is left to take off. Now measure over the boring bar at the cutter. Move the cutter forward the amount to take off and take another cut. Boring bars can flex, so I usually make the cut 0.1mm undersize, then take another cut at the same setting, measure again and readjust for a final cut.

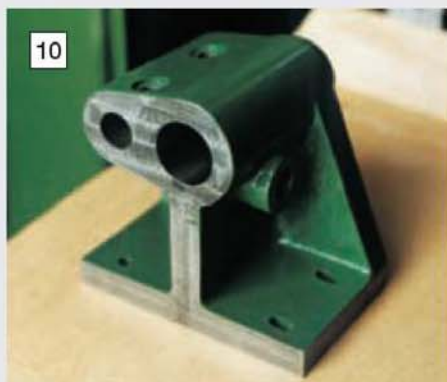
Set up the boring head again but this time with the tool cutting edge facing inwards. This will require the lathe to be run in reverse so that the back spigot can be trued up to receive the existing swinging arm. This is shown in photo 9.

The 5mm step shown on the drawing is to allow the head on the pivot screw to clear the casting. It is not seen on the photograph as the spigot on the casting was poorly formed and needed to be machined parallel along its whole length to clean up. So the step was added as a steel ring attached with Loctite.

Set the cross-slide dial to zero. Unlock the cross-slide and reposition it for drilling and reaming the overarm hole. I hope you made the original overarm tailstock to the given dimension so that you can use it again.

FINE TUNING A WARCO BH600C LATHE





Finished dividing head casting after cleaning up and painting.

Remove all sharp edges and, after preparing the surfaces, paint to match the lathe colour. Photographs 10 and 11 show the completed body castings after painting.

GHT spindle (Part 03)

I have shown the spindle I used on my dividing head; it is a replica of the original spindle but a longer to cope with the new casting. You can, of course, alter the nose to suit your own requirements.

Cut off a length of 45mm diameter mild steel bar, chuck, centre and provide tailstock support. Reduce to 27mm (1 1/16 in.) diameter and at the end to 25.4mm (1 in.) diameter and thread 24tpi to suit the existing nuts. Use a parting tool to put in some run outs for the screwcutting tool.

After screwcutting, support the end of the spindle with a fixed steady and drill down, opening out to 5/8 in. diameter. Reverse and with a dial indicator check that the spindle is running true. If your self-centring 3-jaw chuck is out it might be better to use a 4-jaw independent chuck so that you can get the spindle running true.

Turn down the end to form the spindle nose. In my case, *à la* Myford. Turn the two diameters and be very careful that the register is on size — the accuracy of fitting the chuck depends on this. Machine a run out groove and screwcut the nose thread 1 1/8 in. x 12tpi. This is quite a deep thread so it will be as well to reduce the depth of cut as you approach full depth.

Set over the top-slide for turning the Morse taper. The half angle is just under 1 1/2 degrees. Bore it undersize and check it carefully, re-setting as required until the taper is correct. Lines marked with a felt tipped pen along the length of the male taper are one way of finding if the two tapers are well fitting. If you twist the taper in the bore the marks will be rubbed off indicating where the tapers are touching. An alternative setting method is to place an existing Morse taper centre between male and female centres and to set the top-slide to this using a dial indicator. Then proceed with the machining.

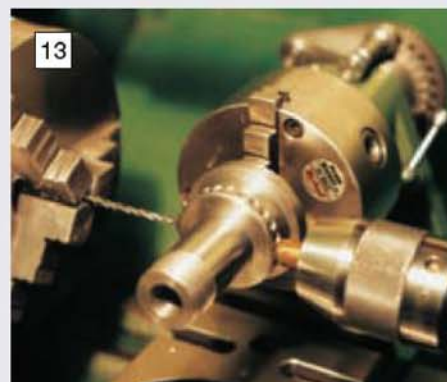
Take a finishing cut to finished size. Bear in mind that with slow



The finish turned spindle for the dividing head; a Myford spindle nose was used.



The simple indexer spindle after drilling and numbering the indexing holes.



Drilling the indexing holes in the simple indexing head spindle.

tapers like this, taking off only a very little will allow the male taper to enter a lot further. Measure your existing spindle at the front to give you an idea when you are approaching finished size. The ideal way to finish the taper is with a Morse taper reamer. These are available from Tracy Tools (01803-833134) — usual disclaimer. Transfer the spindle to the milling machine vice and cut the housing for the key with a Woodruff cutter. The completed spindle is shown in photo 12.

Simple dividing head spindle (Part 04)

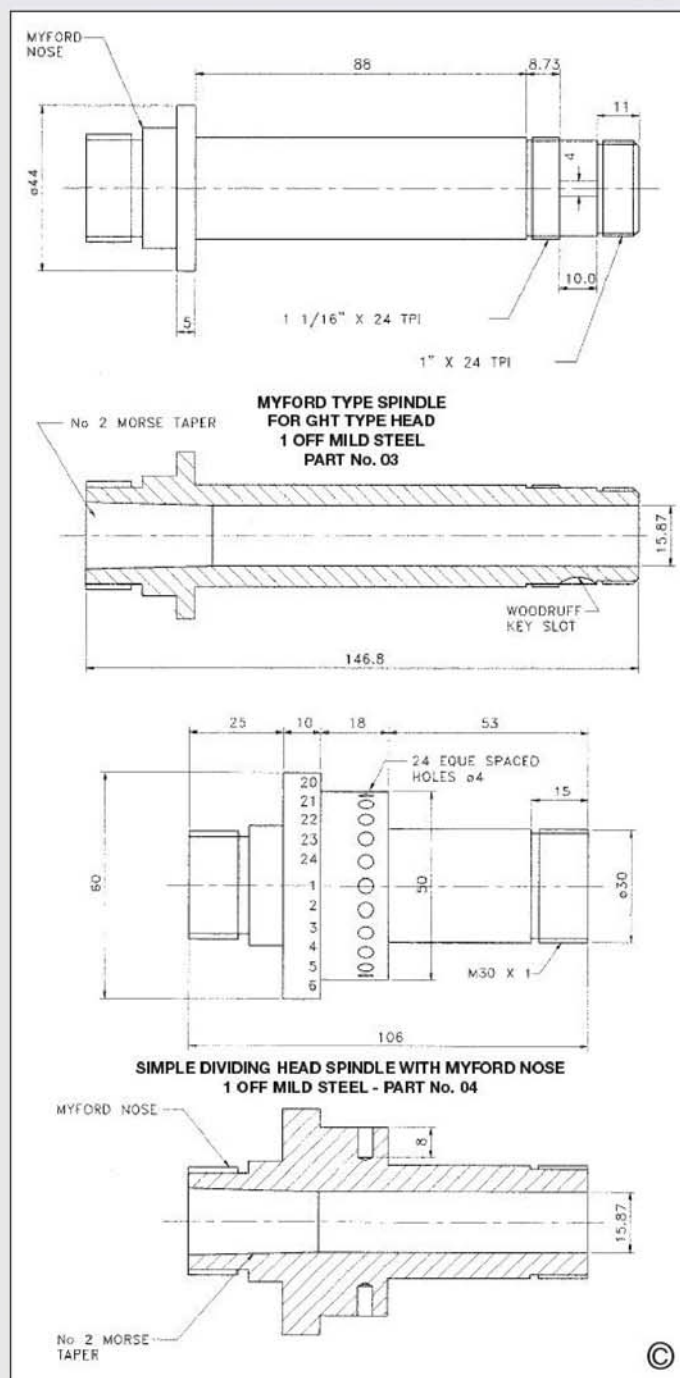
Much the same procedure is followed for the simple dividing head spindle except that it is shorter and the step at the front is for a ring of 24 holes. When the spindle is almost complete, set up the spindle in the body and part drill one hole using the detent hole in the casting as a guide. This hole can be used to position the spindle on another dividing head to complete this hole and to drill the other detent holes.

We are now in a bit of a chicken and egg situation in that you need a dividing head to form the ring of holes. If you already have a GHT head then make the modifications to this first and use it for the simple spindle. Failing that you might be able to borrow one or to get a friend to put in the holes for you if they do not like lending tools.

Photograph 13 shows the spindle held in a chuck on the completed GHT dividing head. Note that the tailstock chuck is gripping a piece of brass bar, and the tailstock is being used to feed the spindle in to the drill, removing strains on the saddle hand feed and the overhang of the spindle in the chuck. The flange at the front is used to stamp on the numbers so that you can keep count when using the head.

I find it easier to achieve nice numbering if a jig of some sort is used to guide the number punch, even one made of wood will suffice for a few numbers. Alternatively, if you have the equipment, the numbers can be engraved on the spindle. The completed spindle is seen in photo 14.

●To be continued.





Brian Hunt ran his traction engine alongside the track.



The queue waits patiently for another train.

WORTHING EXHIBITION

Gerry Collins

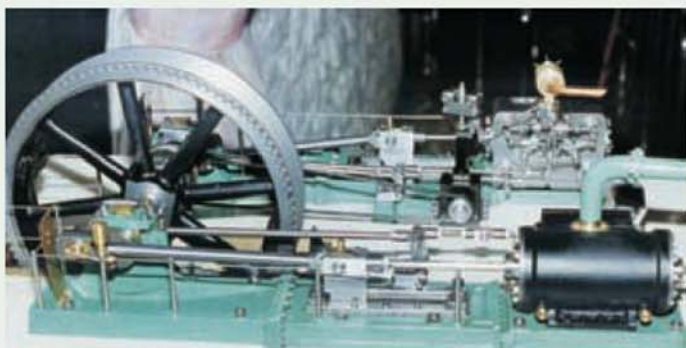
looks forward to this year's event, 17/18 April 2004, with a report on Worthing DSME's previous exhibition staged at Field Place.

Most societies when organising an exhibition have to rent a school or church hall with the attendant problems of transporting a large amount of equipment from their headquarters in order to present the show. In addition, many are prevented from operating live

steam models due to local fire regulations or other restrictions.

The Worthing and District Society of Model Engineers are lucky, their headquarters and track are based at Field Place, Durrington, on the outskirts of Worthing. Field Place was a large house with extensive grounds which is now owned and maintained by the local authority and is a Leisure Centre for the many small clubs and societies in the area. The house has an engineering connection as it was briefly the home of Henry Greenly in the 1930s when he was working on the electrification of the west coast line of the then Southern Railway.

The old barn has been converted into a small theatre for amateur dramatics and the Worthing members used this for the main display. Outside was a small pond for the many radio controlled boats built and displayed by the boat section. Entering the hall the first person to greet me was Colin Barter with his miniature universal lathe recently described in these pages. Every time I looked Colin was deep in conversation with at least one onlooker and the pencil and paper was not far away to sketch a detail. One point I was pleased to see was a spare chair in place so that the visitors could sit with Colin and talk in



1:16 scale 500hp cross-compound mill engine by C. J. Worsfold.



John Briarley's superb 'O' gauge model of an LBSCR class 13 locomotive.



Lady Margaret by Alan Bibby to the Allchin design by W. J. Hughes.



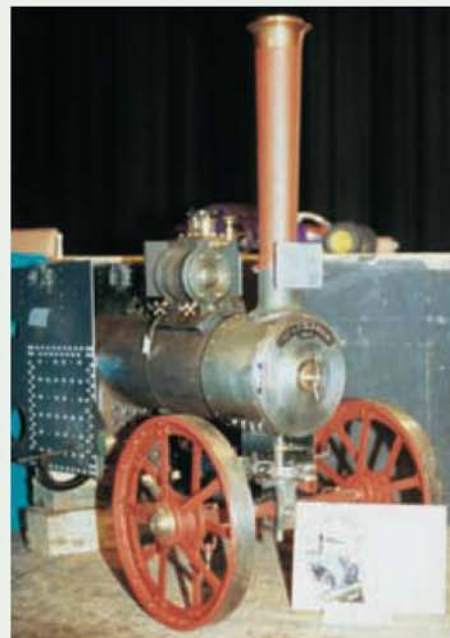
Colin Barter (right) explains a detail on his universal lathe.



Les Patience with his 4in. scale Allchin.



Derek Betterton's de Veulens fairground organ.



Anrew Breeze's 4in. scale Tasker Little Giant.

comfort. Well done — perhaps other exhibitions could take note.

The Worthing Society encourages youngsters to take up modelling with courses during the summer holidays and examples and demonstrations of their work was shown on the stage. Member John Bibby must be a glutton for punishment as he had on display three Allchin traction engines. One in black was called *Lady Margaret*, one in red called *Lady Elizabeth* and the third built as a showmans traction engine with canopy and generator fixed to the extension of the smokebox. This engine is fitted with a belly tank and covers to the motion. The livery of this engine is lined green. The three engines standing side by side made a grand sight and John is to be congratulated for the fine work put into these models. Andrew Breese is probably better known for his award winning locomotives but he is now building a 4in. scale Tasker *Little Giant* and the craftsmanship seen in his locomotives is evident in this tractor, I look forward to seeing it in steam in the not too distant future.

With an exhibition of this size and scope I can only pick out a few of the items that caught my eye. One which stood out was a model of the 16th

century galleon *Pelican* made entirely of matchsticks. A total of 50,000 matches were used and were stuck together by four litres of glue over a period of four years. The builder of this masterpiece is Dave Vincent. A diorama I found fascinating was by Mick Boyd involving a Hawker *Hurricane*. Using the Airfix 1/24 scale kit, the aircraft was depicted being serviced ready for another sortie, the engine cowlings removed so that the Rolls-Royce *Merlin* engine could be seen in all its detail. A small bench had been set up on the grass complete with a tiny vice and tools and the station's black and white cat was standing on the tailplane.

At the far end of the main hall was a demonstration of the modern face of model engineering with a computer running valve gear simulation programs. The working of the valve gear was clearly shown and the passage of the steam through the valve chest and cylinder was demonstrated far better than would be possible with the usual sectional model.

The dates chosen for this event were those of an early spring weekend for which it is hard to predict the weather. The society was fortunate in that it was sunny and warm, making running the track a pleasure and the queues proved how

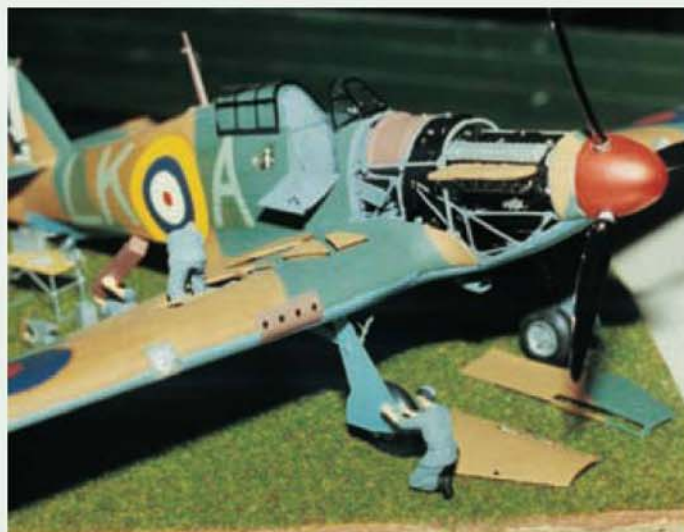
popular it was. Also in steam alongside the track were two 4in. scale traction engines, one an Allchin, and the other Brian Hunt's Foster, a familiar sight on the rally fields of the south. To give a real fairground atmosphere Derek Betterton from Littlehampton was showing his De Veulens organ. A member of the Worthing Society, Derek attends many fairs, rallies and exhibitions raising money for The Fire Services National Benevolent Fund.

On entering the society's headquarters I found plenty of space to sit and enjoy tea and cakes expertly dispensed by the ladies (and gentlemen) of the society. I am sorry if I have left anyone out of this brief review. All exhibitions are a joint effort and the input of everyone is worthy of note. Hopefully the photographs will give an idea of the excellent craftsmanship on display. The venue is easily reached from the A24 and A27 and Durrington railway station on the Brighton-Portsmouth line is just five minutes walk away so with the next exhibition on 17/18 April, why not come along and see for yourself — you will be made most welcome.

My congratulations to Exhibition Manager Roy Russell and all his helpers and exhibitors who put on such a splendid show.



50,000 matches, 4 litres of glue and 4 years work by Dave Vincent.



Engine detail on Mick Boyd's Hawker Hurricane.



Keith Wilson

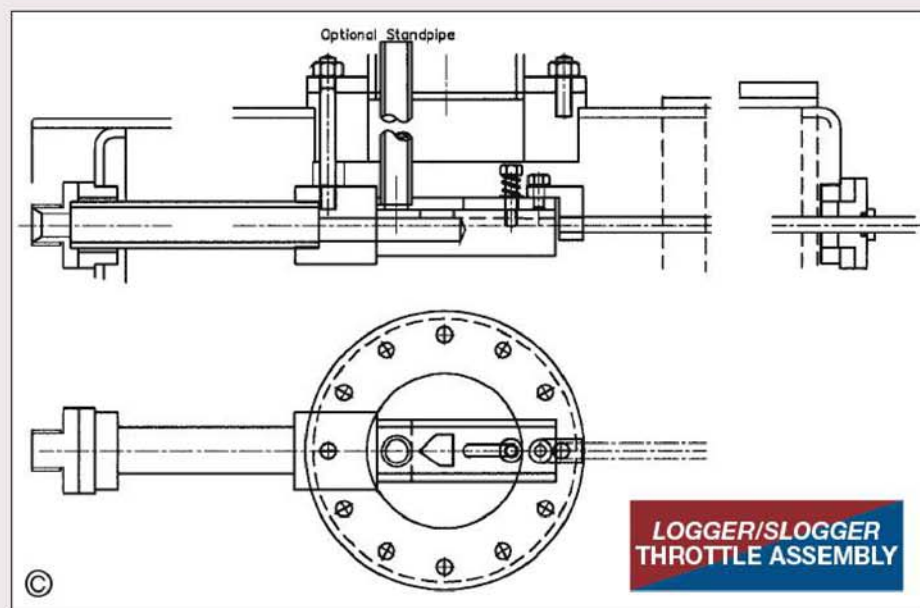
acknowledges readers' assistance with this project and continues with a poppet valve regulator design.

●Part XXVIII continued from page 220 (M.E. 4215, 20 February 2004)

The throttle gave me a merry task, for only then did I notice an error in the boiler design which fortunately is not irreparable. I doubt if anyone has yet begun this particular kettle, but looking ahead it could happen that someone could make the urn only to find later that it had to be added to. It concerns the front regulator bush shown in the detail drawing but not on the assemblies.

Instead of describing it at the time, I deliberately left the throttle until later, for I wished to get some definite information on the American style of throttle. It did not appear in any way on the drawings, and since it was missing on the prototype, photographs could not assist. I thought it was probably a pull-out type, and this has been confirmed by one or two e-mails from my helpful interested and informed band of readers. My public thanks to them, which reminds me of something that happened a few years ago.

I had been sent some special documents that are most certainly not available to the general public, and noticed that the word 'public' was spelt 'pubic' — consternation! For although these documents had been read by many others privileged to see them, no-one else had noticed. Re-printing was hastily organised, and when a year later I happened to visit the 'headquarters', despite the extra work involved, I was profusely



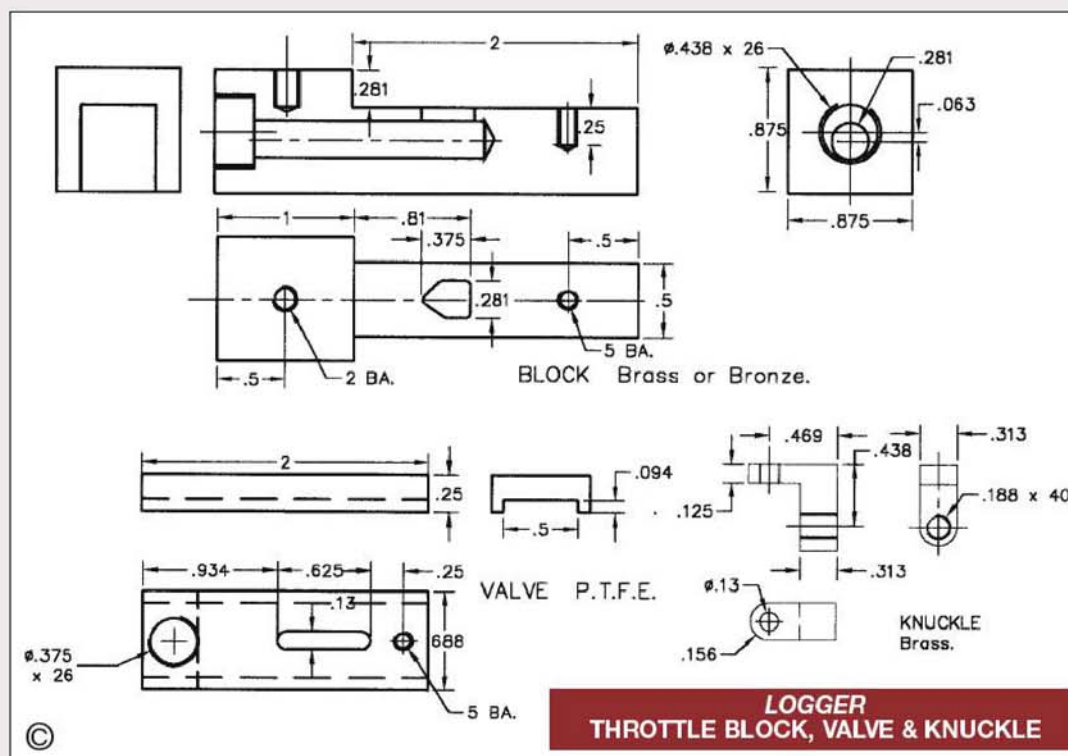
**LOGGER/SLOGGER
THROTTLE ASSEMBLY**

thanked for the discovery. It reminded me of a similar incident 'wayback-when' in the RAF, when I noticed exactly the opposite mistake: the word 'pubic' printed as 'public' — just as confusing, but I digress.

The following remarkably informative e-mail is of general interest, so I offer it here:

"I hope this is not too long winded for you, but it seems to me to be the complete and utter history of American locomotive throttles. The drawing in Bruce's book of the double seated balanced valve looks almost identical to those used on Gresley Pacifics except that the bell crank is the opposite way round so preventing 'night walking', though why the US locomotives weren't stabled in mid gear with the cylinder drains open is a mystery to me.

*Malcolm Young,
P.S. I live in Milton Keynes, and
earn my crust as a train driver.*



**LOGGER
THROTTLE BLOCK, VALVE & KNUCKLE**

"As a long time admirer of American steam locomotives, I have been following your Logger & Slogger series in Model Engineer with great interest. I have a book, published in 1952 entitled The Steam Locomotive in America, its Development in the Twentieth Century written by Alfred W. Bruce, who was one of the senior engineers at the American Locomotive Company where the last steam locomotives



Backhead of prototype with the throttle just in sight at bottom right.

for the home market were built in 1949.

"In your article in M.E. 4211, you asked about the throttle. Bruce makes it clear that the 'pull-out' type was almost universal from the beginning to the end of steam in the USA, although the valve itself changed in design over the years. I will quote from the book:

Throttles

"The poppet valve type of throttle has been most generally used in the United States from the beginning, although the slide valve type was in common use abroad. The early throttle of 1870 was a single seated valve of the simplest possible construction, but it proved to be fairly satisfactory in small sizes and with low steam pressures. As sizes and pressures increased, double seated valves were introduced. As might be expected, however, they were difficult to keep steamtight because of the difference in expansion and contraction of the two valve seats. When carefully designed for uniform expansion and contraction and properly balanced, they were the best type of valve available for many years. These came into use in 1910.

"The throttle operating mechanism was simple and located entirely inside the boiler. Thus any contraction of the dry pipe or throttle rod (because of their smaller cross section) relative to the contraction of the boiler shell when the shell is filled with water in the roundhouse, after the fires are dumped, tended with the usual method of linkage assembly to lift the throttle valve off its seat and to permit the gradual build-up of steam pressure in the cylinders to a point at which engine movement took place. This was generally known as 'night walking'. As the size of the throttle increased, greater difficulty was experienced in maintaining a proper balance between the two valve-seat areas, and the valve became 'jumpy' in action due to the rapid inflow of steam through both valve openings.

"All these difficulties eventually led to the introduction of several types of large single seated throttle valves equipped

with balancing pistons which were in fairly general use in 1925. These valves had a notable advantage in that they were all located in the smokebox, with all the operating rods located outside the boiler shell. But since the throttle lever in the cab was again necessarily fulcrumed on the boiler back head, the expansion of the long boilers

remained a problem until a compensating lever was placed about mid-length of the throttle rod.

"As the centre of this lever was fulcrumed on the boiler, it assumed an angular position under longitudinal boiler-shell expansion and permitted the throttle rod to compensate automatically for any amount of boiler shell expansion.

"These large single-seated throttle valves to suit 10in. or larger dry pipes required pilot valves to permit the initial opening. They were also exceedingly temperamental in their operation, since the equilibrium between the load on the valve and the load on the balancing piston could not be maintained under all operating conditions owing to the high pressure and velocity of the steam. They were the subjects of many complaints from the engine crews.

"All these large throttle valves were also very difficult to handle during drifting, when only a very small amount of steam was required in the cylinders. The problem of the throttle had thus become very serious in 1925, for the engine crews did not approve of the application of power cylinders to throttle-valve operation since it eliminated the manual 'feel' of the moving valve which the operator relied on.

Wilson's Words of Wisdom:
Ignorance
is never a barrier
to expression of opinion!

"The final solution came about in 1927 and was fairly generally adopted by 1930. It was based on the use of several smaller valves opened in a series by a suitable camshaft after the initial chamber pressures had been equalised by a small pilot valve that was also used to admit drifting steam to the cylinders. The entire assembly was housed in the superheater header, making a very simple and compact unit arrangement.

"Some difficulty was naturally experienced at first in getting the correct load differential between the single-seated valves and the balancing pistons, and there were occasional cases of stuck valves and other difficulties. In general, however, this 'multiple' front end throttle has been remarkably successful in view of the high smokebox temperatures to which it is exposed."

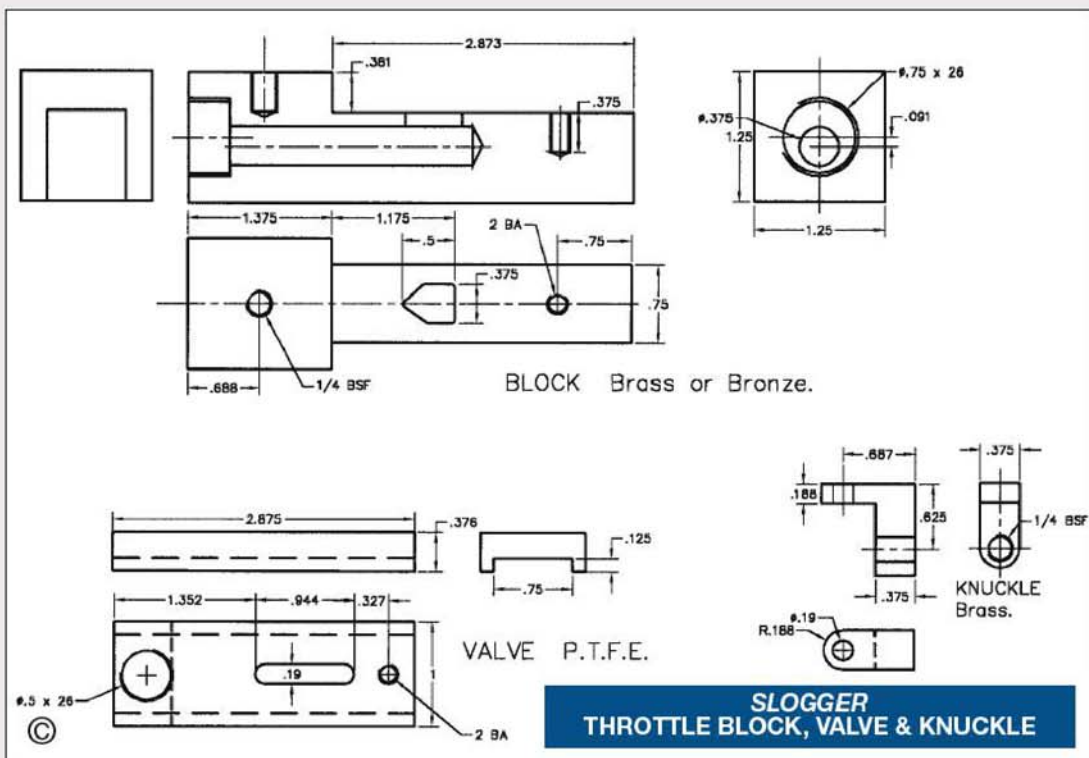
Whistles

American locomotive whistles generally had the valve built in and were operated by a chain or rope from a lever in the cab. I have a beautiful 1 1/2in. scale 6-chime whistle that works! It is possible to build scale size whistles that work despite what the 'experts' say.

They are made by a company in California, they are not cheap (about £75 each) but are well worth the money for an item which is very prominent on American locomotives. They are available in 3, 4, 5 and 6 chime versions.

I reckon that just about sums it up. I would note that 'scale' whistles certainly can be made to work, but getting the correct frequency or 'pitch' is a horse of another colour.

It appears from backhead photographs that a pull-out type regulator — sorry — throttle was probably fitted 'through the boiler', but due to the presence of a steam dome, the actual working bits were in this dome. So I had to design a simple throttle that could be assembled without anyone



actually going inside the boiler — possible in full size but somewhat difficult for us.

I have not shown details of just how the throttle handle is fixed, but I reckon anyone getting this locomotive built to this stage will have no difficulty in suiting him (or her) self.

This design has generally worked well. I am not over-keen on pull-out throttles, for due to high boiler pressures on the far end of the rod, they can be self-opening. Rather alarming, what? I believe that in some cases, severe damage was done to the driver (engineer) when the lever swung round and clouted him. For, if the rod was for example 1.5in. diameter, with a boiler pressure of 180psi or more, then the endwise force can be upwards of 300lbf. Quite a lot. For us however, friction is greater in proportion to size, lower pressure helps, and our endwise thrust is of the order of 5lbf. A sector/quadrant could of course be used with a hefty pin to prevent sudden undue opening.

A very important point with throttles is that they should not be directly proportional. In other words half the lever travel should not produce half the opening, for due to Bernoulli's theorem very nearly the 'full' amount of steam can pass, it being a compressible fluid.

I do not know the correct shape for a 'proportional' port, but 'logarithmic' comes easily to mind, in other words halfway point = 1/10 opening. With this system, 'inching' the locomotive, as when backing onto a train, is much easier. I found this with my second full size drive, I had to take a Castle from Stafford Road sheds back to Wolverhampton Low Level, and back it onto its train. And 135 very solid tons needs

somewhat gentle handling! I made it, anyway.

This is the reasoning behind the peculiar shape of the port in the block. I think it might be better if the point was sharper and the triangular sides convex, however this is a minor point. To get this port, I recommend drilling out the five corners with a small drill, a bigger drill for the inner portions then relying on fine files. Alternatively a small slot-drill in a milling machine will do much. There is a third way, drill a very small hole (No. 60) in the apex, a larger one (No. 50) just behind it then one larger still, or two No. 50s side by side, and a 3/8in. one for the main port.

The vertical pipe in the upper side of the PTFE valve is an optional fitting, ensuring that steam is collected from the highest point in the boiler. If you don't want to use it, then the valve may be shortened to the rear edge of the hole, which of course would be omitted.

Dead sharp tools are the order of the day to machine PTFE, for it is important that the under surface of the valve is dead flat. It may well help

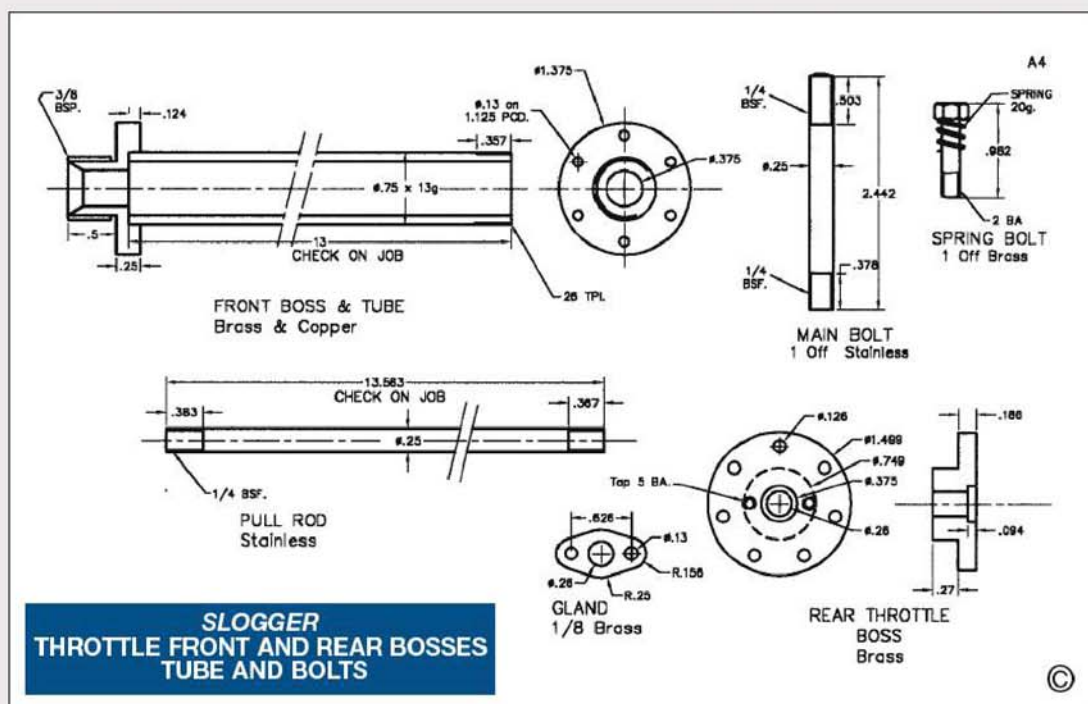
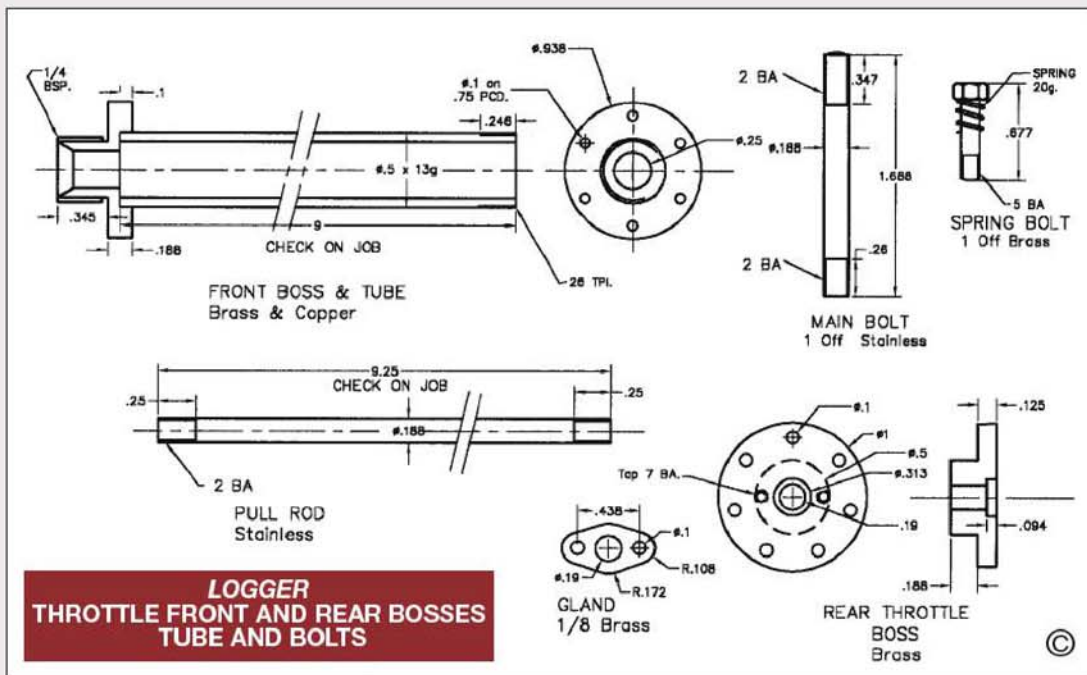
sealing if the edges of the block are rounded off slightly. Make sure that the special bolt through the knuckle is at most dead flush with this lower valve surface, or just above it.

The downward force of the valve on the face is determined by the product (area of the port x the pressure); *not* the total area of the valve. This can be a common mistake. In full size, this force can be very high; but we have two advantages. One is the use of Teflon, as I believe it is named 'over there', which has a very low friction co-efficient, the other advantages are our lower pressures and smaller ports. It follows that our sealing will be improved by the use of a light spring. It may not be too clear from the drawing, but this spring should be fairly close pitch and press on a small brass washer, to prevent the end of said spring catching in the slot.

To assemble this throttle (after checking) remove the retaining bolt and spring and washer, the main block can be lowered into the boiler and with a little care the retaining bolt can be manipulated into its socket. Leave it a bit slack for the present, as this will make the insertion of the front tube easier. If this is screwed in with a little Red Hermetite, it will seal nicely but not beyond being undone. Once in place, it could be useful to remove the vertical bolt, anoint the lower end with Loctite 252, and replace it. This will be useful when removing the dome for any reason.

Assemble the knuckle with the valve; this can then be inserted into the boiler and the washer, bolt and spring screwed in. If the front end of the rod has a good bevel on the end to be screwed into the knuckle, it will facilitate this operation. Since the rod will not rotate in use, this will be adequate. The rod is sealed at its rear end with an O-ring, preferably of Viton.

●To be continued.



LETTERS TO A GRANDSON

M. J. H. Ellis

discusses the effects of scale in a live steam injector and continues with advice on construction.

●Part LXI continued from page 217 (M.E. 4215, 20 February 2004)

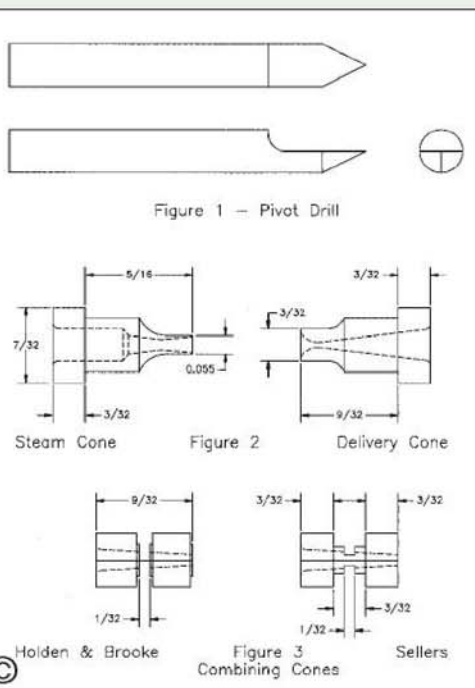
Dear Adrian, you raise an interesting question when you ask "Bearing in mind that the velocity of the steam and water in the combining cone of a miniature injector is comparable with that in the full size counterpart, how is it that the combination of the two in the miniature injector can be accomplished in so much shorter a distance?" I don't know enough to give an informed answer to the question, but at least, I can offer one or two comments.

In the first place, the angle of the cones in either case is limited to what the flow of fluid will stand without becoming turbulent. Granted this limitation, as the volume of flow in full size greatly exceeds that in the model, the bore of everything must be bigger, and that means, longer in proportion. Consequently, even if combination of steam and water did take place in full size in the same short distance as in the model, that would not permit the combining cone to be shortened. Besides which, if you were to read a book about the injector, you would find that it is doubtful whether complete condensation of the steam has occurred even when the mixed water and steam leaves the full size combining cone, and it is suspected that it continues right into the throat of the delivery cone.

This is substantiated, moreover, by the fact that the diameter of the small end of the delivery cone is less than that of the small end of the combining cone. In view of this, it surprises me that a miniature injector could ever be made to work at all, and I have always felt that it was a major triumph for LBSC to have done so. For want of any better hypothesis, I suggest that the spray of water droplets and bubbles of steam in the miniature injector could be on a much finer scale in the miniature version, so that a given quantity of water has a greater surface area over which condensation can occur.

This business of 'scale' has long preoccupied the minds of model engineers, and I think it was LBSC himself who roundly declared "You can't scale Nature." Even if he did, I am afraid that I shall have to disagree with him, because it is contrary to the facts, as he demonstrated. What is undoubtedly true is that all the relevant quantities do not scale down in the same proportion. Take a simple example: all the dimensions of an engine could be scaled down in the same proportion, say $1/10$, but volumes and weight would be diminished to $(1/10)^3$, that is $1/1000$. Other quantities would be reduced more still. For example, the moment of inertia of a flywheel would be lessened (I think!) to $(1/10)^5$ or $1/100,000$. This means that the rim of the flywheel of a model engine must be made disproportionately thick.

Fortunately, however, the effect of scaling-down is often either neutral or even beneficial; for example, a model boat can withstand misfortunes



which, in full size, would result in ship-wreck.

What I found for a long time hard to credit is how, in the space of less than $1/2$ in., the delivery cone could convert the kinetic energy of the water-jet into pressure energy. But it can, as I discovered when I started to think about it seriously, and the following figures demonstrate.

As I demonstrated in an earlier letter, the water jet enters the delivery cone with a velocity of about 230ft./second. The kinetic energy of one pound of water is given by $(1/2Mv^2)$ which in this case is given by $(1/2 \times 1 \times 230^2) = 26450$ ft. poundals.

The throat diameter of the cone, as we shall find later, is 0.021in., whereas its far end diameter, as I have just ascertained by measurement, is approximately 0.065 inch. The increase in the area of cross-section is therefore in the ratio of $(0.065/0.021)^2 = 9.6$.

The velocity of the water is accordingly reduced in the same ratio, that is, to $(230/9.6) = 24$ ft./second.

Its kinetic energy is now only $(1/2 \times 1 \times 24^2) = (1/2 \times 576) = 288$ ft. poundals.

Assuming that no energy has been lost in turbulence, the difference, $(26450 - 288) = 26162$ ft.pdl.s has been transformed into pressure energy, and of the original kinetic energy, this is $(26162/26450) \times 100 = 98.9\%$.

I will admit I found this result astonishing, but when you think about it, the basic ratio of a 1:3 increase in the diameter of the cone was magnified to the power of 4 in the calculation. I imagine that similar astonishment is the unhappy lot of those who are foolish enough to accumulate debt at compound interest.

Pivot drill

Well, if nothing else, these discursions make for variety, but it is time for us to return to the business of injector-making. As I said before, all the credit for arriving at the size of the cones must be ascribed to LBSC, but I do think that I have made some minor improvements on his methods.

Care is required in making the cones in two respects. First, in turning the outside diameters accurately to size, and secondly, in producing the smallest diameters of the bores, which should be short cylinders, no more than $1/32$ in. long. If you take care of these two matters, you should have no trouble.

If you do as I did, and I use cast gunmetal throughout, you will first have to produce the raw material by cutting the gunmetal stock, whatever it may be, into $5/16$ in. slabs, and then cutting these into pieces like potato chips $5/16$ in. square. If it pleases you to do so, you can proceed to turn these into cylinders by turning one end cylindrical in the 4-jaw, and when you have done this to all of them, fitting the 3-jaw and turning the other ends cylindrical as well. It won't matter if they are a bit irregular.

There is one more small tool for you to make before proceeding further, and I am sorry that I did not think of it before. It is a little drill for making the centres from which the drills can start. I don't think that I have mentioned such a thing, before, but it belongs to the family of 'pivot drills', and it is shaped like a pointed D-bit. I can't say for certain, but my supposition is, that they were given that name because they were used by the old time clock makers to drill

the holes or pivots to receive the arbors of the clock. If you had to use some crude contraption like a bow-drill which rotated to-and-fro, the pivot drill would cut on both the forward and backward stroke. For the present purpose, it has the advantage over other types of drill of coming to a sharp point. I have made you a sketch of it (fig 1), and you can make it from silver-steel — $1/8$ in. dia. would do. The angle of the point can be about 60deg. and, as with a D-bit or a reamer, the flat is formed by filing half the diameter away. There is no point in making the little drill any longer than you have to, and I don't think that I need repeat the rigmarole of hardening and tempering.

Combining cone

It will be best for you to dispose of the combining cone first, because this has to be a press fit in the centre of the injector bore, and on its way in it will be liable to enlarge the bore slightly. Consequently, if you had made your steam cone first, and as our mentor advises, an "easypush fit" in the bore, you might very well find that after the combining cone had been pressed in, the steam cone was no longer a press fit of any kind at all.

Start by cutting out a small block of gunmetal, about $1/2 \times 1/4 \times 3/16$ in. and face one of the $1/2 \times 1/4$ in. sides. This will form one half of the cone, which is to be of the Holden & Brooke pattern in two separate parts, spaced $1/32$ in. apart (fig 2). LBSC offered a cone of the 'Sellers' pattern as an alternative (fig 3). If the injector 'knocks off' (i.e., stops operating) the steam, now running wild, finds an easy escape route by way of slots in the sides of the cone, which serve the same purpose as the gap between the two parts of the Holden & Brooke cone. I specify the latter pattern, for the good reason that I have never been able to make one of the Sellers type successfully. I shall have to break off at this point, but I'll be back.

Your affectionate Grandpa,

●To be continued.

TRADE TOPICS

WORKSHOP DRAWING

by Tubal Cain

No. 13 in the

WORKSHOP PRACTICE SERIES

Published by Special Interest

Model Books Ltd.

ISBN 1-85486-182-4

Price £6.95

Available from Highbury Leisure
Customer Services.

While recently chatting with an acquaintance, I happened to mention that I was reviewing a copy of the latest edition of Tubal Cain's book *Workshop Drawing*. He suggested that this work is obsolete as most technical drawing is now done on the various computer aided drafting packages available. Of course, he was wrong in the assumption that the advent of computer aided design automatically makes good draftsmen. Being able to use a CAD program no more makes you a good draftsman than a word processing one makes you an award-winning author.

To be able to produce good drawings, whether manually or on a computer screen, requires knowledge of engineering coupled to an understanding of the conventions used to convey information to the person making the part. This book is designed such that someone with engineering knowledge but an absolute beginner at technical drawing could, with careful study and practice, produce and read engineering drawings. In that alone it is possibly unique as most books on the subject are textbooks designed to be used in a class environment.

Tubal Cain (the late T. D. Walshaw) was the ideal person to produce a book of this nature as not only was he an accomplished model engineer and writer on model engineering matters, he also

had broad experience as a teacher of engineering topics including drawing.

The book is divided into eleven sections. The first two sections deal with the rules and 'grammar' of drawing and the conventions of 'projection'. Subsequent sections then deal with hidden details and sections, dimensioning, the conventional representation of such things as screw threads, tolerancing and machining marks. Section 8 deals with the actual making of drawings and sketches and defines the tools needed to produce drawings the conventional way using pencils and a drawing board. Section 9 gives advice on reading drawings and section 10 explains how to make developments and intersections. The final section deals with the topical issue of converting drawings from imperial to metric standards and vice versa. Two appendices give information on the theory of orthographic projection and standard sizes of drawing paper. A full index is provided.

This edition amalgamates Tubal Cain's text with some completely new illustrations and technical drawings especially created for the purpose. Stan Bray, who will need no introduction to regular readers of this magazine, researched these new illustrations.

If you are already an accomplished draftsman then this book will serve as an *aide memoire*. If you are a beginner it is required reading and should be read before attempting to produce engineering drawings either manually or on a computer screen. Printed in paperback *Workshop Drawing* by Tubal Cain, ISBN 1-85486-182-4 is No. 13 in the Workshop Practice Series. It costs £6.95 and is published by Special Interest Model Books Ltd., Stanley House, 3 Fleets Lane, Poole, Dorset BH15 3AJ; tel: 01202-649930; fax: 01202-649950; email: chrilloyd@globalnet.co.uk N.R.

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The new Myford oil gun doesn't leak

TRIED AND TESTED!

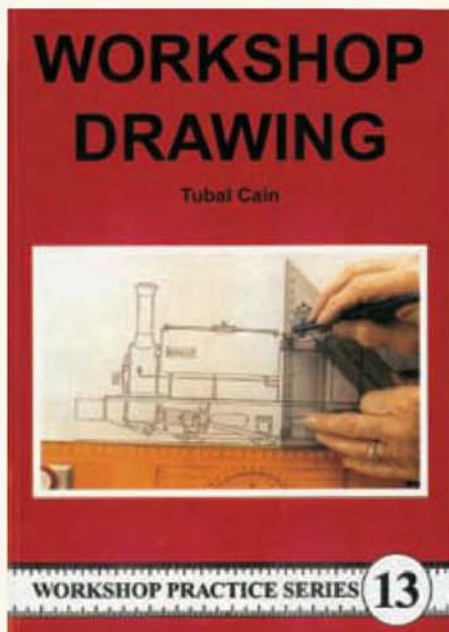
NEW OIL GUN

FROM MYFORD LTD.

Recent correspondence concerning Myford oil guns probably brought back memories for many readers who own and operate this make of lathe. The lathes do not change much over the years, least of all their quality, but the oil guns supplied certainly do. My first lathe, an ML7 purchased over thirty years ago, came with a small oil gun finished in a hammered green paint finish. I suspect it was a Tecalemit product as I had a larger version in an identical finish with this company's trademark on the cap. Otherwise satisfactory, this oil gun tended to leak and this, coupled with its limited capacity, which was little more than the average egg cup, meant that it had to be filled every couple of days or so. I got round this by transferring the Myford nozzle adaptor from the small Tecalemit gun to its bigger brother and used this until I parted with the lathe. It leaked but its larger capacity meant I had to fill it up less frequently.

When the current Super 7 arrived it came with a small, black Wanner oil gun of rather superior construction. Strangely, for a product from a company with the reputation of Wanner, it leaked like a sieve and I went back to using my faithful large old Tecalemit gun. Some time later another of the little black Wanner guns came my way and for some reason this is oil tight. I guess the later ones were fitted with the correct seals for oil and the early ones were not.

When the subject of these notes was presented to me for test I therefore surveyed it with a cynical eye. True, it is an imposing looking device some 12in. long overall, but all oil guns tend to leak — it is just that some leak more than others, right? Well, I have to tell you now that this one does not. It just so happens that my Super 7 has been receiving a fair bit of use recently and I



have therefore called on the new oil gun to perform its duty most days during the course of the past three weeks. When not in use it has been laid on a clean white paper kitchen towel.

To try to provoke a leak I have stood the thing on end and on its side. The only leak has been from the nozzle when it has been stood over-night with the nozzle pointing down. This was not leakage but residual oil left in the nozzle draining out. It left a slight stain about 1½in. across. Placed on a surface any other way up it does not leak. It also lubricates the lathe beautifully — the oil goes in

with a positive action that tells you it is getting where it is needed. It is the only oil gun I have that can live near the machine and does not need to be stored in a drip tray. Indeed the only criticism I have of it is that it is too long to enable me to apply it to the oil nipple lubricating the rear saddle slide.

For economy of space my Myford stands very close to the wall and is fitted with an industrial style splashguard of my own design and manufacture. The space between the splashguard and saddle is insufficient for this length of gun. I can hardly blame Myford for this and an angled

nipple would solve the problem for me. Until I sort this out the small Wanner has to serve this particular lubrication point.

This new oil gun is now available and costs £35.70 inclusive of VAT and delivery. This is not cheap but you should save a good deal on oil over the coming years which can only be good for your wallet and the environment. Contact **Myford Ltd.**, Wilmot Lane, Chilwell Road, Beeston, Nottingham NG9 1ER; tel: 0115-925-4222. email: sales@myford.com website: www.myford.com

Neil Read



At the time of writing, we have just received a bundle of newsletters and assorted documents at the Editorial offices which have been delayed by being sent to Orpington. We would remind those seeking publicity for forthcoming club events that newsletters and other items for inclusion in *Club Chat* should be sent to the Model Engineer Editorial Office, PO Box 310, Hemel Hempstead HP3 8XL. This will avoid delays and the possibility of missing advance publicity for your events because the date has passed by the time we get the details.

UK News

The celebration to mark the 10th anniversary of operations at the Summerfields site of the **Bedford MES** was a great success with many visitors arriving to test out the new hydraulic locomotive unloading ramp and to enjoy running on the raised and ground level tracks. A number of traction engines and other steam road vehicles also took part. Mary Jolliffe organised a superb evening meal for the participants on the Saturday evening while a visiting fish and chip van provided sustenance on the Friday evening. Several traders also attended and we hope they did brisk trade. The society's own 'Uncle Wainwright' used more forceful methods to ensure no-one 'escaped' without a 'bargain'.

Bournemouth DSME members have had a successful year with the commissioning of their new track and some enjoyable meetings using the new facilities. Thoughts are now turning to plans for the new engine



Bedford MES regular Mary Ann raises steam in preparation for a busy day of passenger work ahead.

shed. A new traverser is under construction and the track is due to be officially opened in April by the Mayor. Editor Richard Harvey visited the Sinsheim event this year and thoroughly recommends the trip.

The full size **Bure Valley Railway** reports a very successful 2003 with an increase of nearly 4% on passenger numbers over the previous year. Their new operating season will start a daily service on 4 April. Further information is available by contacting the railway on 01263-733858 or visiting www.bvrw.co.uk for more information. Anyone wishing to become a volunteer helper on the railway should e-mail Andrew Tunwell on volunteer_coordinator@bvrw.co.uk

We have received the winter edition of the *Cardiff Messenger*, the newsletter of **Cardiff MES** and a splendid publication it is too. It includes what I can only describe as a 'rogues gallery' of portraits of the full committee together with their responsibilities which fulfils the serious point of making sure club members know who they are and what they do. The annual visit by model engineers from Brean Sands was marred by heavy rain in the morning so the visitors enjoyed Trevor Bailey's videos until an early fish and chip lunch before taking to the track in the better afternoon weather. Another picture in the newsletter shows 'Santa's Gnomes'

wrapping 550 parcels in preparation for the regular Santa Specials. The society is having a good season of winter talks including *Even More on the Winding Engines* by Brian Davies on 18 March, and on 25 March, *Steel Making* by Don Norman.

Another club celebrating a new track and station building is **Chichester DSME** which reports a good year and has several projects planned for this year, including a new club locomotive, proper brakes on the ground level trains and general maintenance and improvement of the premises. The club is investigating ways to attract new members, so anyone who would like to get involved should contact Secretary Brian Bird on 01243-536468 or at brian.bird@ukgateway.net who will no doubt be pleased to hear from you.

Because track maintenance work on the Goffs Park Light Railway of **Crawley Model Engineers** was completed early, members enjoyed a running day on 7 December with several locomotives in attendance. One member's gas fired *Trevithick* struggled round due to the cold weather freezing the gas tank. The track ran well with a "couple of tight spots" being "ironed out by the weight of a 'Warship' and its passengers." The annual fish and chip supper went up market this year with table decorations and the



A 'Majestic' sight; Bedford MES President John Saunders' Burrell certainly justifies its name.

lights turned down low. This was set up by Jean and Dave Cox.

Leyland SME is considering extending the ground level track to a continuous run of 900 metres. This is dependent on obtaining planning permission, so we wish them success with this venture. The club suffered from "leaves on the line" in the autumn with the short 1:40 gradient proving particularly troublesome. Membership is reported as steady at around 110 with several members now showing an interest in Gauge 1. The club has a website at www.leylandsme.co.uk Members are having (had?) an evening talk on 18 March under the topic *Backhead Evening - or How Do You Make Scale Fingers?* Members are also exhibiting at the **Northern Association of Model Engineers** exhibition at the Risley Centre, Warrington on March 27/28.

Maxitrak Owners Club has a new Chairman in the person of David Oliver. We wish David every success in his role. The society boiler test day is to be held Saturday 3 April at the Staplehurst factory on a "first come first served basis."

Despite the heavy rain, some 15 members of **Saffron Walden DSME** arrived for the New Year's Day steam up. No doubt because of the weather, only "two hardy members" ventured onto the track. The lunch menu included hot sausages, sausage rolls, bread pudding

plus beer, white wine and mulled red wine to wash it all down. Does this explain why the other 13 turned up, I wonder? Good progress is reported on the club locomotive with frames, buffer beams and stretchers "all but finished." The club is looking for suggestions for a name for the locomotive, answers on a postcard please to Jonathan Leech, 9 Mill Road, Henham, Bishops Cleeve, Shropshire CM22 6AD. Some work has been carried out on the signals but is delayed because of the weather.

Members of Scunthorpe SME have spent some time and effort in building extensions to their 5/3 1/2 in. gauge track at Normanby Hall Country Park. When complete the extensions will bring the track length to just over 1,800ft. complete with station, steaming bays and signalling system. The society wishes to thank Bell Waste Management for providing and transporting the "hundreds of tons of soil" needed for the extensions. The official opening is set for this summer on a date as yet to be announced. Further details from Mr. B. Emerson on 01724-840264.

Members of Stamford MES were recently treated to a presentation on clockwork train sets by David Smith which raised a lot of interest, particularly among the "older age group" who no doubt

remembered such things from their early days. David brought a display of 'umpteenth' train sets, mostly in pristine condition and regaled the audience with tales of the acquisition of the 'goodies'. Member Steve Taggart is looking for a chuck key for the Calx (or Galex) chuck on his Potts milling spindle. The problem is that the hole in the chuck is for a 1 5/64 in. spigot rather than the more normal 1/4 in. diameter. Any readers with a suitable key surplus to requirements can contact Steve via newsletter Editor David Ash on 01780-751211.

Sutton Coldfield MES had a successful bonfire night celebration after a busy day setting the fire and carrying out all the other preparations associated with the event. The bonfire was lit at 6:15pm by Rosemary Hadley who was 'honoured' to be allowed to perform the task. The fire burnt well and the resulting sparks necessitated urgent action by 'Gladiator Harrison' and 'Fireman Davies', complete with dustbin lid shields and hoses, to prevent the site going up in smoke. After this entertainment the onlookers enjoyed burgers, baked potatoes and train rides followed by the firework display. In August, the club also hosted a display by Kingsbury Water Park MBC. The visitors brought so many boats with them that some had to remain in car boots

in spite of 28 being on display.

Taunton Model Engineers are producing some new passenger vehicles to drawings by Steve Gosling. Members are also making good progress at the new site at Creech and "an amazing amount of trackwork" is available for the new site. It is hoped that the first phase will be down following completion of the civil engineering works early this year. The floor of the stock shed has been concreted and awaits further work while issues connected with the building regulations are clarified. The club 'lost' 20 fence rails on 6 November, apparently stolen to order as there was no other damage and the fence posts remained in position. New rails have been bolted in position and the heads riveted over as a precaution. The club is also planning an exhibition to be held on 3/4 April.

Another successful Guy Fawkes night was staged by members of the Tyneside SMEE with two locomotives on the track, Eddie and Joseph Gibbons with their GNR 4-4-2 and Malcolm Halliday's SNCF 4-8-0 driven by Dave Dunbar. Both these locomotives are 3 1/2 in. gauge. Bill Lancaster served tomato soup and hot dogs in the club house. The club also held a 'bring and buy' sale in December with various items for sale, including a computer and a video recorder alongside more

usual model engineering items. The society is celebrating its 60th anniversary this year with a special open weekend Martin Evans Rally in May. We will publish further details when we have them.

Members of Wigan DMES came "down to earth with a bit of a bump" in November with a 'Bits and Pieces' evening after the "splendid presentation by Dr. Michael Bailey" the previous month. Members are still having to mount security patrols in their car park on meeting nights to deter vandals. Perhaps we model engineers need to sponsor our own MP to push for better policing and proper deterrents for these sad individuals. At the Bits and Pieces evening, member Frank Parsons got things rolling with some "very large bits indeed." These were the wheels and cylinder assembly for his 4 1/2 in. scale Burrell traction engine. Frank was awarded the Noble Cup for the "superb standard" of his efforts on this large model. Congratulations are due to Frank from us all. The newsletter contains an excellent photo montage of "runners and riders" behind their locomotives during the season. Wigan is another club exhibiting at the Northern Association Exhibition. The Wigan Editor has decided that the best solution to Christmas is a good book and has been enjoying a

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.

MARCH

- | | | | |
|-------|--|----|---|
| 19 | Canvey R&MEC. Keith Catchpole: The Longmoor Military Railway. Contact Brian Baker: 01702-512752. | 22 | Hornsby ME. Meeting. Contact Ted Gray: 9484-7583. |
| 19 | Kinver & West Midlands SME. Bits & Pieces. Contact John Campbell: 01384-891244. | 23 | Historical MRS (East Lancashire/North Manchester Area). Jamie Guest: 'Long Preston' Traffic & Rolling Stock Research. Contact John Sykes: 01706-823989. |
| 19 | North London SME. Work in Progress. Contact David Harris: 01707-326518. | 23 | Surrey SME. AGM. Contact John Cook: 020-8397-3932. |
| 19 | Rochdale SMEE. Annual Models Competition. Contact Mike Foster: 01706-360849. | 23 | Sutton Coldfield MES. Doug Hewson: Ground Level 5in. Gauge Railways. Contact Neal Harrison: 0121-378-3992. |
| 19 | Romford MEC. Geoff Silcott: Sentimental Journeys. Contact Colin Hunt: 01708-709302. | 24 | Birmingham SME. AGM. Contact John Walker: 01789-266065. |
| 19 | Steam LS of Victoria. Gathering. Contact Graham Plaskett: (03) 9750-5022. | 24 | Chingford DMEC. Len White: Smaller Gauges. Contact Martin Masterson: 0208-989-5552. |
| 19 | Woking MRS. AGM. Contact Ronald Dewar: 01932-343331. | 24 | Harrow & Wembley SME. Photo Competition. Contact Dr. Roger Greenwood: 020-8427-2755. |
| 19 | Worcester DME. AGM. Contact M. Lane: 01905-425972. | 24 | Guildford MES. AGM. Contact Dave Longhurst: 01428-605424. |
| 20 | Chesterfield MES. Running Day. Contact Mike Rhodes: 01623-648676. | 25 | Cardiff MES. Don Norman: Steel Making. Contact Trevor Jenkins: 029-2075-5568. |
| 20 | Historical MRS (Scottish Area). Richard Chown: Building an Exhibition Layout. Contact Richard Crockett: 01896-750730. | 25 | Harlington LS. Graeme Matthews: London Bridge. Contact Peter Tarrant: 01895-851168. |
| 20 | Stamford MES. AGM. Contact David Ash: 01780-751211. | 25 | Romney Marsh MES. 35th Anniversary Dinner. Contact John Wimble: 01797-362295. |
| 20 | Steam LS of Victoria. Club Run. Contact Graham Plaskett: (03) 9750-5022. | 25 | Sutton MEC. Models Old & New. Contact Mike Dean: 0208-657-5401. |
| 20 | Southern FMES. AGM. Contact Brian Thompson: 01920-830629 (eve). | 25 | Wimborne DSME. Andrew Farmer: The Revised Track & Signals. Contact Eric Basire: 01202-897158. |
| 20 | Rotherham DMES Model Engineering and Hobbies Show at the Rawmarsh Leisure Centre, Barbers Avenue, Rawmarsh. 10am-4pm. Adults: £2, Concessions: £1, Family: £5. Enquiries 01709-529976. | 25 | Worthing DSME. Summer Public Running Roster/Bits & Pieces. Contact Bob Phillips: 01903-700642. |
| 20 | York City & DSME. Members' Talks. Contact Pat Martindale: 01262-676291. | 26 | Brighton & Hove SMLE. Murray Scott: Photographing Combustion Engines. Contact Mick Funnell: 01323-892042. |
| 20/21 | Guild of Model Wheelwrights at the Shire Horse Show, East of England Showground, Peterborough. Contact Biddy Hepper: 01492-623274. | 26 | Chichester DSME. Club Night/Workshop Evening. Contact Brian Bird: 01243-542266. |
| 21 | Basingstoke DMES. Members' Running Day. Contact Ian Shanks: 01420-561741. | 26 | Colchester SMEE. Models and Project Evening. Contact L. G. Hammond: 01376-511686. |
| 21 | Frimley & Ascot LC. Club Running. Contact Bob Downman: 01252-835042. | 26 | Hereford SME. Meeting: Safe Operating Practice on Open Days. Contact Richard Donovan: 01432-760881. |
| 21 | Leighton Buzzard NG Rly. Mothering Sunday Running. Enquiries: 01525-373888. | 26 | Historical MRS (Essex Area). Alan Rhodes: Shrewsbury to Tremadog Bay. Contact Jem Harrison, 27 Colne Place, Basildon, Essex SS16 5UZ. |
| 21 | Leyland SME. Boiler Testing Day. Contact Mark Entwistle: 01772-422411. | 26 | Kinver & West Midlands SME. AGM. Contact John Campbell: 01384-891244. |
| 21 | Northampton SME. Boiler Testing Day. Contact Pete Jarman: 01234-708501. | | |
| 21 | Woking MRS. Mothering Sunday Running. Contact Ronald Dewar: 01932-343331. | | |
| 21 | York City & DSME. Running Day. Contact Pat Martindale: 01262-676291. | | |
| 22 | Bedford MES. Alan Gildersleeve: SMR Operating Procedures. Contact Ted Jolliffe: 01234-327791. | | |

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.

Ted Eames
Pat Lee
Charlie Stokes

Tyneside SMEE
Crawley ME
Otago MES

Sherlock Holmes story set around the Metropolitan Railway in 1895.

Gary Sutton of the **Wortley Top Forge Model Engineers** describes the rapid construction of a planked bogie wagon driving car prior to his visit to Stoemgroop Turnhout in Belgium last year. The truck was needed so that both Gary and his 10 year-old son could ride behind the locomotive when his son was driving. The main construction was welded, which Gary describes as "not one of his better skills" a point of view with which I sympathise as I have the same problem. The truck was completed in time (just) with the final paint touch up being done late in the afternoon on the day prior to travelling. The wagon performed perfectly during the three-day event and was very stable. Member Peter Stokes described the construction of his County Donegal Railcar No. 4 which has an MDF body and electric power. For those unfamiliar with this design, it can only be described as a 'bus on railway wheels' but I am sure the full size versions were an ideal solution to the need for a small cheap to operate railway service. Alan Ripley bemoans the rapidly disappearing art of writing with proper pens with nibs and ink and wonders how many modern children have actually seen a proper pen.

Talking of writing leads us neatly

into the fact that **York City DSME** have a new secretary in the person of Pat Martindale who may be contacted at 4 The Crayke, Marton Fields, Bridlington, East Yorkshire YO16 5YP; tel: 01262-676291 or by email: honsec@yorksmee.org.uk

World News

Canada

Members of **Hamilton MEC** have had some interesting meetings recently with members describing items including using faceplates, patterns and foundry work by Jim Small, variable feed drives for milling machines, machining exhaust flanges for radial engines among other things. Harry Savile has coined the model engineering term 'wimbly' to describe the lack of rigidity of a large angle plate for machining heavy castings. Harry is building a 2-10-4 locomotive and the trailing truck was the item in question. The locomotive in question had a booster on the truck but on Harry's locomotive "what will look like a booster will really be the axle pump." The club reports that paid up members are down this year from 61 to 55.

At the January meeting of the **Toronto SME** Jim Small (he must move around a lot!) demonstrated

preparation of mould boxes and making cores using water glass. George Cockburn described his Gauge 1 locomotive which was displayed with an assortment of home built goods wagons. Dave Sage talked about the *Acadian* 3hp two stroke engine he is restoring. The engine dates from the 1930s. Jeff Kingma displayed a tool grinder he has built and Gerry Reed explained how he removed a broken quill from a Jacobs chuck.

New Zealand

The **Southland SME** club locomotive has been taken away to be repaired. Tom Frew also reports that there have been "lots of boats sailing on the pond" on the nice long summer Wednesday nights. Patrons at the pre-Christmas train runs also enjoyed the model railway layouts and boats in operation on the day. The club hosted visits from one American and two Australian groups of model engineers over what turned out to be a busy Christmas period.

South Africa

Members of **Centurion SME** are considering building a roof over their steaming bay, preliminary sketches for which have been

produced by Chairman Rudy du Preez. Other projects for this year include a raised track and improving point operation. The newsletter also contains two interesting observations: "Despite the cost of living, have you noticed how popular it remains" and "Nothing is foolproof to a sufficiently talented fool." The society is considering a proposed new constitution which is intended to be "more user friendly." Having spent 20 years in the computer industry, I have a somewhat jaundiced view of that phrase!

The two **Rand SME** Honda 'diesel' locomotives are having "major surgery" to change the gauge from 5in. to 7 1/4 inch. This work is under time pressure as these two locomotives form the mainstay of the society's money earning public running programme. Some details of 'the incredible elbow engine' mentioned in these pages some time ago have been produced by Deon Bouver. This engine has six cylinders but only five moving parts and is apparently based on a type of constant velocity joint known as a Hobson's Coupling. Deon also mentions the full size Wright *Whirlwind* nine-cylinder radial engine he acquired as one of three being sold for R75 two years ago. The engine needed minimal work to get it running.

- 26 **North London SME. Workshop Evening.** Contact David Harris: 01707-326518.
- 27 **Ascot LS (2003). Society Annual Dinner.** Contact Derek Alford: 01344-482485.
- 27 **Chichester DSME. Customer Care Day.** Contact Brian Bird: 01243-542266.
- 27 **Historical MRS (Bristol Area). Gerald Davies: Railways of Sirhowy Valley.** Contact Gerry Nichols: 0117-973-1862.
- 27 **Hornsby ME. Family Day/Boiler Inspection.** Contact Ted Gray: 9484-7583.
- 27 **Tiverton DMES. Exhibition** at St. Georges Church Hall, off Fore St., Tiverton, Devon. 10am-5.00pm. Contact C. J. Shields, Garden Cottage, Colipriest, Tiverton, Devon EX16 4PT.
- 27/28 **Model Railway Club. London Festival of Railway Modelling Exhibition** at Alexandra Palace. Advance booking (to 15 March 2004): Adults: £7.50, Children: £3.50, OAP: £6.50, Family (2+3): £20. Information and Ticket Hotline: 01778-391134.
- 27/28 **Northern Ass'n MES. Exhibition** at Risleigh Conference Centre, Birchwood Park, Warrington. Admission: Adult £2.50, Children 50p. Sat 10.00-17.00, Sun 10.00-16.00. Contact Eric Clifford: 01253-860970.
- 28 **Bedford MES. Road Vehicles Boiler Test Day.** Contact Ted Jolliffe: 01234-327791.
- 28 **Bristol SMEE. Public Running Day.** Contact Trevor Chambers: 01454-415085.
- 28 **Canvey R&MEC. Operating Safety Refresher.** Contact Brian Baker: 01702-512752.
- 28 **Cardiff MES. Open Day.** Contact Trevor Jenkins: 029-2075-5568.
- 28 **Great Western Soc. (Didcot Railway Centre). Didcot Steamday.** Contact Jeanette Howse: 01235-817200.
- 28 **Harlington LS. Alternative Hobbies.** Contact Peter Tarrant: 01895-851168.
- 28 **King's Lynn DSME. Members' Playday.** Contact Mike Cootie: 01533-673728.
- 28 **Maidstone MES. Public Running Day.** Contact Martin Parham: 01622-630298.
- 28 **Steam LS of Victoria. Working Party & Barbecue Lunch.** Contact Graham Plaskett: (03) 9750-5022.
- 30 **Basingstoke DMES. Meeting Night.** Contact Ian Shanks: 01420-561741.
- 30 **Stafford DMES. AGM & Auction.** Contact Chris Dobbs: 01889-270533.
- 30 **Wigan DMRS. Bits & Pieces.** Contact S. Roberts: 01695-726626.
- 31 **Chingford DMEC. Members' Video Evening.** Contact Martin Masterson: 0208-989-5552.
- 31 **Historical MRS (Bedford Area). Ron White: LNER & ER Colour Rail.** Contact John Chamney: 01442-851214.

APRIL

- 1 **Cardiff MES. Bits & Pieces.** Contact Trevor Jenkins: 029-2075-5568.
- 1 **Harlington LS. Loco Night.** Contact Peter Tarrant: 01895-851168.
- 1 **Leyland SME. Call My Bluff Night.** Contact Mark Entwistle: 01772-422411.
- 1 **South Lakeland MES. Meeting.** Contact Adrian Dixon: 01229-869915.
- 1 **Sutton MEC. Bits & Pieces.** Contact Mike Dean: 0208-657-5401.
- 2 **Canvey R&MEC. Speaker from Modelworks International.** Contact Brian Baker: 01702-512752.

- 2 **Colchester SMEE. Hugh Mothersole: Switzerland, an Engineer's View.** Contact L. G. Hammond: 01376-511686.
- 2 **Vale of Aylesbury MES. Photo Competition.** Contact Clive Ellam: 01296-623433. Ian Meikle: 01844-291590 or Bob Jones: 01296-29468.
- 2 **Kinver & West Midlands SME. Bring & Buy.** Contact John Campbell: 01384-891244.
- 2 **Maidstone MES. Guest Speaker.** Contact Martin Parham: 01622-630298.
- 2 **North London SME. On The Table: Work in Progress.** Contact David Harris: 01707-326518.
- 2 **North Norfolk MEC. N. Digby: My Modelling.** Contact Gordon Ford: 01263-512350.
- 2 **North Wiltshire MES. AGM.** Contact Les Stiff: 01249-521658.
- 2 **Rochdale SMEE. John Hopkins: The Welsh Highland Railway.** Contact Mike Foster: 01706-360849.
- 2 **Romford MEC. Competition Night.** Contact Colin Hunt: 01708-709302.
- 3 **Isle of Wight MES. Track & Pond at Broadfields.** Contact Ken Stratton: 01983-531384.
- 3 **Maxitray Owners Club. Boiler Test Day.** Contact Eric Penn 0208-979-4335.
- 3 **York City & DSME. Allan Birkin: Preservation Permanent Way.** Contact Ken Bateman: 01904-421445.
- 3/4 **Dockland & E. London MES. Miniature Passenger Train Services.** Contact P. M. Jonas: 01708-228510.
- 3/4 **Llanelli DME. Spring Rally.** Contact P. C. Bassett: 01554-820294.
- 4 **Canvey R&MEC. Sunday Running Commences.** Contact Brian Baker: 01702-512752.
- 4 **Cardiff MES. Steam-Up and Family Day.** Contact Trevor Jenkins: 029-2075-5568.
- 4 **Frimley & Ascot LC. Public Running.** Contact Bob Dowman: 01252-835042.
- 4 **Great Western Soc. (Didcot Railway Centre). Didcot Steamday.** Contact Jeanette Howse: 01235-817200.
- 4 **Kew Bridge Steam Museum. 5th Stirling Hot Air Engine Rally and Competition.** 11.00am-5.00pm. Adults: £5.20, OAP's and Students: £4.20, Children (5-15 years) £3.00, Family: £15.95. Information: 020-8568-4757.
- 4 **Lancaster & Morecambe MES. Running Day.** Contact Harry Carr: 01524-411956.
- 4 **Leyland SME. Ground Level Public Running Day.** Contact Mark Entwistle: 01772-422411.
- 4 **Northampton SME. Boiler Testing Day.** Contact Pete Jarman: 01234-708501 (eve).
- 4 **Ottawa Valley Live Steamers. Meeting.** Contact John Bryant: 761-1109.
- 4 **Oxford (City of) SME. Public Running.** Contact Chris Kelland: 01235-770836.
- 4 **South Durham SME. Steaming Day.** Contact B. Owens: 01325-721503.
- 4 **Steam LS of Victoria. Public Run.** Contact Graham Plaskett: (03) 9750-5022.
- 4 **Surrey SME. Members' Steam Up.** Contact John Cook: 020-8397-3932.
- 4 **Sutton Coldfield MES. Steam Up.** Contact Neal Harrison: 0121-378-3992.

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- 4 Vale of Aylesbury MES. First Steaming of the Season. Contact Clive Ellam: 01296-623433. Ian Meikle: 01844-291590 or Bob Jones: 01296-29468.
- 5 Frimley & Ascot LC. Evening Meeting. Contact Bob Dowman: 01252-835042.
- 5 Leicester SME. John Ballis: Video Evening. Contact Raymond Wallis: 01162-858824.
- 5 Lancaster & Morecambe MES. Topic Night: Marking Out. Contact Harry Carr: 01524-411956.
- 6 Auckland SME. Terry Boyd: Materials Testing. Contact Gary Farquhar: 576-7025.
- 6 Romney Marsh MES. Vintage Film Evening. Contact John Wimble: 01797-362295.
- 6 South Durham SME. Meeting. Contact B. Owens: 01325-721503.
- 6 Stamford MES. Bits & Pieces. Contact David Ash: 01780-751211.
- 6 Taunton ME. Steve Gosling: Vehicular Autobiography. Contact Don Martin: 01460-63162.
- 6 West Wiltshire SME. AGM. Contact R. Nev. Boulton: 01380-828101.
- 7 Bradford MES. Meeting. Contact John Mills: 01943-467844.
- 7 Chingford DMEC. Bits & Pieces. Contact Martin Masterson: 0208-989-5552.
- 7 Guildford MES. Geoff Meekums: Engineering on the Mid Hants Railway. Contact Dave Longhurst: 01428-605424.
- 7 Harrow & Wembley SME. Auction. Contact Dr. Roger Greenwood: 020-8427-2755.
- 7 Leeds SMEE. Video Evening. Contact Colin Abrey: 01132-649630.
- 7 Tyneside SMEE. Bits & Pieces. Contact Ian Spencer: 0191-2843438.
- 8 Cardiff MES. Boiler Testing. Contact Trevor Jenkins: 029-2075-5568.
- 8 Sutton MEC. Meccano Night. Contact Mike Dean: 0208-657-5401.
- 9 Lancaster & Morecambe MES. Running Day. Contact Harry Carr: 01524-411956.
- 9 Surrey SME. Public Running. Contact John Cook: 020-8397-3932.
- 9 Toronto SME. Meeting. Contact Art Gordon: (905) 820-1988.
- 9-12 British Columbia SME. Easter Meet. Contact Sean Laurence: (604) 931-1547.
- 9-12 Leighton Buzzard NG Rly. Easter Fun. Enquiries: 01525-373888.
- 9-12 Vale of Aylesbury MES. Thomas' Easter Weekend. Contact Clive Ellam: 01296-623433. Ian Meikle: 01844-291590 or Bob Jones: 01296-29468.
- 10 Brighton & Hove SMLE. Public Running. Contact Mick Funnell: 01323-892042.
- 11 Annerfield Miniature Railway. Public Running. Contact David Jerome: 0118-9700274.
- 11 Harlington LS. Public Open Day. Contact Peter Tarrant: 01895-851168.
- 11 Hereford SME. Public Open Day. Contact Richard Donovan: 01432-760881.
- 11 North London SME. Easter Running Day. Contact David Harris: 01707-326518.
- 11 Leeds SMEE. Easter Sunday Running Day. Contact Colin Abrey: 01132-649630.
- 11 Leicester SME. Public Running. Contact Raymond Wallis: 01162-858824.
- 11 MELSA. Easter Sunday Run for Life Line. Contact Graham Chadbone: 07-4121-4341.
- 11 Pinewood MRS. Public Running. Contact Ivan Hurst: 01276-28803.
- 11 Romney Marsh MES. Easter Track Meeting. Contact John Wimble: 01797-362295.
- 11 Sutton MEC. Track Day. Contact Mike Dean: 0208-657-5401.
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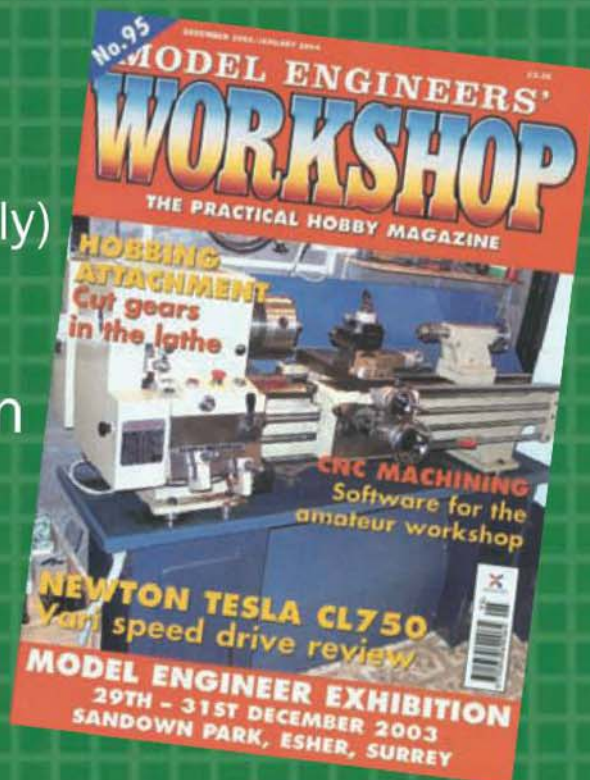
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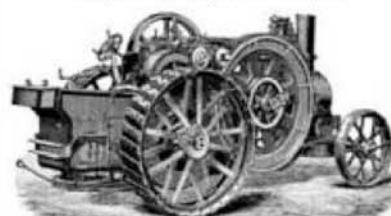
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There is a 3 1/2 / 5" high level track located from 20 miles to the west of Aberdeen at Alford, albeit the track is in need of serious TLC, unfortunately the club has no general workshop facilities and so members tend to work from home. Anyone interested in joining the club should contact: Charlie Milne 01467 621881 or myself Colin Foster 01224 749504 or e-mail: colin.foster@halliburton.com

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Safe operation of pressure systems for the model engineer

Introduction

This information sheet is aimed at model engineers operating, as a hobby activity, models and equipment that include pressure systems. It is provided as guidance as to how the *Pressure Systems Safety Regulations 2000* (PSSR) may be used as a basis for the design, construction, installation, examination, testing, maintenance and safe operation of boilers and ancillary safety devices used in miniature locomotives, miniature traction engines, miniature road vehicles, miniature stationary engines and boats. It also includes information on other pressure vessels to which the regulations equally apply, eg. compressed air systems.

PSSR, strictly speaking, only applies to pressure systems used at work, but there may be some implications when using miniature locomotives, etc. where the public may be present and so in order to demonstrate a commitment to safety it is prudent to follow the principles in PSSR. The HSE considers it good practice for those using such equipment to provide the same level of health and safety protection as they would if they were duty holders under the Regulations. It is suggested that you should obtain a copy for reference.

Anyone operating pressure vessels as part of a work activity or in the course of business will have to fully comply with all relevant statutory legal obligations.

The guidance in this information sheet has been prepared after consultation with:

- Ground Level 5" Gauge Mainline Association
- Health and Safety Executive
- Midlands Federation of Model Engineering Societies
- Model Steam Road Vehicle Society
- Northern Association of Model Engineers
- 7½" Gauge Society
- Society of Model and Experimental Engineers
- Southern Federation of Model Engineering Societies
- Representatives from the trade, manufacturers, model engineering press and insurers

Application of PSSR to model engineering activities

It is worthwhile considering the purpose of the Regulations and how its principles may be adopted by the model engineer.

The aim of PSSR is to prevent serious injury from the hazard of stored energy as a result of the failure of a pressure system or one of its component parts. The Regulations are concerned with steam at any pressure, gases which exert a pressure in excess of 0.5 bar above atmospheric pressure and fluids (which may be mixtures of liquids, gases and vapours) where the gas or vapour phase may exert a pressure in excess of 0.5 bar above atmospheric pressure.

PSSR is concerned with the risks created by the release of stored energy through a system failure. The amount of stored energy in a vessel is directly related to the volume of the vessel and the pressure of the contents, so as pressure and volume increase so does the danger therefrom in the event of a failure. The application of heat to a pressure vessel increases the stored energy and introduces added risks, eg. scalding in the event of a release of steam or hot water.

Obviously, the foregoing equally applies to the safe operation of boilers in miniature locomotives, traction engines, boats, etc. and therefore the principles laid down in PSSR can be used to advantage.

As with all safety matters, the steps that need to be taken to reduce the risk should be commensurate with the level of risk, and the following outlines how the Regulations may be applied by the model engineer. Appropriate extracts from the Regulations appear in *italics*.

Design and Construction

(Reg 4.2) The pressure system shall be properly designed and properly constructed from suitable material so as to prevent danger.

This regulation places duties on the designer and manufacturer to ensure it is fit for purpose, so as to prevent danger. The material used for construction must be suitable for the intended use, and of appropriate thickness. Material certificates may be required in certain circumstances, eg. welded steel boilers, TIG welded copper boilers, stainless steel boilers, etc.

A boiler must be designed for intended use, eg. a traction engine boiler is subjected to additional stresses imposed by the reciprocating motion and road shocks and may have to be of a sturdier construction than a similar sized locomotive boiler.

Those undertaking joining procedures, eg. silver soldering, welding or riveting should do so only if they are sufficiently competent. In this instance, 'competent' may be described as having a level of practical and

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theoretical knowledge that will enable them to produce joints of satisfactory quality and strength. Individuals should know their own limitations and should not undertake joining operations outside their level of qualification, experience or knowledge.

Any boiler manufactured in the course of business and placed on the market after 29th May 2002 needs to comply with the *Pressure Equipment Regulations 1999* (PER) and should be provided with sufficient documentation to show that it complies - see the Appendix and Further Reading sections of this information sheet. A boiler made in the course of business should thereby satisfy the design and construction requirements of PSSR.

Boilers constructed by model engineers, not in the course of business, and put into service for their own use, are not subject to the requirements of PER; although it would be prudent to consider the design and manufacturing criteria within the essential safety requirements of PER, as they contain much useful information as to what is deemed to be good practice. Nevertheless, the design and construction requirements of PSSR should be considered, even though the full application of PSSR to model engineering activities may not necessarily be appropriate.

(Reg 4.3) The pressure system shall be so designed and constructed so that all necessary examinations for preventing danger can be carried out.

Wherever practicable, and particularly for larger boilers, provision should be made to enable internal inspection.

(Reg 4.5) The pressure system shall be provided with such protective devices as may be necessary for preventing danger, and any such device designed to release contents shall do so safely, so far as is practicable.

Provision shall be made for the fitting of protective devices, eg safety valve(s), water gauge(s), pressure gauge(s), etc. Safety valve(s) should be designed and set so that no matter how hard a boiler is worked the pressure will not exceed more than 10% above the working pressure of the boiler.

Information and marking

(Reg 5.4) Any person who manufactures a pressure vessel shall ensure specific information is marked on the vessel in a visible, legible and indelible form.

At the very least a boiler should be marked with a serial number that can identify the boiler against records appertaining to it. The date of manufacture and the working pressure of the boiler should also be included. If space permits, a plate should be permanently affixed to the boiler for this purpose, to enable the stamping of such information without affecting the integrity of the boiler, and that it should be in an easily viewed location, eg. on the backhead above the firebox door. Boilers manufactured in the course of business (after 29.5.02) should additionally identify the

manufacture and those over two litres capacity will need to be be marked with the CE mark.(See Appendix)

Installation

(Reg 6) shall ensure that nothing about the way it is installed gives rise to danger or impairs the operation of any protective device

Ensure that safety valves are clear of obstruction, operate correctly without hindrance or blockage and that the discharge is routed to a safe place. Where possible provide suitable protection against mechanical damage for items such as safety valves, water gauge glasses and pressure gauges. Ensure that water gauges indicate the true water level and are not blocked (fir-cook water gauges should be fitted where practicable. This enables the water gauge to be isolated in the event of a gauge glass failure and also enables the gauge glass to be 'blown-down').

Safe operating limits

(Reg 7.2b) ensure that the system is legibly and durably marked with safe operating limits and that the mark is clearly visible.

In addition to any information marked on the boiler itself, pressure gauges fitted to a model should be marked with a red line indicating the working pressure. Pressure gauges should have a capacity of at least 30% beyond working pressure.

Written scheme of examination

(Reg 8.1) The user shall not operate the system unless he has a written scheme for the periodic examination, by a competent person, of all protective devices every pressure vessel in which a defect may give rise to danger

(Reg 8.3) the scheme of examination shall be suitable and specify the nature and frequency of examination and provide for an examination to be carried out before the pressure system is used for the first time.

A Written Scheme of Examination needs to be formally documented and should include:

- the name of the person or organisation drawing-up the scheme;
- the date the scheme was written;
- identification of the types of model covered by the scheme;
- the parts of the system to be examined;
- the nature of the examination, including inspection and testing of protective devices (e.g. safety valves);
- any preparatory work necessary;
- specify what examination is necessary before the system is first used;

TABLE 3

CATEGORY I
(Boilers above 2 litres volume, up to and including 50 bar-litres, maximum pressure 32 bar.)

Boilers in this category need to have been designed and manufactured in accordance with Module A of the Conformity Assessment Procedures. (Internal Production Control)

What to expect:

Pressure Vessel only.

The boiler should be marked to show the manufacturer's identity, its serial number and the CE mark.

- Documentation should include:
- the manufacturer's name and address;
 - the date of manufacture;
 - the maximum allowable pressure;
 - the volume of the boiler;
 - valid pressure test certificate;
 - intended use;
 - instructions for use;
 - weight (empty);
 - a Declaration of Conformity, that the equipment satisfies the requirements of the Pressure Equipment Directive

Boilers should have the appropriate material certificates.

- Additionally:
- provision should be made to allow the fitting of protective devices (eg a safety valve, a pressure gauge and, if a heated vessel, provision for fitting a device to assess water level);
 - provision should be made to allow the boiler to be drained.

Kits and Completed models.

As Table 2.

The manufacturer will have drawn-up technical documentation for the equipment that includes manufacturing drawings, design calculations, examinations carried out, test reports etc. along with a Declaration of Conformity. Records of materials used in manufacture shall be kept. The manufacturer must keep documentation, for inspection by the relevant national authorities, for a period of ten years from the date of manufacture. A method of internal production control must be established that ensures the manufacturing process enables the manufactured pressure equipment to comply with the technical documentation and meet the requirements of the Directive. All the relevant Essential Safety Requirements must be met.

TABLE 4

CATEGORY II & III
(Category II. Boilers above 50 bar-litres, up to and including 200 bar-litres, maximum pressure 32 bar) (Category III. Boilers above 200 bar-litres, up to and including 3000 bar-litres, maximum pressure 32 bar, maximum volume 1000 litres)

Boilers in these categories need to have been designed and manufactured in accordance with one or more of a number of conformity assessment modules, which increase in severity according to the increase of stored energy in the boiler. Design and manufacture will be monitored by a Notified Body.

What to expect:

Pressure Vessel only.

The boiler should be marked to show the manufacturer's identity, its serial number, and the CE mark, together with the identification number of the Notified Body involved at the production control stage.

Documentation and provisions:

- As outlined for Category I (See Table 3) but:
- all boilers should have the appropriate material certificates (eg, certificates of specific product control), prepared by the material manufacturer, affirming compliance with specification. Barrel tube and plates be marked with the correct numbers, to relate materials to certificates.

Kits and Completed models.

As Table 2.

The manufacturer will have drawn-up technical documentation for the equipment that includes manufacturing drawings, design calculations, examinations carried out, test reports etc. along with a Declaration of Conformity. The manufacturer will work in conjunction with a Notified Body, whose job it is to monitor and verify that the pressure equipment has been manufactured according to the relevant assessment module. Typically the Notified Body will examine the technical documentation and quality control methods, conduct checks on samples, assess materials and check conformity to harmonised standards, approve procedures for joining and verify that personnel undertaking such joining are suitably qualified. All the relevant Essential Safety Requirements must be met. All documentation regarding design, manufacture, quality assessment, examinations and reports from the Notified Body and other similar records must be kept, for inspection by the relevant national authorities, for a period of ten years.

The national organisations that administer the affairs of various branches of the hobby have somewhat more stringent requirements in that whenever steel is used in the construction of a boiler, irrespective of volume or working pressure, full traceability of materials are required and the boiler should be marked with the relevant material codes. Any joining of a steel boiler will have been carried out by a competent welder.

Appendix

For the purposes of this document, it is considered the term 'working pressure' to have the same meaning as maximum allowable pressure in PSSR and PER.

The following tables outline the requirements of PER that a manufacturer making pressure equipment in the course of business would need to meet for the documentation, design and manufacture of boilers likely to be used by the model engineer. Steam boilers are classified according to pressure, volume, or a combination of both.

TABLE 1

LESS THAN 0.5BAR OPERATING PRESSURE. (No upper volume limit)

Below 0.5bar (approx 7.5psi) PER is not applicable. However, the boiler and any ancillary equipment (if supplied) must comply with the requirements of PSSR in matters relating to design and construction.
The pressure system or article shall be properly designed and properly constructed from suitable material so as to prevent danger - PSSR Regulation 4.(2)
The pressure system shall be provided with such protective devices as may be necessary for preventing danger - PSSR Regulation 4.(5)

Pressure Vessel only.
The boiler should be permanently marked to show the manufacturer's identity and its serial number.

Documentation should include:

- the manufacturer's name and address.
- the date of manufacture.
- the minimum allowable pressure (ie. 0.5bar).
- the maximum allowable pressure, if other than atmospheric. (A vessel of such a low operating pressure could be part of a condensing system and therefore subjected to vacuum).
- design temperature.
- valid pressure test certificate.
- operating instructions.
- the standard to which the vessel was built.

Additionally:

- provision should be made to allow the fitting of protective devices (eg a safety valve, a pressure gauge and, if a heated vessel, provision for fitting a device to assess water level).
- provision should be made to allow the boiler to be drained.

Kit.

In addition to the above, the fittings should be supplied and, if a heated vessel, a means of being able to remove or shut down the heat source in an emergency should also be provided.

Completed model.

In addition to the above, the fittings should be installed with the safety valve pressure set and tested. The boiler test certificate should be suitably amended to record this fact.

The manufacturer should be able to provide sufficient written information regarding design and construction as may reasonably, foreseeably be needed to enable the provision of the Regulations to be complied with. The manufacturer doesn't necessarily have to supply such information to the purchaser, but it must be retained for inspection should the need arise.

TABLE 2

BOILERS UP TO AND INCLUDING 2 LITRES VOLUME. (No upper pressure limit)

Boilers in this category need to have been designed and manufactured in accordance with 'sound engineering practice' (SEP) in a Member State in order to ensure safe use.

Pressure Vessel only.

The boiler should be marked to show the manufacturer's identity and its serial number. CE marking shall not be affixed to SEP equipment.

Documentation should include:

- the manufacturer's name and address.
- the date of manufacture.
- the maximum allowable pressure.
- the volume of the boiler.
- valid pressure test certificate.
- intended use.
- instructions for use.
- weight (empty).

Additionally:

- provision should be made to allow the fitting of protective devices (eg a safety valve, a pressure gauge and, if a heated vessel, provision for fitting a device to assess water level).
- provision should be made to allow the boiler to be drained.

Kit.

In addition to the above, the fittings should be supplied and, if a heated vessel, a means of removing or shutting down the heat source in an emergency should also be provided.

Completed model.

In addition to the above, the fittings should be installed with the safety valve pressure set and tested. The boiler test certificate should be suitably amended to record this fact.

The manufacturer needs to be able to show the boiler has been designed and manufactured in accordance with 'sound engineering practice'. Copies of all drawings, calculations, etc relating to its design should be retained to enable subsequent inspection by the relevant authorities should the need arise. The manufacturer doesn't necessarily have to supply such information to the purchaser.

1 bar = 14.5038 psi
1 litre = 1.760 pints
1 pint = 0.568 litres
10 psi = 0.689 bar

- the maximum interval between examinations;
- any parts of the system which if repaired or modified should be examined before it may be used again;
- a description of how the results of the examination are to be recorded and communicated;

Most, if not all, of the foregoing is already documented in one or other of the boiler test codes prepared by the national organisations that administer the affairs of the various branches of the hobby. Individual modellers not belonging to a club, etc are to be encouraged to acquaint themselves with such test codes or other written schemes of examination - see Further Information section of this information sheet.

Examination in accordance with the written scheme

(Reg 9.1a) the user shall ensure the pressure system is examined by a competent person within the intervals specified by the scheme and before it is used for the first time;

A competent person shall examine, test and report on all parts of the system as covered by the foregoing written scheme of examination. This person should be someone other than the designer, builder, owner or seller of the boiler. An independent witness may verify the outcome of the proceedings

In the context of the regulation, a 'competent person' means someone who has sufficient sound practical and theoretical knowledge and experience of the plant he is to examine, as will enable him to detect defects or weakness which it is the purpose of the examination to discover; and to assess their importance in relation to the strength and function of the particular plant. The individual should know his own limitations and should not act outside his level of qualification, experience or knowledge.

Initially, the person who carries out the examination needs to satisfy himself that a boiler has been constructed to the relevant design drawings and that materials of adequate strength have been used in its construction. Particular emphasis shall be paid to the penetration of silver solder used in the jointing procedures, alternatively the adequacy of any welding should be assessed. Once satisfied with a visual inspection of the boiler, a hydraulic test should be carried out, to the pressure as indicated in the written scheme of examination.

Subsequent retests should be made at the specified intervals.

The hydraulic test pressure, for both copper and steel boilers, is twice (2 x) the working pressure for the initial test. The pressure for subsequent tests are at one and a half times (1.5 x) the working pressure.

At the first steaming and at each subsequent test a steam test shall be undertaken to ensure that the safety valve(s) are correctly set and limit the pressure rise to

not exceeding 110% of the working pressure, no matter how hard the boiler is worked, and that the water gauge functions correctly. The operation of injectors and feed pumps should be checked and it should be established that there is an adequate method of refilling the boiler, when in steam, by at least two independent means.

The pressure gauge should be permanently marked with a red line indicating the working pressure of the boiler. This mark should be made to indicate the true pressure when compared against a calibrated master gauge.

Preparatory work may need to be undertaken prior to the examination, eg it may be a requirement of the scheme that after every so many periodical examinations are undertaken a more thorough examination needs to be made of the external surfaces of a boiler, that requires the external cladding be removed.

The minimum requirements for the examination/testing of miniature steam boilers as drawn up by the national model engineering organisations also include information on the equipment and methods to be adopted for boiler testing.

Operation and maintenance

(Reg 11.1) any persons operating the system should have adequate and suitable instructions for the safe operation of the system; and the action to be taken in an emergency;

The user of any boiler should be fully acquainted with its operation. It is recommended that novices in the operation of this type equipment should seek guidance from those experienced in its operation. Consideration should be made to:

- what checks and precautions are necessary before the system is used;
- start-up and shut-down procedures;
- precautions for standby operation;
- the effect of controls and protective devices;
- likely fluctuations expected in normal operation;
- methods of establishing the proper water level in the boiler and maintaining adequate water supplies;
- the requirements to ensure that the system is adequately protected against overpressure at all times;
- safe blowdown of the boiler;
- precautions to be taken when emptying a boiler, eg. allow a reduction in pressure to enable emptying to be safely carried out;
- procedures in the event of an emergency, eg. low water level, shortage of water, bursting of water gauge glass.

(Reg 1.2) The user shall ensure that the system is properly maintained in good repair, so as to prevent danger.

In addition to the periodical examination, a pressure system should be checked prior to each time it is used and any problems identified should be rectified. This may entail nothing more than checking and rectifying faults as outlined below; but may involve more detailed checks and maintenance to systems that have been out of service for a significant period of time, eg. winter lay-up. Problems identified during use of any system should be noted and rectified at the earliest opportunity, the system being taken out of service if there is the likelihood of danger, eg. sticking safety valve. A simple maintenance programme (inspection, replacement of parts, etc) should be decided for all those parts which, through failure or malfunction, would affect the safe operation of the system.

The need for maintenance should not be confused with the requirements undertaken under the written scheme of examination.

Whilst not comprehensive, the following is a list that should be considered before everyday operation:

- does the safety valve(s) operate at its specified release pressure?
- are the waterways clear in the water gauge(s) enabling it to show the true water level?
- do mechanical pumps/injectors work effectively enabling the water level to be maintained in the boiler?
- do the slack valves seat properly?
- does the regulator operate smoothly enabling it to be completely closed and opened?
- is there provision to be able to remove or shut-down the heat source in the event of an emergency, eg. the grate can be removed enabling the fire to be dumped?

Modification and Repair

(Reg 1.3)shall ensure that nothing about the way in which it is modified or repaired gives rise to danger or otherwise impairs the operation of any protective device

The design of any modification or repair should be in accordance with appropriate standards, taking into account the expected future use of the system as well as the original design specification.

Modifications or repairs must be carried out so that the integrity of the system is not adversely affected and that the operation of any safety device is not affected. The design and carrying out of any modification or repair must be undertaken by a person who is competent to do so.

Consideration should be made to the continued suitability of the existing written scheme of examination and alterations made if necessary.

A modified or repaired boiler will require a competent person to examine, test and report on all parts of the system as covered by the (revised) written scheme of examination before it is placed into service. Details of any modification or repair will need to be appended to the documents relating to the system.

Documentation

(Reg 14.1) The user shall keep the last report relating to the system made by a competent person and any such previous reports which will assist in assessing whether the system is safe to operate

(Reg 14.3) Where the owner of the pressure system changes, the previous owner shall give to the new owner anything (documentation) kept by him under this regulation.

It is essential to be able to prove that a particular boiler has satisfactorily passed examination by a competent person. A certificate (Boiler Certificate) is issued to this effect which is normally acceptable by anyone seeking proof that the boiler is safe to operate. The certificates should include the following information:

- a means of identifying that the certificate relates to a particular piece of equipment, eg. serial number of boiler;
- type of boiler;
- material used in construction;
- date of construction;
- date of hydraulic test;
- validity period;
- expiry date;
- maximum working pressure of boiler;
- test pressure;
- date of steam test;
- safety valve working pressure;
- names and signatures of examiner (and witness, if applicable);
- Registration number if a miniature road vehicle that is registered for use on the road.

A boiler certificate is not valid for safe operation until both the hydraulic and steam tests have been undertaken. One copy of the test certificate should be handed to the owner/operator, a second copy should be retained by the examiner.

No boiler/pressure equipment may be used unless the owner/operator is in possession of a valid boiler certificate.

Any modification or repair to a boiler will void a current boiler certificate and it may not be used again until a new boiler certificate is issued.

Any boiler built in the course of business after 29th May 2002 will need to have documentation to show that it has been built in accordance with the Pressure Equipment Regulations 1999.

All documents and certificates should be retained by the owner, along with details of any repairs or modifications to the boiler, thus enabling a historical record of the boiler to be kept. This record should be passed on to the new owner should the model change hands.

Other Equipment

PSR applies to any form of pressure system, and the foregoing principles can also be applied to any system that might have impact on the public and/or club members and their families. For example:

- air compressors used in workshops and signalling/points systems;
- pneumatic systems associated with steaming days;

PSR does not apply to any pressure system that forms part of any braking, control or suspension system of any wheeled, tracked or rail mounted vehicle. (Note that guidance on the required performance of braking systems for miniature railways is given in HSG 276 paras 80-84)

Further information relating to these topics can be found in the relevant publications suggested in the Further Reading section of this information sheet.

Refillable Gas Tanks.

Now known under the generic term 'Transportable Pressure Equipment', gas tanks and valves are subject to their own regulations under *The Transportable Pressure Vessels Regulations 2001 (TPVR) and The Carriage of Dangerous Goods (Classification Packaging and Labelling) and Use of Transportable Pressure Receptacles Regulations 1996 (CDGCP12)* (see the relevant references in Further Reading). The current regulations are due to be replaced in 2004 and further information concerning the application of the new regulations to model engineers will be issued in a separate publication.

Further Reading

Pressure Systems Safety Regulations 2000.
L122 HSE Books 2000 ISBN 0 7176 1767 X

The Pressure Equipment Regulations 1999.
SI 1999/2001 The Stationery Office Ltd.

Pressure Equipment – Guidance Notes on the UK Regulations.
Department of Trade & Industry (November 1999, URN99/1147)

<http://www.dti.gov.uk/srtd/srtdpubs.htm#pressure>

Compressed Air Safety
HSG39 HSE Books ISBN 0 7176 1531 6

Guide to the selection and installation of compressed air services
British Compressed Air Society ISBN 0 905608 13 5

The Carriage of Dangerous Goods (Classification, Packaging and Labelling) and Use of Transportable Receptacles Regulations 1996.
SI 1996/2092 (as amended) The Stationery Office Ltd.

The Transportable Pressure Vessels Regulations 2001
SI 2001/1426 The Stationery Office Ltd.

Passenger-carrying miniature railways - Guidance on safe practice.
HSG216 HSE Books ISBN 0 7176 2035 2

Safe operation of miniature railways, traction engines and road vehicles.
Entertainment Sheet No12. Free leaflet HSE Books

Harris, K N - *Model Boilers & Boilermaking*
TEE Publishing 2000 ISBN 1 85761 114 4

Evans, Martin - *Model Locomotive Boilers*
Argus Books Ltd 1976 ISBN 0 05242 483 3

Farmer, Alec - *Model Locomotive Boilermaking*
Alec Farmer 1988 and reprints ISBN 1 85260 007 1

Further information

Boiler testing procedures are available from the secretaries of the following organisations:

- Midlands Federation of Model Engineering Societies
- Model Steam Road Vehicle Society
- Northern Association of Model Engineers
- 7½" Gauge Society
- Southern Federation of Model Engineering Societies

While every effort has been made to ensure the accuracy of the references listed in this publication, their future availability cannot be guaranteed.

HSE priced and free publications are available from HSE Books, PO Box 1999, Sudbury, Suffolk CO10 2VA. Tel: 01787 881165 Fax: 01787 313995 Website: www.hsebooks.co.uk

HSE priced publications are also available from good booksellers.

For other enquiries ring HSE's Infoline Tel: 08701 545500, or write to HSE's Information Centre, Broad Lane, Sheffield S3 7HQ. Website: www.hse.gov.uk

This leaflet contains notes on good practice which are not compulsory but which you may find helpful in considering what you need to do.

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FOBCO 1/2" pedestal drill tilting table.....	£345
MEDDINGS 1/2" pedestal drill.....	£245
MEDDINGS 2MT pedestal drills.....	£275
POLLARD CORONA pedestal 1/2"IMT.....	From £100

SIP HDP 600B 3/4" / 2MT bench drill, table operated by rack, speeds; (16) 162 – 3000 rpm.....	New £175
STARTRITE Mercury 1/2" 4 speed bench drill.....	£225

GRINDING / BUFFING

CLARKSON MKI Tool and cutter grinder complete with universal head and centres.....	JUST IN £550
EAGLE 4W wet surface grinder + magnetic chuck.....	£725
HERBERT drill grinder + followers.....	as is £245
HERBERT tool and cutter grinder.....	as is £425
JONES & SHIPMAN SURFACE GRINDER complete with 18" x 6" magnetic chuck and coolant.....	please ring first to view this machine £2750
MILFORD 12" Pedestal Grinder.....	£325
VICEROY Grinder, pedestal model.....	£145
VICEROY Buffers, pedestal models.....	each £250
VICTOR EAGLE surface grinder, 21" x 6", complete with + 14" x 6" magnetic chuck, dust extractor & coolant.....	£1250

MISCELLANEOUS / FABRICATION MACHINERY

BOXFORD Dividing head and column suit 4 1/2" and 5" lathe complete with three dividing plates.....	£845
MYFORD dividing head (boxed) suit ML10, ML7, Super 7 lathes.....	£450
JUN-AIR 18-50 compressor 120psi / 50 litre tank.....	£425
HPC TWO twin large compressor.....	£675
GABRO 24" box and pan folder.....	£325
BATY digital vernier 6" with metric / imperial, origin and absolute buttons.....	new £35
EDWARDS 39 1/2" x 16g treadle gullotine with all its stops in very nice order.....	£625
ALCOSA hearth.....	Just in £245
WELLSAW 4" hacksaw.....	£325
RJH horizontal 4" finisher + built in dust extractor.....	£625
RJH vertical 4" finisher complete with built in dust extractor.....	Very nice machine £750
BOXFORD 8" SHAPER, powered table + vice in nice condition.....	Very Clean £425
OMT Optical Measuring Tools universal boring head, 40 INT, boxed + tooling.....	£345
CLARKE strip heater, 110 amps in very good order.....	£75
MITUTOYO 7-8", 9-10", 10-11", 11-12" micrometers just in.....	Each just £45
ABWOOD SWIVEL/TILT 4" vice in all round good condition.....	£245
ABWOOD SWIVEL/TILT 6" vice in all round good condition.....	£375
CLARKSON RADIUS MK1 radius grinding attachment in nice condition.....	Boxed £345
NEW FROM NEW ZEALAND:- Machine vice, 55mm. Jaws precision miniature type ideal for vertical slides and smaller milling machines such as BCA now with the swivel base.....	£134
Vice on own.....	£85
Swivel base on own.....	£49
CROMPTON PARKINSON HP, resilient mount, Boxford / Myford Super 7 Type motor.....	New £140
MYFORD RODNEY HEAD MILLING HEAD FOR THE MYFORD ML10.....	£550
MYFORD CAPSTAN ATTACHMENT (LARGE BED TYPE).....	£550
HOFFMAN DIVIDING HEAD complete with tailstock.....	£425
ARCHER tapping heads.....	from £70
HARE MODEL 51T complete with hydraulic indexable table.....	just £425
MARLCO notch broaching fixture + notch broach.....	£425
MYFORD vertical slides.....	just in £140 / £245
BCA 12" horizontal/vertical rotary table.....	very nice £425
Quantity of slips, height gauges, squares, straight edges, micrometers, cubes, angle plates and miscellaneous measuring tools.....	
COPE AND DRAGS / BLACKSMITH'S FRAMES.....	WOOD £20 / METAL £30
TONGS (a varied selection).....	EACH £5
FLAMEFAST DS 130 ceramic chip forge.....	£345
FLAMEFAST DS 100 hearth.....	£140
JONES AND SHIPMAN 4" x 24" bench centres.....	very nice example £245
TOM SENIOR slotting head.....	£450
RJH BT 125 Fretsaw, variable speed.....	£345
SMART AND BROWN / CLARKSON H3-H5 toggle presses.....	Each £195 / £275
VERDICT CLOCKS, Long/Short Metric and Imperial models.....	New £40
FLAMEFAST LD300 soldering iron stove.....	£75
GRANITE 18" x 12" Surface Plate.....	£140
VIBROSHEAR Nibbler.....	Just in £425
SIP 7" bandsaw, horizontal & coolant.....	New £750
DUPLEX D29 toolpost grinder.....	£345
BOXFORD (imperial only) thread dial indicator.....	£65
BURNER, D14 lever collet chuck + collets.....	£400
BURNER, LO lever collet chuck + collets.....	£400
VERTEX Dividing head.....	New £245
VERTEX 6" - 8" - 10" rotary tables good value equipment.....	New From £135
MYFORD ML7 / Super 7 rear tool post.....	£40
MYFORD 254" rear tool post.....	New £40
LOCKWOOD quad headed 2MT Die Holder quality equipment.....	New £40
LOCKWOOD quad headed 3 MT Die Holder quality equipment.....	New £40
STARTRITE 352 woodworking band saw.....	£975
STARTRITE 14-S-5 woodworking band saw.....	£775
ALCOSA GF 080/1 Rapid Melting Furnace.....	£300
COLCHESTER D13 Burnerd 4 Jaw 8" light body independent chuck.....	one off £245
AJAX 6" hacksaw.....	£425
STEEL STOCK different stock rolling in almost daily.....	to callers only £475
ELLIOT U1 / U2 Slotting Head.....	£475
SWAGE BLOCKS.....	£125 / £145
J & S Universal grinding vice.....	Choice £275 / £325
HORIZONTAL METAL BANDSAW 6" x 4 1/2" capacity.....	New £170
COLCHESTER STUDENT / MASTER Round head, face-plates, small / large.....	£50 / £80
QUALTERS AND SMITH 6" Hacksaw.....	£345
TRANSWAVE 3HP Converter (including delivery charge from factory).....	New £325.50
TRANSWAVE 1.5HP Converter (including delivery charge from factory).....	New £440
TRANSWAVE MT & RT rotary converters.....	From £400
CROMPTON PARKINSON HP, resilient mount, Boxford / Myford Super 7 Type motor.....	New £140
CROMPTON PARKINSON SINGLE PHASE start / stop switch model DL1 2000 series (4.5-7.5amps).....	New £69
DEWHURST reversing switch the original from Dewhurst!.....	New £126.50



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- 10 micron Accuracy



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Cobra Lathe

- Centre height: 70mm • Distance Between Centres: 250mm
- Speed Range: 100-200rpm • Metric or Imperial Leadscrews
- Variable Speed Control



Cobra Mill

£299

Special Deal
includes 4 metric
& 4 imperial
Collets

- Variable Speed Control
- Spindle Taper: MT2
- Table Size: 145 x 240mm
- Metric or Imperial Leadscrews



DB8 Lathe

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- Centre Height: 105mm • Distance Between Centres: 400mm • Complete with 3 & 4 Jaw Chucks, Fixed & Travelling Steadies & Face Plate
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- Centre Height: 125mm • Distance Between Centres: 550mm • Thread Cutting Gearbox • Complete with 3 & 4 Jaw Chucks, Fixed & Travelling Steadies & Face Plate • Vee Bedway • Accuracy Report

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£670

- Maximum Swing: 420mm
- Distance Between Centres: 520mm
- Cast Iron Construction
- Metric or Imperial
- All Tapers MT3
- Supplied with 3-Jaw Chuck, Drill Chuck & Arbor and more!



£1100 Centurion

- Distance Between Centres: 520mm
- Centre Height: 210mm • Spindle Bore: 28mm
- Powered Crossfeed • Separate Motor for Lathe/Mill
- Complete with 5" 3-Jaw Chuck, Lathe Tools, Change Gear and more!



Conquest Lathe

Complete with a USA
Built PCB

£380



- Centre Height: 90mm
- Distance Between Centres: 325mm
- Large MT3 Spindle Taper
- Spindle Bore: 19mm
- Now C/W Quick Change Toolpost
- Variable Speed Range 100-2500rpm
- Metric or Imperial Leadscrews

626 Turret Mill

£1299

Now Supplied
with a 100mm
Machine Vice

- Table Size: 156 x 745mm
- 1.5HP Motor
- MT3 or R8 Spindle
- Metric or Imperial graduations



Champion Mill/Drill

£585

- 1/2HP Motor
- Table Size: 150 x 630mm
- Complete with Drill Chuck & Arbor
- Ground Cast Iron Column
- MT3 Spindle



Craftsman Lathe

£1499

- Centre Height: 150mm
- Distance Between Centres: 570mm
- Swing in Gap: 450mm
- Powered Crossfeed • Spindle Bore: 36mm
- Complete with 3 & 4 Jaw Chucks, Fixed & Travelling Steadies, Face Plate, Machine Stand, Accuracy Report & much more!

