

MODEL ENGINEER

Vol. 187 No. 4155

£2.10

INSIDE:
PETER LEWIS
ANTHONY MOUNT
JOHN WILDING
•
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REGULAR
CONTRIBUTORS

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hot air engine
of 1881*

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 Tel: 01322 660070; Fax: 01322 616319
 www.nexusonline.com
 Nexus Special Interest
 is a wholly owned subsidiary of
 Highbury House Communications plc.

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Editor
 Mike Chrisp
Technical Editor
 Neal Read
Assistant Editor
 Kelvin Barber
Club News Editor
 Stan Bray
Technical Consultants
 Martin Evans, John Haining, Stan Bray,
 J. Malcolm Wild FBHI, D. A. G. Brown,
 H. D. Bickley BSc CEng MIEE
Editorial Administrator
 Sarah White

PRODUCTION

Design
 Elizabeth Marfell
Production Executive
 Sifa Symons
Printed by
 Polestar Colchester Ltd.
Origination by
 Atelier Data Set, St Austell, Cornwall

SALES & MARKETING

UK Sales Manager
 Colin Taylor
Marketing
 Rebecca Bradberry

CIRCULATION

Group Circulation Director
 Steve Hobbs
Circulation Manager
 Richard Kingerlee

MANAGEMENT

Managing Director
 Robert Lehmann
Editorial Publisher
 Dawn Frostick-Hopley
Commercial Publisher
 Roy Kamp

SUBSCRIPTION & BACK ISSUES:

Direct Subscriptions and Back Issues are available from
 Nexus Subscription Services, Link House, 9 Bartholomew's Walk,
 Ely, Cambs CB7 4DZ;
 tel: 01353 654422; fax: 01353 654400
 Customer Care tel: 01858 438807
 Rates for 26 issues (annual), 13 issues (six months):
 UK: £52.00 (annual), £26.00 (six months);
 Europe: £66.50 (annual), £33.25 (six months);
 Sterling Overseas: £72.50 (annual), £36.25 (six months);
 US dollars Overseas: \$94 (annual), \$47 (six months).
 Cheques payable to Nexus Special Interests Ltd.
 Airmail rates on request. Second class postage paid at
 Rahway NJ USA. Postmaster, send address corrections to
 Model Engineer c/o Mercury Airfreight International Inc, 2323
 Randolph Avenue, Avenue 1, NJ 07001. Usps 0011099.
 US Subscription Agent: Wise Owl Worldwide Services,
 1926 S. Pacific Coast Highway, Suite 204,
 Redondo Beach, CA 90271-4145, USA.
 Phone: 310 944-5033; Fax: 310 944-8963.
 Visa/MC/Discover accepted.
 Model Engineer is published fortnightly.



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 ISSN 0026-7325

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KEITH'S COLUMN: SAINT CHRISTOPHER

Hints, tips and invaluable advice on
 making the rods for the GWR 29xx and
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On the cover ...

Photographed at the Guildford MES
 Steam Rally and Model Engineering
 Exhibition in July, Anthony Mount's
 new vertical concentric hot air engine
 was greeted with interest by all who
 studied its elegant simplicity.

With a detailed description of its
 construction commencing on page 270
 in this issue, and drawings and castings
 available from Bruce Engineering
 (call 01932-254529), this interesting
 power plant could well be an
 ideal project to occupy
 the forthcoming winter evenings.
 (Photograph: Mike Chrisp)

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A 20 TON LMS BRAKE VAN in 5in. GAUGE

We regret that pressure on space in this
 issue has prevented the inclusion of the
 final part in this fascinating series. We
 apologise to the author and to readers
 for the disappointment caused.

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 experiencing problems in obtaining copies of Model Engineer or any other Nexus Special Interest magazines.
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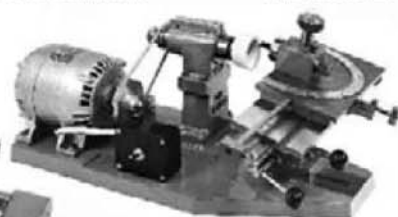
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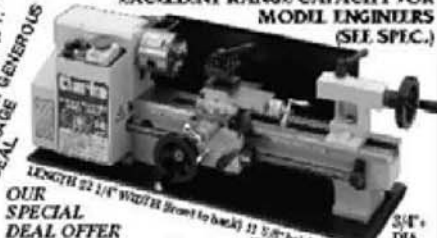
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SMOKE RINGS

With the Editor

Reviewing the situation

Throughout its long and illustrious past, *Model Engineer* magazine has continued to publish despite overwhelming obstacles including world wars and recessions. Undeterred by changes in frequency during such times, it has continued to bring to its readers a fascinating mix of news and features, making it the leading journal of its kind in the world.

During the past 12 months we have experienced a different kind of obstacle which has led to an alteration in publishing schedules. Over the past year, we have been searching for a technical editor to assist our editor, Mike Chrisp. To many of you, it will seem unbelievable that it has taken us so long to find someone to fill this position, especially when there are so many thousands of readers of the magazine. However, the job of technical editor requires many attributes, only one of which is an in-depth knowledge of the hobby and all it encompasses.

During this time Mike has worked tirelessly to bring you a magazine which adheres to the high standards you have come to expect. To publish a fortnightly journal, with only two members of staff, is an extremely tough order and to maintain quality, it was inevitable that the publishing schedule would have to change. Such changes in schedule unfortunately lead to difficulties with reproduction houses and printers, matters totally beyond the jurisdiction and control of the editorial department. However, these problems have also been addressed and the publication will now return to a normal, uninterrupted routine.

As a company, Highbury Nexus is indebted to Mike for his loyalty during this difficult period and we thank him for his commitment.

You, as readers, quite rightly expect a certain service and the telephone calls to my office show how deeply you care for this magazine and all it represents. I can assure all subscribers that they will receive the requisite number of issues they have paid for, although this will be achieved over a slightly longer period of time than they would have originally expected.

I am pleased to inform you that the publishing dates for the rest of the year are as follows:

4156: 16 November 4157: 31 November

4158: 14 December 4159: 24 December

I am sure you will also be pleased to hear that from issue 4160 the dates will once again be printed on the cover.

Finally, I would like to take this opportunity to officially welcome Neil Read as our new technical editor and to thank you all for your continued loyalty and support of *Model Engineer* and its editorial team.

Dawn Frosdick-Hopley
Editorial Publisher

Model engineering classes

We have information about two courses which may be of interest to readers, as follows:

Model Engineering at Newcastle-under-Lyme College, Crossheath. Call 01782-254295 for details. The course will run for three terms on Monday evenings 6.30-8.30pm and commenced 17 September 2001.

Model Engineering (Code GE40B) at Coleg Menai, Bangor, North Wales. Call 01248-370125 for details. The course will run for three terms on Wednesday evenings and commenced 29 September 2001. The good news is that we understand this course to be completely free of charge.

We are grateful to Mr. K. T Bevington for bringing the Newcastle-under-Lyme course to our attention, and to John Howl for the update about the course in Bangor.

Ron Drake retires

Phil Owen writes: "The year 2001 sees the 25th Anniversary of the founding of *Blackgates Engineering* in 1976 by Phil Owen and Ron Drake. *Blackgates* have attended countless exhibitions around the UK over the years, including numerous *Model Engineer* exhibitions at Wembley, Alexandra Palace and Olympia.

"Ron Drake has been a well-known figure at these events, but as from 1 July 2001 he has now retired from the business.

"Phil and Jacqui Owen and staff wish Ron a long and happy retirement and hope that perhaps he might now find time to do a little modelling of his own.

"*Blackgates* look forward to continuing to serve their many friends and customers over the next 25 years and hope to meet as many as possible at forthcoming model engineering exhibitions around the UK."

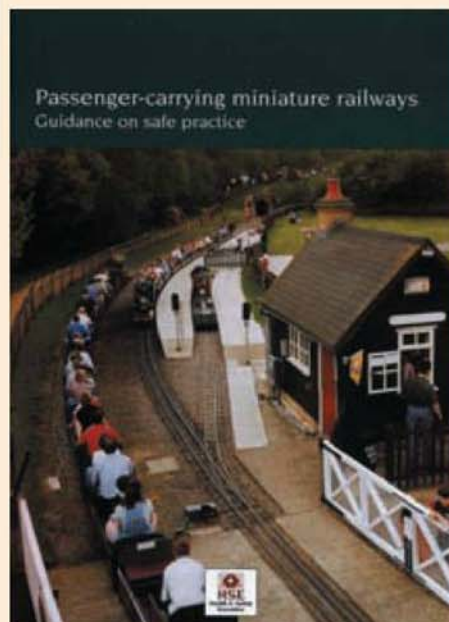
We at *Model Engineer* would like to thank Ron for his contribution to the hobby for more years than we care to admit, and to associate ourselves with Phil's good wishes. We too hope that Ron will enjoy a long and healthy retirement, doing exactly what he wants to do.

Passenger carrying miniature railways: Guidance on safe practice

Health and Safety Executive Booklet HSG216 with the above title is now available.

Prepared and agreed by the Health and Safety Executive and the Miniature Railway Liaison Group, the content of this extremely useful publication has been carefully considered and is well presented. The Miniature Railway Liaison Group includes representatives from the Northern Association MES, Southern Federation MES, Midlands Federation MES, Society of Model and Experimental Engineers, Ground Level 5in. gauge Main Line Association, 7 1/4in. gauge Society, trade, manufacturers, press and private railways.

The guidance is intended for all those involved in the miniature railway business and concentrates on the safety of employers, employees, volunteers and the general public using miniature railways of under 350mm gauge. The guidance describes a system for constructing miniature railways, and its infrastructure, which will meet the relevant legal requirements, and also describes appropriate systems to ensure safe operation. Contents: Preface, Introduction, Risk assessment, Track, Infrastructure, Signalling, Level crossings, Locomotives and rolling stock, Operation, Maintenance of equipment, Appendices, Further reading.



We are convinced that the guidance will be found both helpful and interesting by all who read it. We feel that it should be available to all involved with miniature railways and recommend that clubs and societies should have copies available for study by all members who run locomotives and pull passengers, and those concerned with the management of the society.

HSE booklet HSG216 presents all the appropriate and relevant information in an attractive and readable style on 22 copiously illustrated A4 pages printed in full colour on high quality paper. HSE booklet HSG216 (ISBN 0717620352) is published by HSE Books and is available (price £5.95) from booksellers or direct from HSE Books, PO Box 1999, Sudbury, Suffolk CO10 2WA; tel: 01787-881165; fax: 01787-313995; website: www.hsebooks.co.uk

New premises for MJ Engineering

We learn from Malcolm Frost and John Steer that the approaching conclusion of the lease on their shop was conveniently accompanied by an opportunity to move their business to a new countryside museum venture on the outskirts of Ringwood. This will give them more scope in the future when the museum opens next year as among the planned museum facilities is a tea room and space outside to run engines in steam, which will be most useful on their Open Days.

With the change of premises however, Malcolm and John have decided to operate a 'Customers by Appointment' system by which customers will be welcome to visit and purchase their requirements at a mutually convenient time, having telephoned beforehand. This has the added benefit of knowing whether the required items are in stock, thus saving a wasted journey if not. No longer tied to rigid opening hours, they hope this will give them more workshop time and enable them to provide a quicker turn-around on their gear cutting service, etc.

The move to the museum took place during September 2001, so readers are advised that the new 'Customers by Appointment' system is now in place. The MJ Engineering number remains unaltered (call: 01425-476234) but anyone who prefers to write should address their letter to MJ Engineering, PO Box 4683, Ringwood, Hampshire BH24 1BL.

We hope the move went well and that the venture is a success.

POST BAG

Briggs boilers

SIRS, - I was very much interested in the article by Martin Wallis in *M.E.* 4149 (29 June 2001) concerning Briggs boilers.

Having read many articles, mainly from readers 'down under', who spoke of their popularity in the antipodes, I never realised that they had originated in England early last century. Nor did I appreciate that O. V. S. Bulleid's *Leader* locomotive was furnished with a Briggs boiler until I compared the photographs in *M.E.* with those of Bulleid's boiler in Kevin Robertson's book *Leader: Steam's Last Chance*.

I am surprised that no *M.E.* designers appear to have offered a Briggs type boiler as an alternative to a conventional locomotive type boiler, yet in Australia model builders use them regularly, and as the supply of quality fuel dwindles, they continue to be high-performance boilers in our small sizes.

It appears that whether in copper or in steel, Briggs boilers are much simpler to build than the conventional type and I wonder what opinion our knowledgeable contributors have of the design.

John Drewell
West Yorkshire.

Martin Evans replies:

Other than the limited room for backhead fittings which tend to become over-heated, I have nothing against Briggs or dry-back boilers. They are relatively cheap and easy to build and probably have a steam-raising capacity adequate for most requirements. However, because I only build prototype engines, which I prefer to be as close to scale as possible subject to being good runners on the track, I would never build a dry-back boiler for myself. For me, the reduction in construction time and cost is of secondary importance.

Concerning Bulleid, while many seem to regard him with awe, I have never been an admirer. I have no doubt he was a very clever engineer but he was quite unsuccessful in almost everything he tried. The dry-back boiler was obviously a mistake; I understand that the severe heat problem resulted in firemen refusing to handle the *Leader* on long journeys, although they did agree to fire on short trips while the new locomotives were on trial.

Bulleid also made a serious mistake in adopting sleeve valves for his engines. One would think that he

knew about the early Daimler cars which used sleeve valves; I remember them well! On encountering a cloud of blue smoke on the road, one would be immediately aware that a Daimler car was nearby. These early Daimlers were very fine cars, almost up to Rolls standards, so it was much to be regretted that the builders were never able to overcome the lubrication problem.

BA Threads on Myford lathes

SIRS, - In his recent article on cutting BA threads on the Myford lathe (*M.E.* 4151, 27 July 2001), D. A. G. Brown was writing chiefly about using his special attachment. His suggestions were aimed at finding approximations to BA pitches which avoid having to change the whole gear train for each different thread. However, this does require at least eight unusual gears in addition to the gears in the standard Myford metric conversion set. If the time spent changing a gear train is not vital, it is worth remembering that by using the Myford metric conversion set (but not their published gear trains) all the BA pitches can be cut to an accuracy of better than 1 part in 2300, and most to an accuracy of at least 1 part in 15000. The details are set out in my article in *Model Engineers Workshop* magazine No. 65 (April/May 2000).

Another useful reminder is that if worm wheels are to be set at right angles to the worm, their pitch must be larger than the module pitch by a factor which depends on the diameter of the worm. Tables of module pitches as published in most reference books are not very useful for these applications. Interested readers are advised to consult G. H. Thomas' book *The Model Engineer's Workshop Manual* (TEE Publishing 1992), or my article above.

John Peters
North Yorkshire.

D. A. G. Brown replies:

Mr. Peters has an interesting point in his analysis of the gear trains for BA threads but, as he alludes, I was very much concerned with avoiding stripping down the metric gear train on the gearbox machine, a point which I think I made quite clear. Owners of gearbox Myfords begudge the time taken to strip and rebuild that train of gears!

In conjunction with my Table 4 on page 69 I do say that "my design basis was to discover what could be done while maintaining either of the gear trains discussed..." It will also

be seen in that table that for all sizes save 7BA, I include the use of Standard Gears from the Metric Conversion Set.

Like Mr Peters, I was concerned by the implications of specifying non-standard gears in the Myford range, so I make the caveat about the special gears if improved accuracy is desired. However, bearing in mind what happens if a split die is used to cut a thread, for most practical purposes I believe that errors of even 1 in 300 are of no consequence. In an earlier instalment I also invite the reader to experiment with the ratios and, as Mr Peters has found, there is no unique solution.

On the subject of worm pitches, Mr Peters rightly mentions the cosine correction for using straight gears to mesh with worms set over at the helix angle, but such a compromise is not really good engineering practice, certainly not when considerable power needs to be transmitted. In circumstances where straight teeth are employed, it is also quite acceptable to allow the pair to mesh slightly higher up the flank face than the pitch circle, which is achieved by keeping the worm pitch at the original value of DP or Module. Best practice, however, dictates that a wormwheel has correctly shaped teeth, which follow closely the form of the worm.

A good example which springs to mind in model practice is the reversing engine gear on a marine reciprocating steam engine, and I call to mind the splendid examples from many years ago made by the late Commander Barker and illustrated in *Model Engineer* in the 1950s.

Scottie dog

SIRS, - While I regret that I cannot suggest where Mr. Rouse may be able to purchase the Scottie Dog signs he requires (*M.E.* 4152, 10 August 2001) I hope the following may be of some assistance to him and perhaps to other readers.

When I built my class 8 locomotive, I obtained what I required from my local Sign Shop which makes adhesive plastic signs for vans, trucks, estate agents' boards and suchlike applications. They use a computer to generate the words in the required size and style, and a special 'printer' which cuts out the shape of the letters from self-adhesive plastic sheet which appears to be available in a wide variety of colours. All that is then necessary is to peel the letters away from their backing sheet, lay them in position and rub them down to secure them in place by means of their own

adhesive. A protective coat of varnish finishes the job.

The experts at my local Sign Shop have made me several stick-on signs, including 'BR Barbed wire', shed numbers and signal identification numbers. They appear to be able to produce, for example, LMS gold lettering with the red shadow to any specified scale or size. They also appear to be able to work from a photograph.

Nev Boulton
Great Bulkington Railway
Wiltshire.

Silicone seals and graphite dust

SIRS, - At the time of writing my article on vacuum brakes (*M.E.* 4116, 24 March 2000), I had been making silicone seals using materials obtained from a local firm for casting small sculptures. I have since tried other silicones which failed to perform so well, but have now located the importer of the preferred type of material. Wacker, USA manufactures the silicone in question, type ELM 4503 which is used with catalyst T46. It can be obtained in UK from Beacon Hill Silicones Ltd. Stoke-on-Trent, tel: 01782-399499. The smallest pack size is 1kg but the cost is reasonable.

Most importantly though, I have found that over a period of time, silicone oil or grease causes any silicone rubber to swell. Consequently, I have changed to the use of dry graphite with these seals, which additionally has the benefit of producing a much lower level of friction than grease or oil.

Peter Gardner
Hampshire.

Construction systems

SIRS, - Meccano is a well known construction system which is well served by specialist suppliers and enthusiasts' groups.

I would like to draw readers' attention to a similarity between Meccano and Dexion. Painted grey and very much larger, Dexion may also be thought of as a construction system and could offer great potential for enlarged versions of Meccano style models for exhibitions and museums.

It should be possible to build civil engineering projects including cranes, flyovers and bridges to suit, say a 5in. gauge passenger carrying railway, from a range of Dexion components which could be augmented by additions made from appropriate stock, punched, bent shaped and machined as required.

M. Barrell
Essex.



BAILEY'S BEE A VERTICAL CONCENTRIC HOT AIR ENGINE

Anthony Mount

introduces an engine patented in 1881, and presents it here in model form for enthusiasts of the work of the Rev'd Patrick Stirling.

●Part I

A few years ago I built a model of a hot air engine produced in the 1880s by Baileys of Manchester. A vertical engine with its power cylinder fixed to the side of the displacer water jacket, it ran well and was described in *Engineering In Miniature*, March-December 1999. Some time later, I received a letter from Bob Sier who told me of another vertical engine by Baileys which was of concentric design with both displacer and power piston in the same cylinder. Marketed under the name *Bee*, it was patented in 1881 and was available in two sizes.

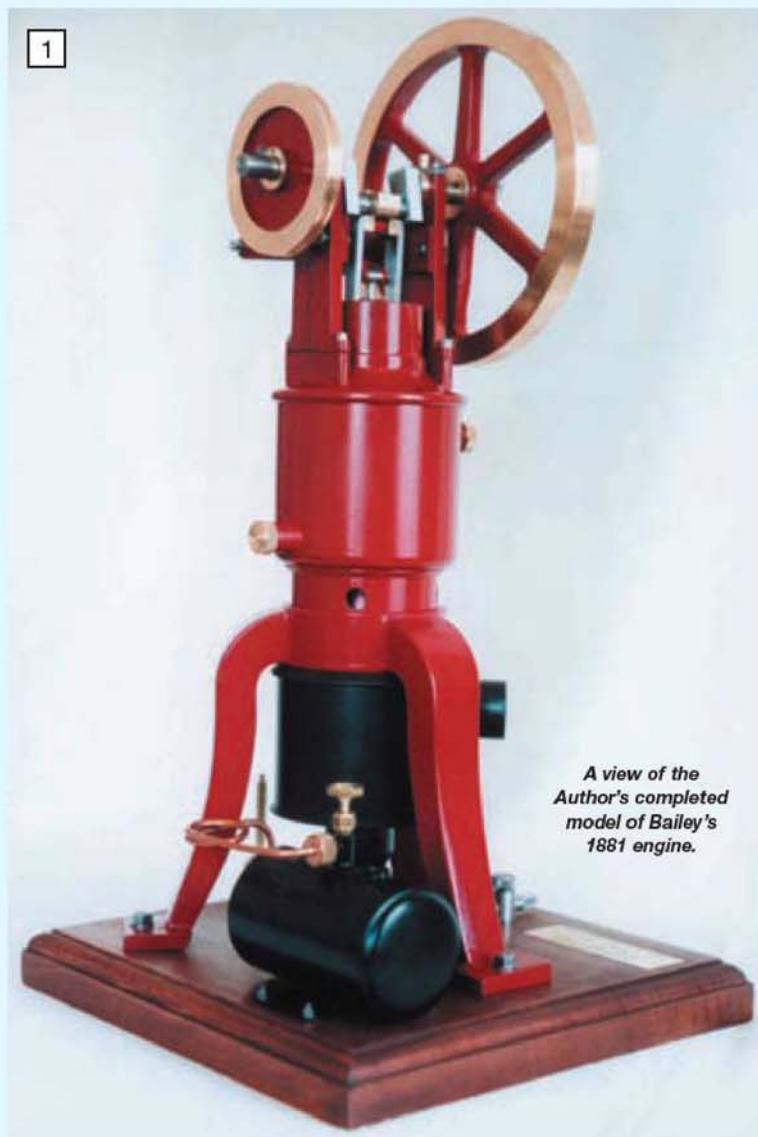
The output of No. 1 was rated at approximately 1000 foot pounds. Priced at £10 (£11-10s with the bright parts nickel plated), its overall height

was 2ft. 9in. (840mm) and it was suitable for such applications as driving shop window advertisements, model coffee mills, roasting jacks and dental lathes. Engine No. 2 was rated at approximately 2000 foot pounds, cost £15 (£16-10s with the bright parts nickel plated) and had an overall height of 3ft. 6in. (1067mm). It was suitable for driving large sewing machines, amateurs' lathes, band-sawing machines and the like.

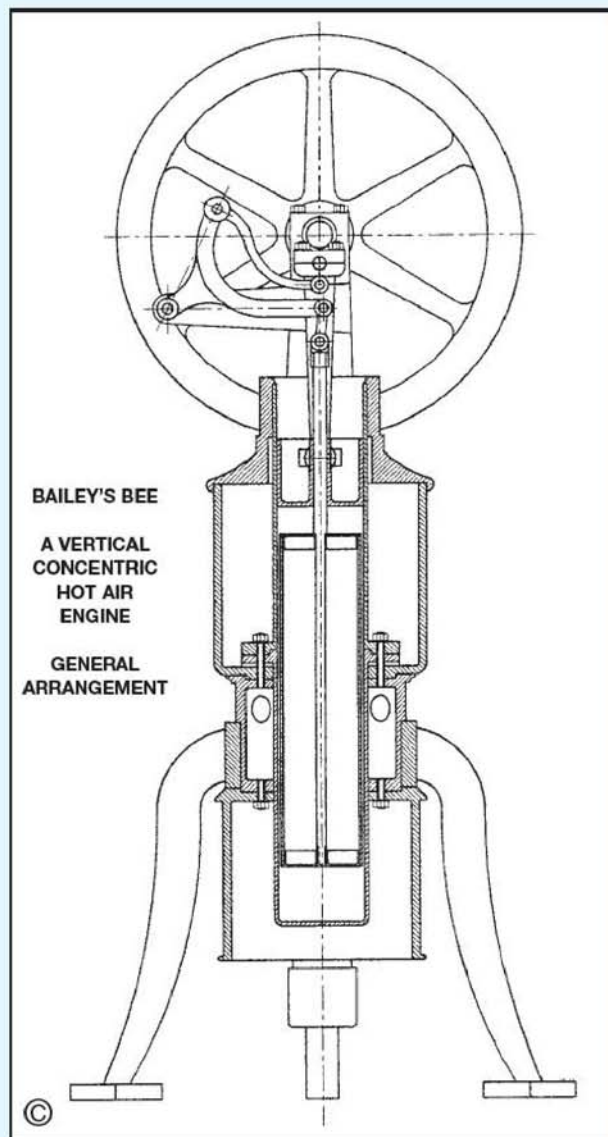
Apart from the one to be described, Baileys built two other types of hot air engines: a small vertical of about a 1/4hp as mentioned above, and a larger horizontal engine, also patented in 1881, similar to the German Lehman hot air engine with its hot cap contained in a brick box. I believe one

of the horizontal engines to be in the Museum of Science and Technology in Manchester.

Sir William Henry Bailey was born 10 May 1838 in Salford. He left Manchester Grammar School at the age of 14 to join the Albion Works, established in 1838 by his father, John Bailey. He became Proprietor and sole Manager of the Works in 1866. He entered Salford town council in 1874, was elected an Alderman in 1880 and Mayor of the Borough in 1893. He was knighted by Queen Victoria on the Royal Yacht in 1894 on the occasion of the opening of the Manchester Ship Canal of which he was one of the promoters. He was also a Fellow of the Royal Geographical Society, a Governor of the John Rylands Library,



A view of the
Author's completed
model of Bailey's
1881 engine.



THE BEE: BAILEY'S VERTICAL CONCENTRIC HOT AIR ENGINE - PARTS LIST

PARTS LIST		METRIC SIZES		IMPERIAL SIZES	
Part No.	Dwg. No.	Description	Material	No. off or size	No. off or size
01	06	Flywheel	Gunmetal casting	One	Gunmetal casting
02	07	Stand	Gunmetal castings	Four	Gunmetal castings
03	08	Firebox	Gunmetal casting	One	Gunmetal casting
04	09	Air chamber	Gunmetal casting	One	Gunmetal casting
05	10	Water jacket	Gunmetal casting	One	Gunmetal casting
06	11	Water jacket cap	Gunmetal casting	One	Gunmetal casting
07	12	Hot cap	35mm O/D s/s tube 1.5 wall	105mm	1 3/4in. O/D s/s tube 1/16in. wall
			60mm dia. s/s disk	6mm	2 3/8in. dia. s/s steel disk
			35mm dia. s/s disk	1.6mm	1 3/4in. dia. s/s steel disk
08	13	Displacer tube	30mm O/D s/s tube 1mm wall	125mm	1.181in. O/D s/s tube 0.039in. wall
09	14	Displacer top cap	30mm dia. mild steel	25mm	1 1/4in. dia. mild steel
10	14	Displacer bottom cap	30mm dia. mild steel	Part of 09	1 1/4in. dia. mild steel
11	15	Piston	32mm dia. mild steel	30mm	1 1/4in. dia. mild steel
12	15	Piston collar	19mm dia mild steel	30mm	3/4in. dia mild steel
13	15	Pivot bolts	6mm dia. mild steel	30mm	1/4in. dia. mild steel
14	16	Bearing brackets	40 x 6.35mm mild steel	200mm	1 3/4in. x 1/4in. mild steel
15	17	Bracket feet	40 x 6.35mm mild steel	Part of 14	1 3/4in. x 1/4in. mild steel
16	17	Bearing caps	22 x 6.35mm mild steel	50mm	7/8in. x 1/4in. mild steel
17	18	Pivot brackets	20 x 3mm mild steel	160mm	3/4in. x 1/8in. mild steel
18	18	Link	8mm square mild steel	25mm	5/16in. square mild steel
19	19	Rocker arm	Gunmetal casting	One	Gunmetal casting
20	19	Rocker shaft	4mm dia. mild steel	55mm	5/32in. dia. mild steel
21	20	Drive link	10mm square brass	75mm	3/8in. square brass
22	20	Crosshead	12.7 x 6.35mm brass	25mm	1/2in. x 1/4in. brass
23	21	Connecting rod	19mm square brass	25mm	3/4in. square brass
			12 x 3mm mild steel	180mm	1/2in. x 1/8in. mild steel
24	22	Displacer tie rod	5mm dia. brass	105mm	3/16in. dia. brass
			3mm dia. mild steel	140mm	1/8in. dia. mild steel
25	23	Crankshaft	10mm dia. mild steel	200mm	3/8in. dia. mild steel
			12.7mm square mild steel	50mm	1/2in. square mild steel
26	24	Pulley	Gunmetal casting	One	Gunmetal casting
27	24	Crankshaft bearings	16mm dia. bronze	60mm	5/8in. dia. bronze
28	25	Displacer cylinder	Gunmetal casting	One	Gunmetal casting
29	26	Gasket	1.6mm jointing material	60mm dia.	1/16in. jointing material
30	26	Oil cups	5mm dia. brass	Part of 24	3/16in. dia. brass
31	26	Link bolt	5mm dia. mild steel	75mm	3/16in. dia. mild steel
32	26	Rocker bolt	5mm dia. mild steel	Part of 31	3/16in. dia. mild steel
33	27	Alternative hot cap	35mm dia. s/s tube 1.5mm wall	210mm	1 3/8in. dia. s/s tube 1/16in. wall
			35mm dia. s/s disk	6mm	2 3/8in. dia. s/s disk
			35mm dia. s/s disk	1.5mm	1 3/8in. dia. s/s disk

Supplier

Drawings and castings for *The Bee* are available from Bruce Engineering, Hollow Tree, Penny Lane, Shepperton, Middlesex TW17 8NF
tel: 01932-245529; fax: 01932: 226738; e-mail bruce.engineering@zetnet.co.uk
Please send £1.75 for a full catalogue for this and many other engines and fittings.

and a Governor of the University College of Wales. He strove to have the Morse code adopted as the alphabet of the sea. Together with members of his family, he was responsible for nearly 100 specifications between 1857 and 1912. He died at the age of 75 on 22 November 1913.

After the publication of my first Bailey hot air engine series, I was approached at an exhibition by a model engineer from Manchester who told me that Baileys Manchester Works is still open, although unfortunately no longer building hot air engines.

Although the full-size engines were smaller than my earlier prototype, I decided to make the model similar in size to my other engine, so it finished at 686mm (1ft. 5in.) high, with a 152mm (6in.) diameter flywheel. The firebox, legs, air cooler, water jacket, cover, flywheel, rocker, displacer cylinder and pulley are all gunmetal castings while the hot cap and displacer tube are both made of stainless steel.

All the necessary machining was completed on a Myford Series 7 lathe and a small milling machine. Both metric and imperial dimensions are shown on the drawings, but I feel it is high time we stopped using imperial units.

The original engines were shown fired by means of a Bunsen burner and town gas. My miniature version runs with a small ceramic burner and Butane gas for which I chose a rechargeable gas tank from Cheddar Models and their smallest ceramic burner. Once the engine has warmed up, a small flame is all that is required to keep the engine ticking over.

The volumetric displacement ratio between the piston and displacer is the standard 1:1 1/2 which seems to be the optimum and was used by Stirling in his engines. The annular air gap around the displacer is 1mm, a dimension which evolved because I wanted to use standard tubes. Checking other designs of similar size, I found this air gap to vary between 0.45 to 2.5mm and wonder if anyone has a formula for determining the ideal air gap?

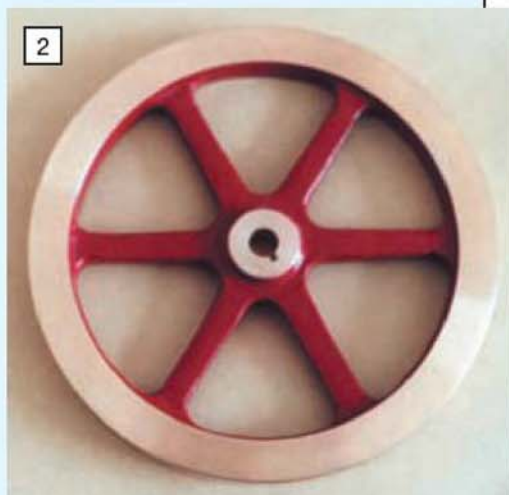
As with most Stirling engines running at atmospheric pressure, the power to weight ratio is not very good. I suppose the engine produces about one mouse power.

Bob Sier provided me with a small drawing of the engine which is little more than a thumbnail sketch but, like most Victorian engravings, of adequate quality to provide a good external view

of the engine. I also referred to the patent drawing which, as is so often the case, was somewhat different to the sketch, so externally I have followed the sketch.

The photographs of the completed engine reveal that it has quite a striking appearance, especially with its three 'Grecian Urn' type legs. It runs well and consumes little gas. It is not difficult to make and is particularly pleasing in that many of the components are turned all over. I do like freshly turned components gleaming on all surfaces as they leave the lathe.

It will be noticed that in the following text I make a number of references to drilling in the milling machine. I have a Warco VMC vertical milling machine which is equipped with a lever operated quill as well as a screw operated down-feed. The mill is very convenient for drilling because the component can be clamped in the machine vice and the X- and Y-axis table movements can be used for co-ordinate drilling. This method is much more accurate and easier than manual marking out, even if only used for spotting the holes after which the component is transferred to a regular drilling machine, this technique makes life much easier.



So without further ado let's make a start on cutting metal. For inspiration the photograph on the cover of this issue and at the head of this article (photo 1) shows the completed engine.

Flywheel (Part 1)

I am sure that the machining of flywheels has been described in these and other pages hundreds of times over the years, but many builders experience difficulty in getting them to run true. Apart from poor machining, there can be a number of reasons for this, as follows:

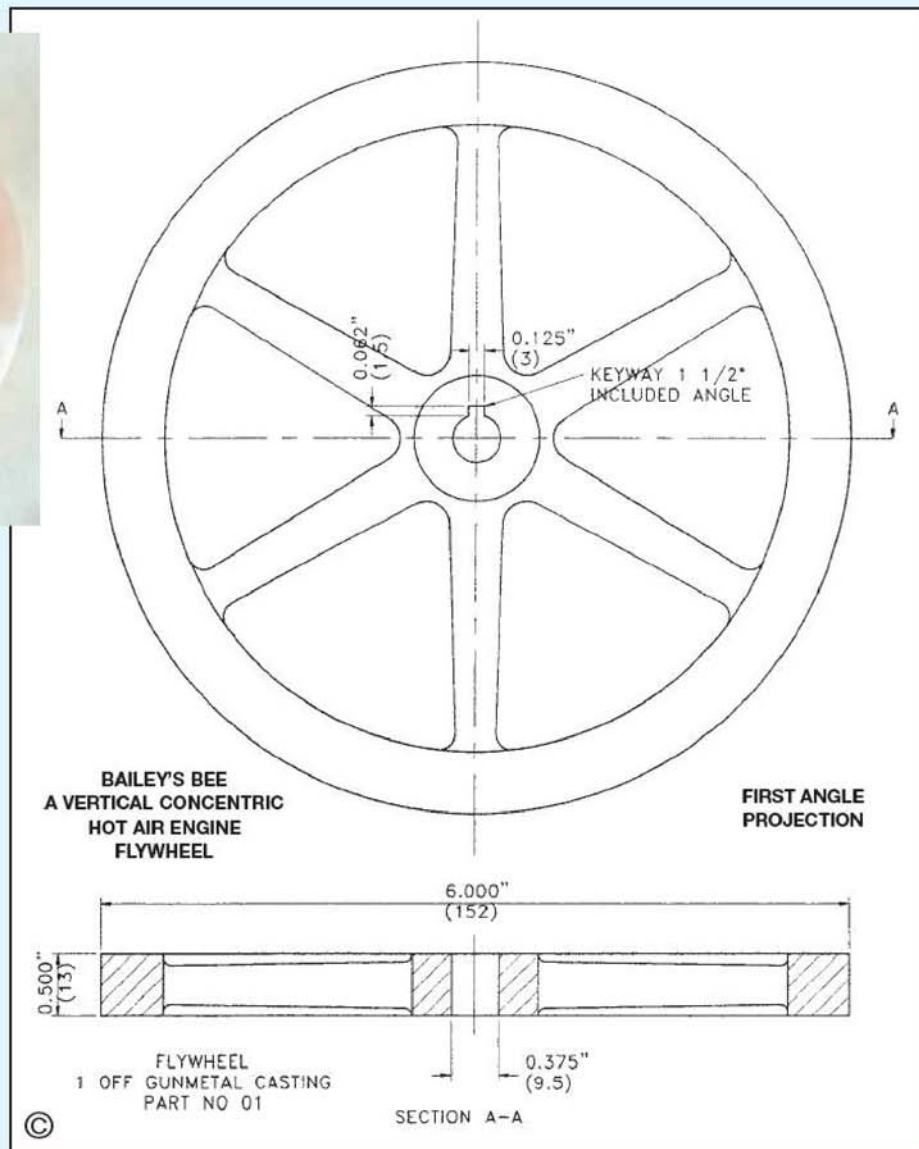
- When securing the casting to a faceplate, uneven clamping pressure may easily be applied and the spokes bent. On release after machining, the wheel may then take up a different shape.
- Stresses within the casting caused by cooling after solidification may be released by machining, causing the wheel to change shape, sometimes a little while after machining.
- The flywheel bore may be a slack fit on its shaft and when fitted, the key can then push the wheel over to one side.
- The crankshaft may be untrue.

I have started work with the flywheel so that it can be rough machined all over and set aside to age a bit when any casting stresses will hopefully work their way out. The flywheel is only 152mm diameter, so all the work can be completed using the 4-jaw independent chuck.

Grip the casting with the chuck jaws on the inside of the rim and set the inside edge of the wheel to run as true as possible. Take facing cuts across the edge leaving it about 0.5mm oversize. Machine the side and the boss, chamfer the edges and reverse. Machine the other side, centre and drill through about 8mm diameter. Now leave it aside until the engine is nearing completion.

To finish the flywheel, re-chuck and set it to run as true as possible. Take facing cuts all over to bring it to finished size, and finally bore out the boss to a fairly tight push fit on the crankshaft. Small boring tools are prone to spring a bit when cutting and I always feel that getting the bore to size is a bit of a hit-and-miss affair. The following procedure may help in getting a good fit.

Turn up a stub of mild steel 0.2mm smaller than the diameter of the crankshaft and bore the flywheel until the dummy shaft just begins to enter the bore. We now know we have 0.1mm to remove for the flywheel to fit the crankshaft. We could advance the cross-slide by 0.1mm but try 0.05mm instead and pass the tool through the bore using power feed. This in itself will produce a different size than if the top-slide was used.



Stop the lathe, withdraw the tool, but *do not* touch the cross-slide setting. Try the crankshaft in the bore. It should be tight, it might not even enter. Try another pass at the same setting and if the crankshaft still won't fit try yet again at the same setting. By now any spring in the tool should have been worked out. If necessary, try another 0.01mm cut and repeat the procedure until at last the crankshaft enters the bore.

I realise that the above is a pretty long-winded, business but hopefully you'll end up with a nicely fitting flywheel that doesn't wobble.

Cut the keyway before removing the flywheel from the chuck. This could be done with a broach, but just as effectively by planing the groove using a square faced tool the same thickness as the key and fitted in a boring tool holder. The boring tool is clamped sideways in the tool post and by using the top-slide as a ram, the keyway can be cut using the cross-slide to apply cuts of about 0.025mm at a time.

If after all this the flywheel still doesn't run true, the crankshaft shaft can be mounted between centres and the flywheel skimmed until it does run true. I have been given this last piece of advice many times as being a good way to obtain a true running flywheel. I have tried it but it doesn't work for me; the flywheel just 'rings' and I finish up with horrible chatter marks no matter how slowly I run the lathe. The finished flywheel is shown in photo 2.

A word or two about the key. The type used is a saddle key, so called because its underside is hollow to fit the curved surface of the crankshaft. It has the advantage of requiring no slot in the crankshaft.

To make the key, grip a length of 20mm dia. mild steel in the chuck, face it off, centre and drill 9.5mm (3/8in.) diameter. Set over the top-slide to 1 1/2deg. and turn a taper until the front edge is just a little thicker than the height of the flywheel slot. The length of the taper can be 6mm (1/4in.) longer than the thickness of the flywheel boss. Part off 3mm (1/8in.) past the end of the taper, forming a step.

Now cut a slice out of the cone as in a cake and there's your saddle key. File the edges flat, taking care to keep the underside hollow radius central, until the key slides into the keyway. Put the flywheel onto the crankshaft and file the top edge of the key until the key partly enters the keyway. Gently tap the key into the bore using a hammer, but not too hard, as we still need to remove the flywheel from the crankshaft, aiming for the key to grip firmly with the small end still about 2mm inside the flywheel boss. On final assembly the key can be tapped home a little further.

I think you'll be surprised how tightly a saddle key can grip. With its 1 1/2deg. taper, just a very small amount removed from the top will allow it to enter the keyway considerably further.

●To be continued.

Peter Lewis

describes progress with his 5in. gauge Bulleid pacific locomotive to Keith Wilson's original *Ariel* design and discusses problems encountered with valve gear and cylinder components.

●Part II continued from page 169
(M.E. 4153, 24 August 2001)

The total thickness of the main driving wheels is shown as $2\frac{23}{32}$ in.; it is actually $1\frac{11}{16}$ in. which makes the length of the axles $5\frac{15}{16}$ in. not 6in. as shown. I reduced the bores of the main driving wheel from $\frac{3}{8}$ in. to $\frac{5}{16}$ in. diameter and brought them in toward the centre by $\frac{1}{8}$ inch.

While I'm at it, the trailing and tender axles are shown at 4in. between shoulders when this should be $4\frac{11}{16}$ in. At this rate some unsuspecting builder would be rapidly filling his scrap box. As mentioned in part I, I have used needle roller bearings on all axles and have therefore altered the axlebox dimensions anyway.

If I remember rightly, I found the crank axle assembly okay except that I didn't drill horizontal oil holes but will rely on splash lubrication. I used the balanced crank webs and seem to recall Ken Whittle telling me "you can't get the bolts in on the locking plates because the webs are in the way." Well, I managed to do so and reckon that Ken must have had something adrift.

Motion

In some ways this went well but it caused me a good many headaches. First, because of all my concerns about the possibility of errors, I visited York Museum and studied *Ellerman Lines* which has been sectioned for display there, and took all the measurements I could think of. The curator, an ex-Blue Funnel Chief Engineer, couldn't have been more helpful. He arranged to have the movement stopped for me and there I was in full view of the public, diving all over the place to get my information.

Having got as much as I could, I returned home and made complete mock-ups of the inside and outside motion using hardwood with bushes and steel pins. It was surprisingly accurate but I found that simply scaling it down did not work. Keith refers to Realeaux diagrams so I assume he knows what he is talking about and I set about using all his measurements except for some slight alterations, which I hope to remember to point out, and to my joy all the valve events were exactly as they should be.

From this point, the motion was built up, starting with the inside cylinder, although I had tackled all the con. rods previously. I'm sure Keith is right about using black steel, but I had none and I didn't much like the idea of a rough finish; clever blokes use stainless steel, but I still think mild steel looks the best. The drawings show $\frac{1}{16}$ in. thick con. rods after fluting which I think is far too thin, so I settled for fluting just on the outside only to find that the rods distorted. I bent them straight and was promptly reprimanded for saying so, being told that things cannot be bent straight, they can only be straightened! I



The boiler was built by Priory Boilers in Warwickshire. The outside connecting rods seen here are in mild steel and are shown with the fabricated crossheads described in the accompanying text.

GENERAL STEAM NAVIGATION



Above: The inside connecting rod is fluted on both sides and is shown here fitted with its big end bearing and locking plates.

Below: The coupling rods were machined from bright mild steel. They are not fluted but are fitted with oil cups as per the prototypes.



shall just observe that they turned out fine in the end. I fluted both sides of the inside con. rod but was careful not to remove too much material.

The coupling rods are not fluted as shown. They are fluted on Spam Cans and rebuilt West Country's and Battle of Britain's (or should that be Battles of Britain?) One of the accompanying photographs shows my finished rods with a lubricator oiling turret on the rear bush of the front rods as per full-size but which is not shown on the drawing for some reason. The ends have the same radius all the way round and are not square shaped as shown. Fred Grosvenor in Sydney reminded me that the offset of the fork on the rear coupling rod is not shown.

I made the crossheads in two pieces with five threaded 4BA pins holding the two halves together. When completed they were secured with a spot of MIG weld here and there. I have come across some clever chaps who have succeeded in making them out of one piece; how they carved the circular recess and internal cavity I shall never know.

It was pointed out to me that the crossheads will not fit the guidebars. Without going into

detail, much cross-checking was required but I managed to sort it out in the end. The two holes marked 8BA $1\frac{11}{32}$ in. apart I made 10BA for the two tiny brass oil boxes—very neat. The inside crosshead is shown at $\frac{9}{16}$ in. across the top when it should be $\frac{13}{16}$ in., similar to the outside crosshead. I'm pleased I didn't make the bolts tapered. The engine has had to come to bits so many times that I would have been sick and tired of breaking the taper each time. As it was, I used a straight shank bolt locked by an 8BA grub screw in the outer edge of the crosshead before doing up the nut. The grub screw in the inside crosshead is fitted from underneath.

That reminds me of one of the best things I ever did which was to build myself an erecting stand which allowed me to rotate the locomotive about a horizontal axis, rather like roasting meat on a spit. I allowed headroom for the boiler so that it would serve as assembly continued. I used an old reduction gearbox coupled with some extra gears and a spring loaded pawl which drops in when required. I can stop the whole lot at any position which is ideal for fitting awkward

screws, and the like. Apart from this, the locomotive is very heavy and trying to turn it over all the time to work on it is a real pain in the butt.

Now, according to all my scaling down, on checking up on Keith's rods, etc. I found that the combination levers did not tie in so I made the outside levers $2\frac{7}{16}$ in. long instead of the $2\frac{11}{32}$ in. shown, which is quite a difference. When made and assembled, I wasn't satisfied with movement of the union link above and below the horizontal so I studied video tapes, etc. and then remade the levers to $2\frac{11}{32}$ inch! They seem dead right and I was more than a bit sick at having made a job of the first pair. That said, my scrap box is extremely small thanks to thorough checking, regular visits to the Bluebell Railway together with all the help and tips I have received, the vast bulk of which has come from Fred Grosvenor in Sydney.

I was caught out with the inside combination lever which is shown wrong handed; this was scrapped for obvious reasons.

I made what I considered to be a lovely job of the suspension links, only to find that they were too narrow in the width; the radius rod would have carved a face on the guide bar brackets. Their overall width needs to be $1\frac{1}{16}$ in. instead of 1in. which gives $\frac{11}{16}$ in. centres for the valve rod linkage and the combination lever. My choice was either to make a new set or take a chance and modify the old ones. I chose the latter because if I made a mess of them I would have had to make another set anyway. I cut them down the middle, miked them up to determine the loss due to the saw cut, inserted a plate of the required total thickness and then silver-soldered the whole lot together. I finished them by cutting off the bits sticking out and cleaned them up. They turned out fine; you can see what has been done, but they hide under the platform plates anyway.

I did not make the expansion links out of one lump to include the pivot pins but made the latter separately and bolted them through with a long 10BA bolt and brazed them on. I am happy with the result. However, Keith had left off one important item for which I had to take the whole lot to pieces to add it later on. This is a small shaft on each outside link on the side nearest the frames to drive the lubricators on the platform plates. In full-size there is a square on the end of this shaft but it is so small that I used a 6BA stud which can be locked up with nuts.

The eccentric sheave rod and strap gave me some headaches owing to the very limited clearance inside to secure it to the axle. I had made matters worse by fitting $\frac{1}{8}$ in. brass plates on the inside of my axleboxes to cover up the bearings.

The return crank rod gave me some problems and I ended up with a slightly wrong shape at the rear end on the inside of the rod. Fortunately, this cannot be seen unless you stand right above it. According to Martin Evans, in order to check the exact lengths, the return cranks shouldn't be made until the final setting.

As previously mentioned, I made some small alterations to the motion layouts since with various checks I could not obtain equal swing of the expansion link each side of the vertical. The alterations involved the distance to the drive centre from the suspension link, the length of the return crank rod (eccentric rod) and the distance of the weigh-shaft centre from the drive centre. I



The subject of some frustration, the combination levers (left) had to be remade while the expansion links (right) are fabricated using separate pivot pins secured in place by brazing.



Return crank and eccentric rod.

had to draw all the motion out a good many times to get it right. If anyone would like copies of these they are welcome.

The weigh-shaft is a nightmare. Fred Grosvenor made up a splendid jig to hold all the bits and pieces together, only to discover that the measurements were all over the place. I noted all his errors, checked and double-checked the drawings and made the darned thing only to find it was still out. Somewhere there is a lost $\frac{1}{32}$ in. across the locomotive. I think I found it at one stage, but I can't remember now. There is also lost $\frac{1}{32}$ in. on the length, but time has dimmed my recollection of that as well.

I just got away with the weigh-shaft which is hard up against the bearing housings. When running the engine on air later on, the bolts holding the three sections together started to work loose, so I added lock nuts everywhere I could reach plus grub screws fitted into the coupling discs. To add to the fun, the counterpoise lever and shaft fouls the weigh-shaft when the gear is in full forward. That is why the lever is offset. As it happens, if you move the motion too far from full forward to backward gear, the die block pins fall out through the lightening holes in the expansion links. This problem is finally resolved by adjustment to the reverse screw lever arrangement.

I did not case harden the guide bars; in fact I have not case hardened anything. My father used to reckon that it was brutal treatment which also caused distortion. In my experience it makes an awful mess and in any case it's not as if I intend to run my locomotive for thousands of miles.

The radius rods are a delicate job and according to Ken Whittle those on the outside should be $\frac{1}{8}$ in. longer. However, I made them to size.

Before going on to the cylinders I will jump the gun and deal with the happy stage when I ran the engine on air with the middle cylinder only, the first one completed with all the motion. Two things must be mentioned, the first being the inside valve crosshead and the second the valve settings. The inside valve crosshead is not shown on the drawings but Keith mentions it in his article

and discusses the use of a gunmetal casting. I must admit I had previously missed reading this bit.

However, at the time Peter Theobald had already sent me a photograph of his own arrangement which is effectively a circular trunk guide and a very good idea which I have copied in the hope I will not be done for infringing a patent. In due course, I managed to get a photograph of the full-size crosshead by standing on the platform plate of *Port Line*, hanging on to the boiler handrail with one hand and taking a shot with the camera held in the other. It is like a marine crosshead guide but set horizontally.

Keith doesn't mention valve rods either, but I sussed them out and made all three rods from $\frac{6}{16}$ in. lengths of $\frac{3}{16}$ in. diameter stainless rod.

With regard to the piston valves, the one I had made for the inside cylinder was a good fit, but when I came to running all three cylinders on air later, I realised due to the huge air consumption that I had leakage across them and set about making a new set. I literally had to tap them down the bores. I then connected them up one at a time and ran the engine on air on the other two cylinders in order to lap them in.

This brings me to the valve timing. Bearing in mind that the piston valves are just bobbins and have no rings, I took the measurements from the end of the valves; this makes sense, but I am suspicious of leaks over the ends. I don't want the piston coming up the bore to meet a wall of water. I aimed for zero or a slightly positive lead but wasn't really concerned if they ended up slightly negative. The full-size engine has a $\frac{1}{8}$ in. lead. Scaled down, this comes to about 0.010 inch. When it came to the inside cylinder, I managed to get all openings except one to these limits. The one which was out was at back dead centre in reverse gear which was well and truly negative, the port opening well after the piston was going down, but it shut equally quickly. Fortunately I wasn't too bothered about it as it ran well, and who is really worried about it in reverse. Blow me, the same thing occurred on the two outside cylinders later on. I could understand



Top left: The three cylinders which are fitted with cast iron liners, represent a considerable amount of work.

Above: A view of the inside cylinder. All cylinder bores were honed to finish.

Left: Piston and piston valve together with their rods and a piston ring.

Below: Wheel quartering using the jig described by Ian Grayling in these pages in May 1993.



getting unequal openings, say on two, but not on one, and not being able to sort it out. Perhaps some genius out there can throw some light on it.

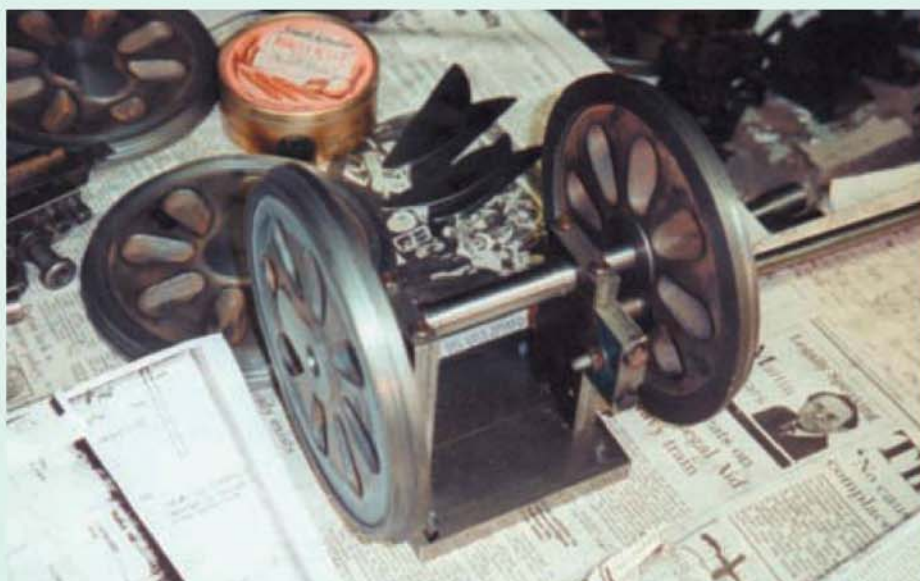
Cylinders

Fred Grosvenor informed me early on that the 3in. length would result in part of the drain plugs being machined off so he made his $3\frac{1}{8}$ in. long. His must have been different castings to mine because this was one problem which I didn't run into, but I followed his advice and stuck to the $3\frac{1}{8}$ in. length. In any case, as Keith has been informed, a 3in. cylinder length combined with his other dimensions will result in the piston hitting both end covers. The extra $\frac{1}{8}$ in. gave me about 25 thou. clearance at each end which is about right.

I used the $\frac{5}{16}$ in. spigot on the end covers as shown. I also made the spigot on the valve covers $\frac{5}{16}$ in., but it turned out that I only had approximately $\frac{1}{16}$ in. clearance from the nuts on the valve rods. By the way, a circular hole needs to be filed in the front of the smokebox saddle in line with the inside valve spindle in order to remove it, otherwise to do so the saddle has to be removed which means taking the cylinders off; the mind boggles!

For the cylinder liners, I managed to get a piece of soft cast iron from Messrs Jay's in Norwich. They went okay but I had some doubts about fixing them in place. Fred Grosvenor kindly sent me some Loctite 620 which stands up to 250deg. C. and was apparently not available in this country at the time. I had some Loctite 648 which survives to 175deg. C, but this is only available here in 50ml sizes not the usual 10ml sizes which are quite enough for our purposes.

I honed all three cylinder bores. According to Keith's drawings the cylinders are fitted with floating glands and there is only enough room for an O-ring, which I have fitted, nipped up to the tune of about 3 thou. This is alright on the inside



cylinder with inside admission but I am not so happy with the outside cylinders with outside admission. Only time will tell.

The little steam operated drain cocks were a gem to make and were blanked off to allow me to run the engine on air. The relief valves on the cylinders are so short that the springs are nearly coil bound, so I don't have too much faith in them. This reminds me of my father's Doble steam cars which had 1in. phosphor bronze balls for relief valves, there being no drain cocks, and if you weren't careful they went off like a cannon.

According to some information I had, the five $\frac{1}{4}$ in. holes for the blower are too big so I have reduced these with inserts to $\frac{9}{64}$ in. I may be wrong about this but we shall see. I fitted snifting valves to each cylinder as suggested, but to Greenly's design; they just looked easier to make.

My photographs include a shot of the jig I used for quartering the wheels. This is described in detail (*M.E.* 3944, May 1993) by Ian Grayling in Victoria. Returning to my difficulties with the valve events and various other problems, I wonder if I have made an error with the cranks, either with the angles or the exact centres of the cranks from the wheel centres. All the experts will know the wrinkles, but it is a headache for a newcomer.

The inside cylinders were no problem. I am lucky that I have a large enough lathe these days, so they can be swung on the face plate for boring. Previously (years ago) I had to mount large cylinders on the cross-slide and line bore them using a boring bar between centres, a method which is just as effective but which takes a lot of careful setting up.

● *To be continued.*



RANSOMES & MAY Horizontal Engine of 1850

Stan Bray

continues the project with the valve fork end and begins work on assembly and fitting up the engine.

●Part X continued from page 173

(M.E. 4153, 24 August 2001)

Although small, and tricky because of that, many readers should find no great difficulty in making the valve fork end, but in case anyone has never tackled such a job before, a note here of how to go about it may be useful.

Start with a piece of square bright mild steel bar of the specified size somewhat longer than required to give something to hold. Put the job in the milling machine or mount it on a vertical slide and mill the slot a little below the finished depth. If you happen to have a suitable corner radius tool, form the radius on the end of the piece; if not put the work in the bench vice and file the radius on it. Either way, bring the slot to its correct depth during this process.

Remove the work from the milling machine and grip the piece carefully in your 4-jaw chuck (self-centring if you have one, or set it to run true if not). If you have a tiny centre drill, centre the bottom of the slot, otherwise use a short stubby point to make a central mark at the root of the slot then drill and tap for the valve rod. Use a parting-off tool to machine the boss behind the slot and then part off to finished length. Finish by marking out and drilling the hole for the pin. A suitable piece of packing in the slot will stop it from closing up while it is being drilled.

Assemble the cylinder block, port face, etc.,

and the valve assembly, and move the valve backwards and forwards by hand. The valve should completely cover two ports and leave one fully open; the same applies at the other end of the stroke. If for any reason it does not do so, some slight adjustment to the outer edges of the valve with a file might be necessary. The same applies to side clearance; the design is such that the valve moves in the chest with a minimum of clearance between it and the walls. If there is any tightness, remove a little metal, preferably from inside the steam chest wall rather than from the edge of the valve itself. Use a Vernier gauge to check finally that the square recess in the valve is exactly the same size as the inlet and exhaust port to ensure good steam distribution.

A final task is to smooth all the surfaces. While some builders may prefer to deal with this at the time of final assembly, others may wish to do it now and know the cylinder block is finished. All port faces, including the inner and outer ones in this case must be perfectly flat and smooth. This can be achieved by rubbing them in a figure of eight motion on a piece of very fine emery cloth laid on a perfectly flat surface. The valve face should receive the same treatment. If this is done properly no gasket will be required between the inner and outer port faces, just a smear of grease before assembly. Those seeking perfection may wish to finish all the faces with a rubbing compound after using the emery cloth. If you chose this route, don't use anything harsh but stick to a good quality metal polish, or something similar, such as household scouring powder mixed with oil. Before commencing work, check also that the plate on which it is laid really is flat. Be sure to remove all traces of abrasive before assembly and testing.

Assembling the guide bars

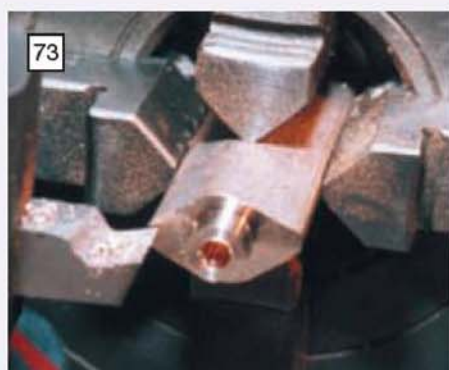
The guide bars bracket has already been described and should be to hand, but it may not be wise to drill it and bolt it to the bed at this stage. It may be better to stick it in place, either with cyanoacrylic adhesive, or our old friend double-sided sticky tape. Bolt the slide bars in place on the cylinder cover bracket and check them against the support bracket at the other end, first making sure that they lie parallel to each other, and secondly that they are parallel to the bed; check also that both pairs are at the same height.

To get a tidy job it will be necessary to dress the bracket with a file in order to create square corners into which the bars will fit. Once satisfied that everything is correct, it should be possible to pass a tapping size drill through the top bars into the bracket, allowing the drill to emerge from the bottom bars. The holes in the bracket can then be tapped and those in the slide bars opened out to clearance size.

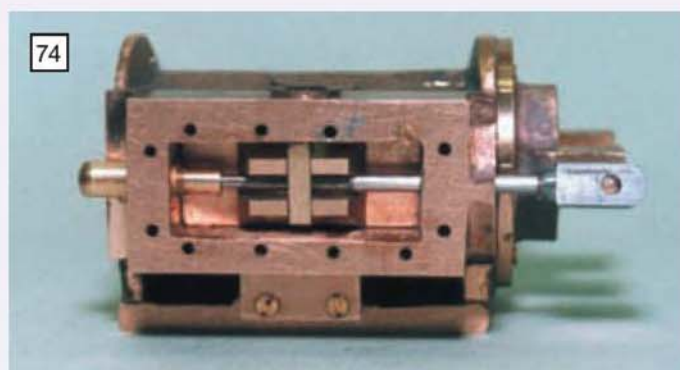
A piece of studding fitted into each hole in the bracket will allow the bars to be secured with a nut and washer. You may prefer to open the hole in the bracket to clearance size, fix a nut to one end of each piece of studding using a retaining compound, pass the studding through the bars and the bracket, and secure with another nut. This of course is not the way things should be done, but it makes life much easier and nobody will be able to tell the difference anyway.

Crosshead parts

A gudgeon pin is fitted through the brasses of the small end bearing which we will come to later. It is fitted to the connecting rod with a strap and secured with a pad and cotter. The two rectangular



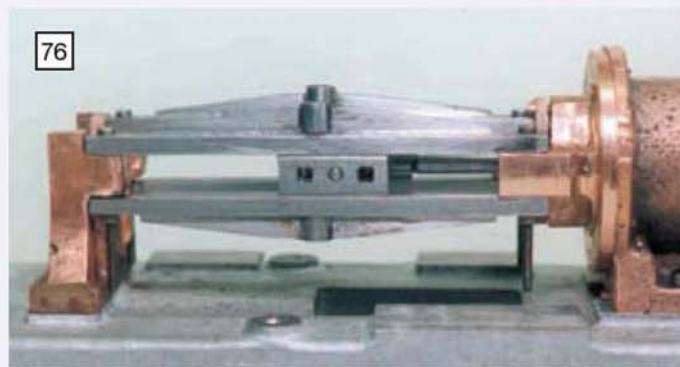
Top left: oval glands are required for the steam chest, rear cylinder cover and pump. Oval bronze cast strip is supplied and can be machined in the 4-jaw chuck.



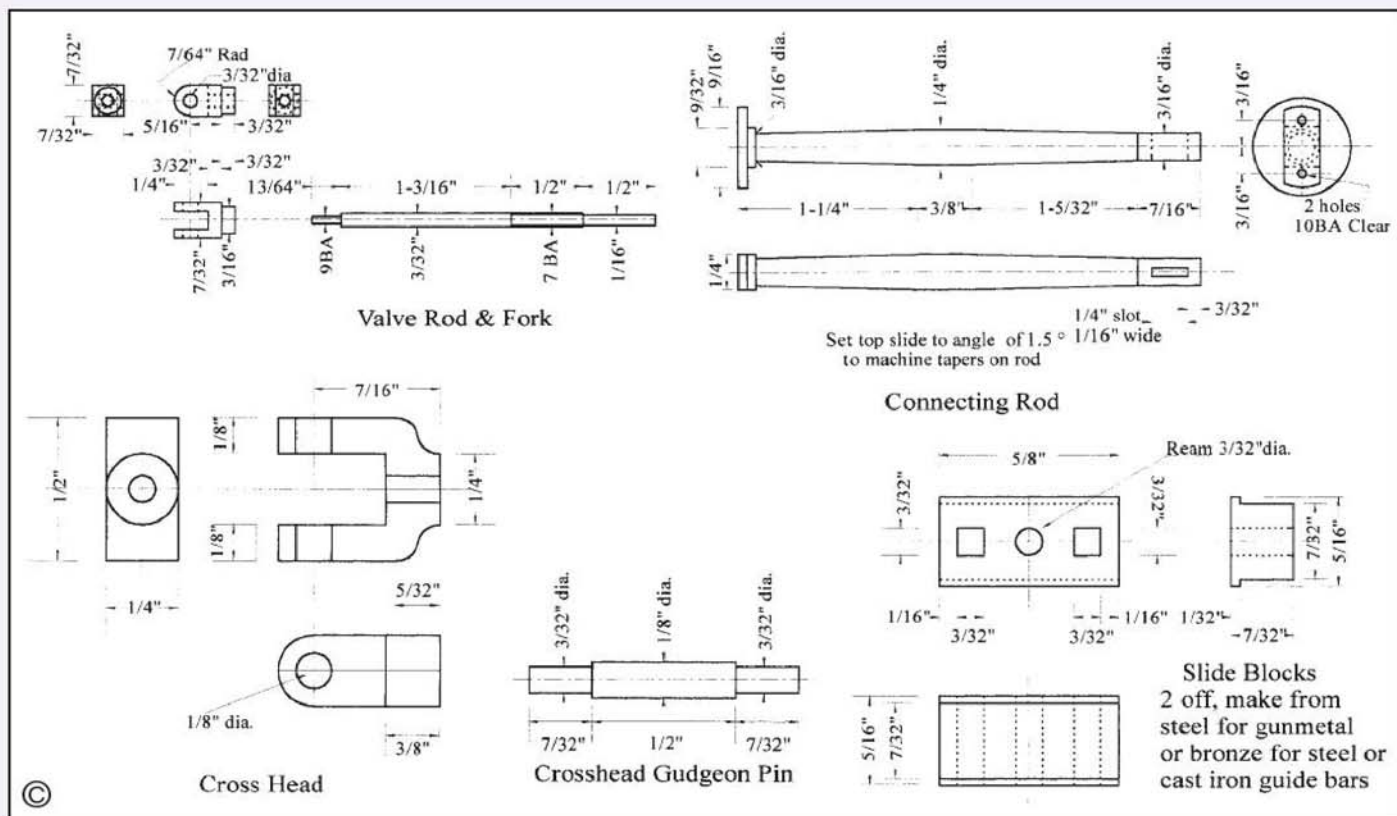
Top right: a trial assembly of the slide valve group provides the opportunity to make any necessary small adjustments.



Bottom left: the support bracket for the guide bars. Apart from machining the base to get it flat, it is finished by hand filing.



Bottom right: a trial assembly of the guide bars to check the fit and ensure the blocks will run smoothly.



blocks which fit between the guide bars either side of the bearing have small lips machined on them to prevent the blocks from sliding out. There are also $\frac{3}{32}$ in. square holes either side of the pin, so it is as well to make both blocks from a single piece of steel bar, considerably over length, and then cut the pieces to size afterwards.

Using a longer piece of bar than required makes it easier to grip the parts to work on them. It also means that if a machine vice is bolted to the drilling table it will be possible to slide the work along it ensuring that the holes, including those needed for squaring up later, are correctly aligned. This technique does not solve the problem of getting the correct distance between them, which is where a mill/drill has the advantage, making it possible to use the index dials to get the spacing right. However, careful marking out will do the job quite well if an ordinary drilling machine is to be used.

Squaring the holes

Converting small holes like these from round to square can be difficult if attempts are made to shape them up with a needle file. It is not easy to keep the holes square, true and dimensionally accurate all at once. The best way to convert the holes is to make and use a proper drift or broach, but this is a time-consuming task. However, for those who would like to have a go, the following method is one way to set about it.

Start with a length of silver-steel, about $\frac{1}{4}$ in. dia. and 3in. long and mill a $\frac{3}{32}$ in. square about $\frac{1}{2}$ in. long at the end. Index for the square by centrally drilling a piece of square mild steel to act as a jig, fixing the silver-steel in the hole and rotating the square after each cut to obtain the square section. Set this jig in the milling vice at an angle of $1\frac{1}{2}$ deg. and mill a taper for a length of about $\frac{3}{16}$ inch. Even at the extremity only about a $\frac{1}{64}$ in. needs to be removed.

The jig should be rotated around all four faces in order to obtain a uniform taper all round. It may be best to set the angle using feeler gauges with the end of the jig aligned with the edge of

the vice. Having machined the square and the taper, about three cutting edges will be needed which can be filed, the tool should then be carefully hardened and tempered to a dark straw colour. Take care because the small tool section will heat up very quickly; this is actually no bad thing because the shank of the tool should remain soft, however it is quite easy to overheat the smaller section, particularly when tempering.

To use it, the tool is held in the drill chuck and simply pushed through the pilot holes with a steady downward movement of the quill. The machine is not of course switched on at the time!

For those who do not enjoy tool making, a square needle file can be used, holding it in the drilling machine chuck and, with the job in the machine vice, simply working the file up and down to make a square, if slightly tapered hole. The machine is again isolated from the supply during operations. The taper will probably not notice; if it offends, turn the work over and work on the other side as well. If your drill has a depth stop, this may be used to set the penetration of the file to achieve the same size on both sides. The result will be a square hole so slightly double tapered that it will not be at all obvious.

It should now be possible to check the set up to see if everything runs smoothly without binding.

Connecting rod

Being slightly fish bellied, this is typical of those used on this type of engine and, with the tiniest bit of cheating, it is very easy to make. Start with a suitable piece of steel, whether mild, silver or stainless is a matter of personal choice. In full-size practice the rod would be of mild steel kept highly polished by the driver, however depending on where the model is to be kept it may not be possible to keep it bright under these circumstances, stainless steel may be preferable. Others might consider silver-steel on the grounds that a more suitable finish can be obtained than on mild steel and although it will still rust, it will do so less quickly than some of the softer materials.

Cut a piece to the correct length and face the ends, putting a small centre in each end. The slot for the cotter is best milled at this stage since with the metal at full diameter throughout its length it is easier to support in the milling vice; once tapered it becomes almost impossible to hold. Put the bar in the 3-jaw chuck, set the top-slide to about 1deg. and machine the taper on the rod stopping about $\frac{1}{8}$ in. short of half way.

Turn the work end for end and machine the end to $\frac{1}{8}$ in. diameter for a length of $\frac{1}{8}$ in. locate in the flat section.

Grip the rod in the 4-jaw chuck, set it to run true, support the outer end with a centre and machine a matching taper. If the tailstock gets in the way and prevents the tool from reaching the workpiece, make up a false centre by machining a 60deg. point on a piece of $\frac{1}{4}$ in. diameter silver-steel which should then be hardened and may be held in the drill chuck.

The rod is tapered at each end with a short parallel section in the middle, which needs to be blended in to make a nice smooth curve. At one time we would have recommended the use of a fine file and emery cloth to blend these three surfaces together with the work rotating. For reasons of safety and to avoid the danger of cut hands and/or broken fingers we must now advise that the work is done with a suitable tool. Readers must make of this what they will.

The flat section is drilled to fit the short piece of the rod and with clearance holes either side to allow it to be bolted to the eccentric. Drilling and milling will be facilitated if the piece is made from a longer length of metal than required. The flat section is then silver-soldered to the rod, locating it by means of the hole and ensuring that the slot is upright and at 90deg. to it. The piece can then be cut to size and finished to shape by filing.

The strap, cotter and brasses are quite straightforward; the strap can be made from strip or milled from a length of bar while the cotter and pad are filed from mild steel sheet: details next time.

●To be continued.

WEIGHT DRIVEN EGG TIMER

John Wilding FBHI

introduces a new project for the novice metalworker, in the form of a simple but elegant mechanism with horological associations.

●Part I

This project is aimed at the complete beginner in metalwork. The egg-timer is shown in photos 1 and 5 and again in the general arrangement drawings figs 3 and 4. A lathe is necessary but, as this is a beginner's project, I have designed the timer so that it can be made using any of the small hobby lathes available on the market today. In this case the project is illustrated on the Unimat 4. This is a 'compact' lathe and by purchasing the milling and drilling attachments, all the machining can be accomplished on the one tool.

Recently I described the construction of a simple clock which was made on the Peatol lathe (see book list). This is perfectly satisfactory for making the egg timer, but a drilling machine would be needed. Other small lathes, such as the Toyo 210 and Cowell, would also be suitable.

As can be seen the timer is wall mounted by the 'hook and spur' arrangement, a method commonly used by the early clockmakers. It is weight driven and requires some 40in. below the movement for the weight fall.

It might be thought that this project is of a frivolous nature, but not at all! A most unusual escapement is used: the MacDowall single pin design, which is quite fascinating to watch in action. I only know of two clocks fitted with this escapement, one is in Ireland and the other is in the collection of Lord Harris at Belmont House, Faversham, Kent where the clock is in the main hall. It is a fine Regulator and the escapement

has been brought to the front where it can be readily seen. I have also done the same with my timer. The pendulum, which is behind the movement, is compounded, i.e. with bobs above and below the suspension. This type has been used because it occupies less room. The bobs take the form of an eggcup at the top and an egg at the bottom.

Train and gearing

Because the timer is only designed to run for six minutes (for a hard boiled egg), only one pair of gears is necessary between the escape arbor and the driving pulley. As many beginners are put off by the thought of having to cut gears, I have used ready-made gears available from Hinchcliffe Precision Components (ref 1). I have employed this firm for many years and bought large pinions for tower clocks from them; their catalogue is some 1½in. thick!

The gear and pinion here are 90t and 9t giving a 10:1 ratio; the module is 0.8. There is a choice of materials and I have used Delrin. The gears come with the centre holes drilled and the total cost is less than £20. When you think that a cutter today costs some £50, it can be seen that this is a sensible option. However, at the end of the series, for the benefit of the enthusiast who likes to make every part, I shall show how this is done on the Unimat 4. The final drive, or 'motion work' as the clockmaker would call it, consists of a two-pin suspended lantern pinion in engagement with a ratchet tooth wheel of 48 teeth. Because the tooth shape is not critical this can be formed by hand methods.



General view of the egg timer.

Escapement

This is a delight to watch and I show its action in fig 2. The crank pin should be imagined as an escape wheel with one tooth. The pin operates within the aperture in the pallet arm. It can be seen that in the vertical plane there are two straight impulse faces. In the horizontal direction there are two radial locking faces. Starting at (a) we see the crank pin, which is turning anti-clockwise, is up against the top impulse face and pushing the assembly to the left. Eventually, the pin slips off the bottom of this face landing on the lower circular arc as shown at (b). The pin rides along this face to the right under the momentum of the pendulum (c). When the energy of the pendulum is spent, the pallet arm returns and the pin slips round the corner onto the lower impulse face as seen in (d) impulsing the pendulum to the right. Eventually, the pin slips off this face and locks on the left-hand circular face (e) running along this then returning to slip round the corner and adopt the position in (a).

The crank pin makes one revolution for each two swings of the pendulum. A major snag to this escapement is the fact that it needs an extra wheel in the train, but this problem does not apply here in the egg timer which only has to run for six minutes. An advantage for non-clockmakers is that there is no adjustment to the escapement, no 'drops' to worry about and no impulse

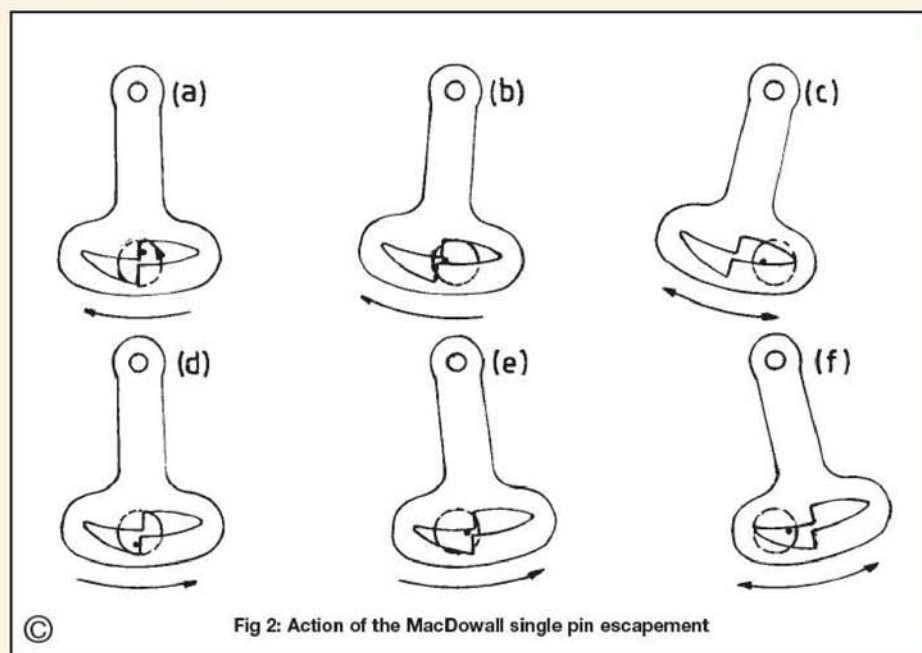
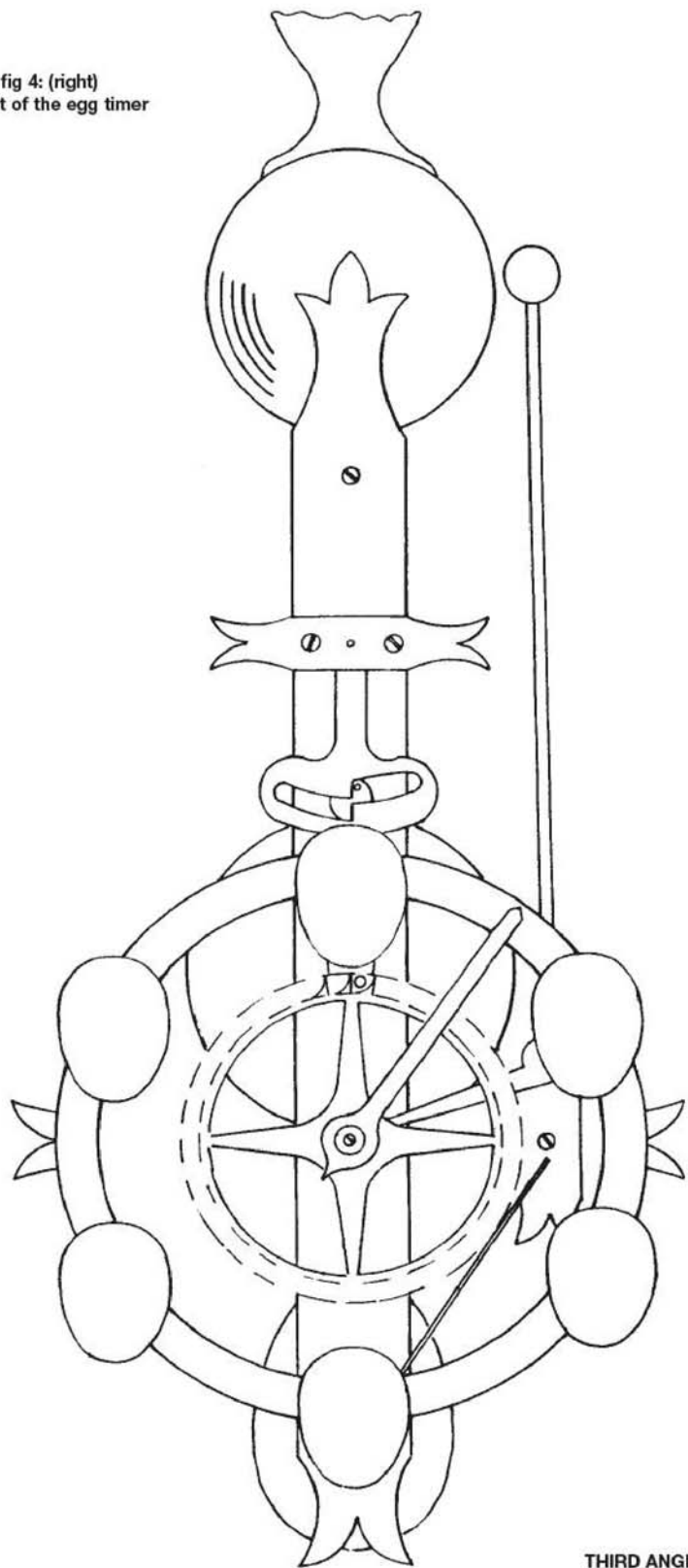
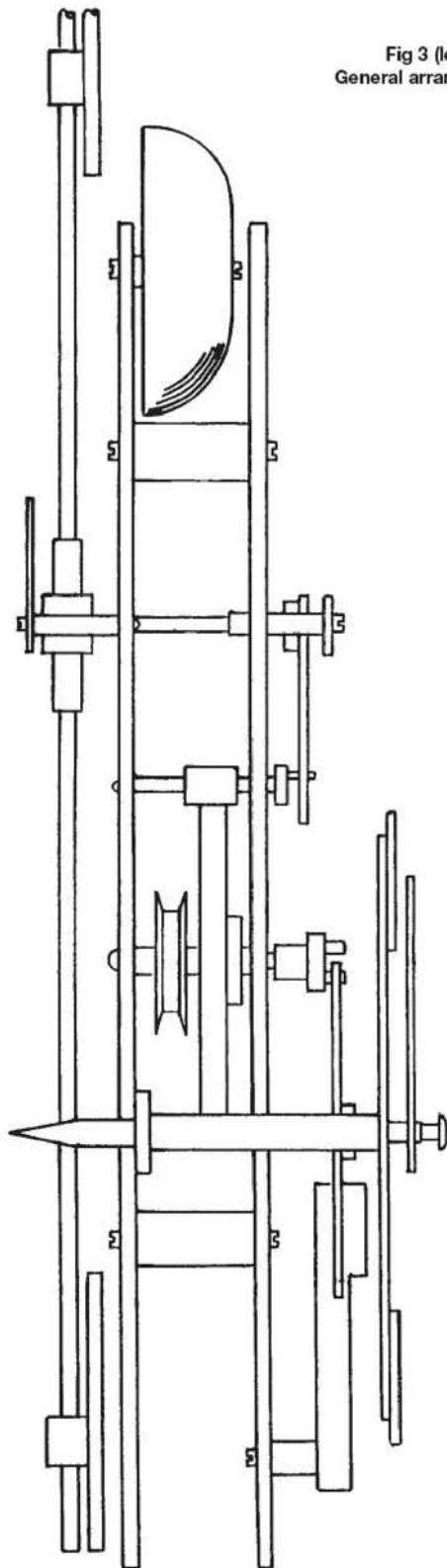


Fig 2: Action of the MacDowall single pin escapement

Fig 3 (left) and fig 4: (right)
General arrangement of the egg timer



THIRD ANGLE
PROJECTION

angles. The pin is in contact with one of the four faces in the pallet arm at all times.

The train

Starting at the top, the pendulum beats three-quarters of a second, thus it makes 80 swings in a minute. The crank pin makes 40 revolutions in a minute and as the ratio between the crank pin

and the pulley wheel is 10:1 the latter will make four revolutions per minute. As we require the timer to run for six minutes the pulley will make 24 revolutions. The hub in the drive pulley is $\frac{7}{8}$ in. diameter and it will let off $2\frac{3}{4}$ in. of line per turn or 66in. in six minutes. With a weight pulley and double fall this will amount to a weight drop of 33in., but we must allow for the

length of the weight and weight pulley which means that we need 40in. under the movement.

The drive pulley carries a two-pin suspended lantern pinion on its arbor which drives a ratchet tooth wheel with 48 teeth and this carries the hand which makes one rotation in six minutes. On completion of the set time a single blow is sounded on the bell at the top of the movement. ►



Close-up of the escapement and 2-pin suspended lantern pinion.

Operation

The pipe which carries the large ratchet wheel and hand is a sliding fit on the stud which is secured to the front plate. By pulling the hand forward, the wheel is disengaged from the pinion and from the let-off lever which releases the hammer. It can then be turned to indicate whatever time is required and pushed back into engagement with the two-pin pinion. The weight is wound by pulling down on the jockey weight. The pendulum is self-starting.

Here is a simple piece of machinery with a horological association which I hope readers will consider to be sufficiently attractive to take its place in the kitchen.

The tooling required to make this timer is modest. Basic hand tools, if not already available, can be purchased as required. Although I have chosen a lathe with an attachment for drilling and milling, it is not essential to buy this equipment but a drilling machine will then be required. Although I say that a drilling machine is necessary, a modern portable electric drill can be used for drilling but it must be used in a drill stand. Having said this, in the shop where I worked they didn't have any sort of a powered drill, all drilling was carried out with a Stanley hand drill of 1/4in. capacity!

The beginner must realise that it will be necessary to read up the basic principles of lathework and at the end of this first instalment I include a list of books which will be useful. A supplier of the raw materials is also provided and I do urge the newcomer to use him as the brass will be of the correct type which I have specified. There is often a tendency to go to a local scrapyard to try to pick up scrap materials, but you will have no idea what type of brass you are buying. Soft riveting brass, for instance, is far more difficult to machine than the CZ 120 which is recommended.

Many beginners think that with the acquisition of a lathe they are in a position to go ahead and make the model without interruptions. Unfortunately, this is not so. In this specialised field many tools and gadgets will be needed which cannot be purchased. However, as a lathe owner, you are in a position to make these tools.

MATERIALS LIST

BRASS

Strip	3/16 x 1 1/2 x 6in.	1 off	Pulley.
	1/8 x 2 x 6in.	1 off	Pendulum bobs and drive pulley.
	1/8 x 1 x 12in.	3 off	Plates and cross strut.
	1/32 x 1 x 12in.	1 off	Jumper spring, click spring and dial eggs.

Sheet	1/16 x 12 x 6in.	Back and front bridges, pallet arm, pulley flanges, hammer bracket, dial ring and ratchet wheel.
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Round	1/2 dia. x 12in.	1 off	Pillars, collets etc.
	3/8 dia. x 12in.	1 off	Pillars, collets etc.
	5/16 dia. x 12in.	1 off	Pillars, etc.
	1/8 dia. x 12in.	2 off	Pendulum rods.

Hex	3/16 across flats x 6in.	1 off	Bridge pillars.
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MILD STEEL

Round	7/8 dia. x 12in.	1 off	Weights.
	1/4 dia. x 12in.	1 off	Arbor and stud.
	1/8 dia. x 12in.	1 off	Arbor and pins.
	3/32 dia. x 12in.	1 off	Hammer arm.
	1/16 dia. x 12in.	1 off	Pins and weight hooks.

Strip	1/16 x 1/2 x 12in.	1 off	Hand.
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MISCELLANEOUS

Spring	0.005in. thick x 1/4in. wide x 6in. long.
Lay-out blue	Small bottle.

SCREWS

5BA steel x 1/2in. cheese heads and steel washers	10 off
6BA steel x 1/2in. cheese heads	10 off
8BA steel x 1/2in. cheese heads	10 off
8BA steel x 1/2in. c/sunk heads	10 off
10BA steel x 3/8in. c/sunk heads	10 off
10BA steel x 3/8in. cheese heads	10 off

For instance, in the first part of the construction you will need a 'tool height setting gauge'. This is a simple device for checking that the lathe tool is correctly set at lathe centre height. It is true that you can put a lathe centre in either the headstock or tailstock to check this but it will not always be convenient; you may have the chuck in place or the tailstock in use for supporting work held in the chuck. This little tool cannot be purchased, you will need to make it.

Today it is becoming difficult to buy good quality tools, especially fine cut files and some of the special tools associated with clockmaking and repairing. I wrote to all the suppliers with a list of some of the tools required in this project asking whether they could supply them. Of those who bothered to reply H. S. Walsh (ref 4) stocked most items and J. M. Wild FBHI (ref 5) can supply the special tools which I suggest such as a depthing tool and the holding clamp for the drilling machine.

Because this project is intended for the newcomer, I have included a large number of illustrations. From my experience, beginners appreciate pictures of lathe set-ups, etc., so I hope the more experienced constructor will excuse the basic nature of many of the pictures.

●To be continued.

Books

The Construction of a 3/4 Second Pendulum Electric Clock by John Wilding. A project for the beginner and illustrated using the Peatol lathe. Available from **Rite-time Publishing**, 18 Woolmer Way, Bordon, Hampshire GU35 9QF. *Unimat Lathe Projects* by Gerald Wingrove.

An excellent book containing general information on the use of the Unimat 3 lathe written for the beginner, obtainable from Unimat agents.

Using the Small Lathe by John Wilding illustrated on the Toyo 210 lathe, mainly describes the use of the lathe for clock repairing.

Tools for the Clockmaker and Repairer by John Wilding describes the construction of the special tools used in clockmaking and repairing.

The Construction of a Weight Driven Brass Alarm Clock illustrated on the Toyo 210 lathe; *The Construction of a 16th Century Style Clock*; *The Construction of a Castle Clock*; and *The Construction of a Scissors Clock* all by John Wilding are illustrated on the Unimat 3. *The Construction of an English Regulator* by John Wilding is illustrated using the Cowell lathe. All these books are available from **Rite-time Publishing**, 18 Woolmer Way, Bordon, Hampshire GU35 9QF.

Materials and suppliers

1: **Hinchcliffe Precision Components Ltd**, Storforth Lane Trading Estate, Chesterfield S41 0QZ. Part nos. ZGO.8-9 and ZGO.8-90 with boss. Delrin.

2: Unimat 4 agents: **PRO Machine Tools Ltd**, 17 Station Road Business Park, Barnack, Stamford PE9 3DW.

3: Materials list available from **College Engineering Supplies**, 2 Sandy Lane, Codsall, Wolverhampton WV8 1EJ.

4: **H. S. Walsh**, 243 Beckenham Road, Beckenham, Kent BR3 4TS.

5: **J. M. Wild FBHI**, 12 Norton Green Close, Sheffield, S8 8BP.

Neville Evans

presents **Simon Bowdich's**
introduction to the Allan straight
link valve gear as fitted to these
Highland Railway locomotives.

●Part IX continued from page 180
(M.E. 4153, 24 August 2001)

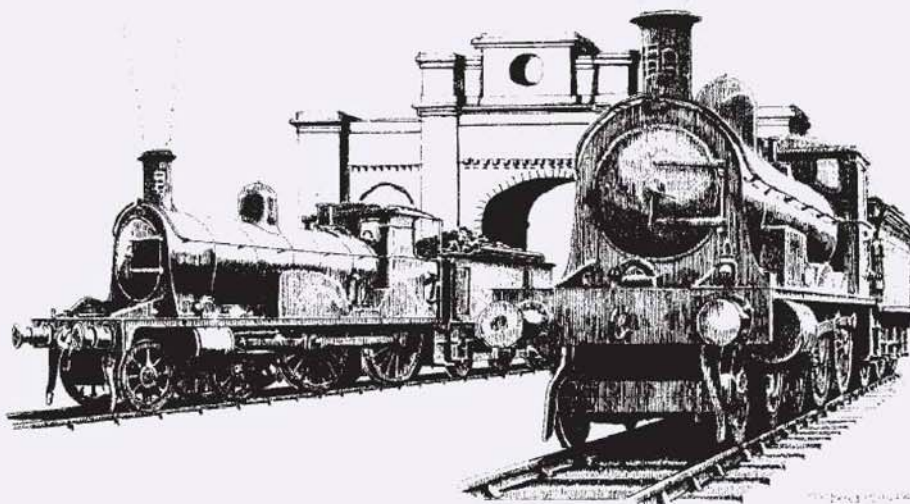
Back at the beginning of this project Neville asked me to optimise the layout of the Allan valve gear fitted to these locomotives using a computer. By way of an introduction it might serve useful to provide a few biographical details concerning the inventor of this gear and how it came to be applied to Highland Railway locomotives right up until the last batch of the Loch Class 4-4-0s which were built by The North British Locomotive Company in 1917.

Alexander Allan was born in 1809 and began his engineering career when he was apprenticed to a Mr Gibb, a wheelwright in his own native town of Montrose. In 1832 he joined Robert Stephenson & Co. at Newcastle where he saw the development of the Patentee type 2-2-2. Eight years later he moved to Liverpool to work with George Forrester at the Vauxhall Foundry where he worked on the *Swiftsure* for the Liverpool and Manchester Railway. This locomotive proved to be very significant in that it had outside cylinders secured in double framing.

Within a few years Alexander Allan had moved across the city to Edge Hill to become Works Manager and Assistant Superintendent of the Grand Junction Railway under W. B. Buddicom. At that time the Grand Junction Railway was experiencing considerable trouble with broken crankshafts on the inside cylindered locomotives of the 2-2-0 and 2-2-2 types. Allan's experience at the Vauxhall Foundry undoubtedly led to the introduction of the outside cylinder design based on Forrester's *Swiftsure*. In 1843 Buddicom left for a post in France and the Grand Junction Works were transferred to Crewe. Allan was passed over for the post of Locomotive Superintendent which went to Francis Trevithick. Allan remained at Crewe for a further 10 years, becoming a founder member of the Institution of Mechanical Engineers in 1847, serving on its council for five separate periods.

In 1853 he left Crewe to become Locomotive Superintendent of the Scottish Central Railway at Perth where he succeeded Robert Sinclair, a former associate from his Edge Hill days. While in Scotland he took out several patents, chief among them being his straight link valve gear in 1854. Allan was unable to travel to London to present his paper in person but it was read before a meeting of the Institution of Mechanical Engineers in 1856. The paper was quite detailed and the valve motion was demonstrated by means of two working models.

When the Scottish Central Railway amalgamated with the Caledonian Railway in 1866, Allan moved back to England to become the manager of the recently established Worcester Engine Works. He retired in 1872 following an injury to his back in an accident and moved to live in Scarborough. The Worcester Engine Works failed in the same year having



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

built over 70 locomotives for various companies in the six years of its existence.

In all, Alexander Allan presented ten papers to the Institution of Mechanical Engineers between 1853 and 1859. Allan's 1856 paper entitled *On an improved construction of Link Motion for locomotives and other engines* began by explaining that his improvement was a combination of the shifting link motion (Stephenson's) and the stationary link motion (Gooch's). He referred to the fact that in Stephenson's gear the lead increased as the gear was linked up but in Gooch's gear the lead was constant.

He explained that in his gear, the simultaneous movement in opposite directions of the link and the valve rod compensated for the curvature of the links found in Stephenson's and Gooch's gear. Allan claimed that the arms of the reversing shaft needed to be proportioned such that the eccentric rods and link moved through $\frac{3}{5}$ of the vertical space described, at the same time, by the link block and valve rod. "Thus the shortening of the valve rod is exactly compensated for by the lengthening of the eccentric rod, and the valve will consequently remain stationary, causing the lead to remain unaltered." Later in this description he admitted to the fact that the error in making the link straight instead of curved caused a total variation of $\frac{1}{32}$ in. which he dismissed as being negligible.

Apart from the excellent steam distribution properties it displayed, Allan claimed two further advantages for his valve gear. The first was that, because the weight of the eccentric rods and link were so nearly counterbalanced by the weight of the valve rod and die block, the weigh-shaft did not need a balance weight or spring arrangement and hence the gear was far easier to link up or reverse.

He also mentioned that because the link was straight it was easier to make in the first place and easier to re-machine when wear occurred.

James Fenton of the Lowmoor Ironworks,

Bradford, who was at the meeting when the paper was presented, also mentioned the fact that the boiler might be placed about 3in. lower in the frame without the lifting arm fouling the underside of the boiler barrel. He also confirmed the case with which the valve gear could be reversed even when steam was on.

The fact that the first locomotives built for the Inverness and Nairn Railway (Highland Railway) in 1855 were designed by Alexander Allan meant that they were likely to contain the design features which he favoured, ie. outside cylinders with Crewe type frames and, of course, his own patent valve gear for which he received a royalty.

William Barclay, the first Locomotive Superintendent of the Highland Railway, was also Allan's nephew. This was an early instance of nepotism creeping into the old Scottish railway companies, a practice that probably reached its peak at the time of the Drummond brothers and their sons. It all tends to lend some credence to the story of the Scottish Kamikaze pilot who supposedly crashed his aeroplane on his brother's scrap yard!

Crewe type frames and Allan valve gear were design features found on Highland Railway locomotives up until 1894 when Jones' protégé and chief draughtsman David Hendrie, persuaded him to drop the former feature for the Big Goods. Even then there was still a hankering back to the old practice in what appears to be a doubler plate which thickened the frames around the cylinders and front end of the locomotive, and the retention of the old Crewe type connecting rod.

Brian Read states in *150 Years of British Steam Locomotives* (David and Charles, 1975) that the maximum travel of the valve on the Big Goods in full gear was $4\frac{1}{4}$ inches. He further states that the lap of the valve was 1in. and that the lead was constant at $\frac{3}{16}$ inch. The general arrangement drawing of the locomotive reveals that the throw of the eccentrics was $3\frac{1}{4}$ in. giving

a pitch circle of 6 1/2 in. set at 103.75deg. and 104.25deg. respectively. The width of the steam ports was 1 5/8 in. and the exhaust 3 1/4 in., and the ports were 16 in. long.

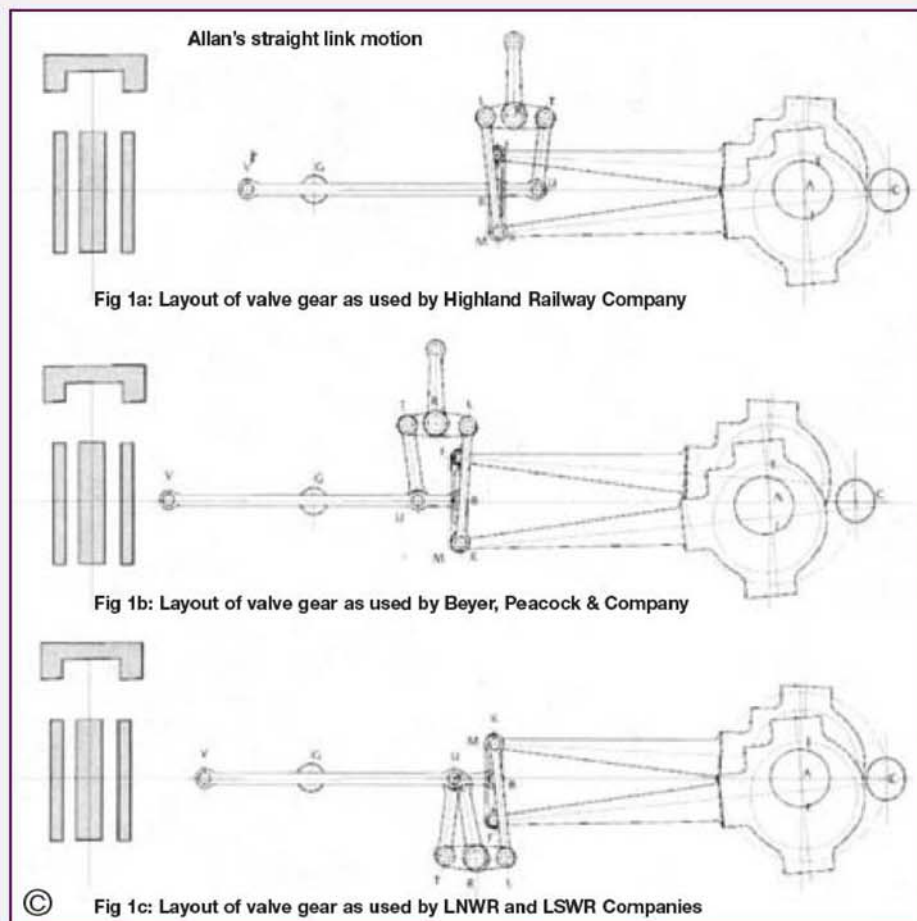
Over the past 10 years I have used various computer programs to analyse the events given by different settings of the most commonly used valve gears. Initially I used an Acorn computer on which I ran the excellent software written by Professor Bill Hall and Duncan Webster. This provided me with a fascinating insight into Stephenson, Walschaert, Joy and Hackworth valve gear. Neither Professor Hall nor Duncan Webster have written programs for Allan valve gear and in order to analyse what was happening to the valve events on the Big Goods I used the program by Dr A. Wallace for use on the PC platform.

I began by scaling the various dimensions from Sharp, Stewart and Company's general arrangement drawing and entered them into the computer. This would give me a good idea of what the full size engine's valve events were like.

Initially I was pleased to find that I had obtained something like symmetry in the Admission and Exhaust phases of the cycle, but because of the amount of die slip present in the layout of the gear used by the Highland Railway, (fig 1) the equality of the cut-offs began to fall off quite quickly as the gear was linked up. There was much better symmetry in reverse gear cut-offs but then the symmetry of the Admission and Exhaust phases both deteriorated towards full reverse gear.

A point which encouraged me to think that my results were reliable was the fact that the maximum amount of lead in full reverse gear was 0.014 inch. This scales up to be roughly equal to the amount given by Brian Read in his data for the Big Goods.

Reflecting on the fact that I had been able to obtain far more symmetrical results with Stephenson, Walschaert and Joy valve gears, I set about the process of getting a set of valve events giving a better degree of symmetry within the range of normal working cut-offs.



Real problems began to occur when I lengthened the ports and laps in order to obtain the sort of valve setting found on more modern locomotives, which would enable the model to be driven on the reversing lever with the regulator left open. Many evenings were spent altering one or more parameter on the computer screen and then sitting and waiting while the old 486 machine performed the calculations. I knew from the very beginning that I could have made life a lot easier for myself by adopting a launch link suspended in the middle, but the prototype indicated that nothing but a locomotive link would be acceptable. During this time I began to

form the conclusion that:

1: The geometry of the Allan valve gear might produce worse distortions and inequalities than other gears when the lap of the valve was increased.

2: The proportions of the suspension points on the weigh-shaft were not the only critical aspects of Allan valve gear. The proportions of the expansion link and the length of the tail-rod between the die blocks and the point where it is suspended from the weigh-shaft needed considerable attention if an acceptable set of valve events was to be obtained.

Eventually, when I arrived at a set of results

Valve events from Allan straight link valve gear fitted to 5in. gauge HR Big Goods 4-6-0

Notch	Angle (deg.)	Travel (in.)	Compression (%)	Admission (%)	Cut-off (%)	Exhaust (%)	Port Opening (in.)	Lead (in.)
1.0	27	0.468	10.6 8.5	0.0 0.0	72.8 67.9	90.5 88.3	0.117 0.113	0.014 0.013
0.9	24	0.440	11.7 9.5	0.0 0.1	69.7 64.5	89.5 87.1	0.103 0.099	0.015 0.014
0.8	22	0.412	12.9 11.5	0.1 0.1	66.5 61.1	87.4 85.9	0.089 0.085	0.015 0.014
0.7	19	0.385	15.4 12.6	0.1 0.1	61.5 57.6	86.2 83.2	0.076 0.071	0.016 0.015
0.6	16	0.360	16.8 14.9	0.1 0.2	56.4 52.3	83.9 81.8	0.063 0.059	0.016 0.015
0.5	13	0.336	19.6 17.4	0.3 0.2	51.2 47.1	81.3 79.0	0.051 0.047	0.016 0.016
0.4	11	0.316	22.5 20.0	0.5 0.4	44.2 40.2	78.6 76.0	0.041 0.037	0.016 0.016
0.3	9	0.298	25.6 22.8	0.5 0.7	35.5 31.9	75.8 71.2	0.031 0.029	0.016 0.016
0.2	5	0.285	30.4 25.7	1.2 1.0	25.6 24.2	71.2 67.9	0.024 0.023	0.017 0.016
0.1	3	0.275	33.8 30.3	1.7 1.7	15.4 14.9	68.1 62.8	0.019 0.018	0.017 0.016
-0.1	4	0.271	52.9 48.8	3.4 2.7	6.5 6.8	49.4 45.3	0.017 0.016	0.016 0.015
-0.2	8	0.278	44.2 40.2	1.2 1.3	11.7 11.5	56.4 54.1	0.021 0.019	0.016 0.015
-0.3	12	0.290	35.5 31.9	0.5 0.7	18.2 18.7	64.8 62.8	0.028 0.024	0.016 0.015
-0.4	16	0.307	27.2 25.7	0.3 0.2	27.2 27.2	72.8 69.6	0.039 0.031	0.015 0.014
-0.5	20	0.327	22.5 20.0	0.1 0.1	35.5 36.8	78.6 76.0	0.049 0.040	0.014 0.014
-0.6	24	0.348	18.2 16.1	0.1 0.1	44.2 45.3	82.6 80.4	0.061 0.049	0.014 0.014
-0.7	28	0.373	14.1 12.6	0.0 0.0	51.2 52.3	86.2 84.6	0.076 0.059	0.013 0.012
-0.8	32	0.399	11.7 10.5	0.0 0.0	58.1 59.3	88.5 87.1	0.091 0.070	0.012 0.011
-0.9	36	0.425	10.6 8.5	0.0 0.0	63.2 64.5	90.5 88.3	0.107 0.080	0.011 0.010
-1.0	40	0.449	8.4 7.6	0.0 0.0	68.1 69.6	91.5 90.5	0.122 0.089	0.010 0.009

which seemed to give the desired effects, I had to revise it again because the proportions of the reversing arms on the weigh-shaft were too small for the bosses on the suspension links.

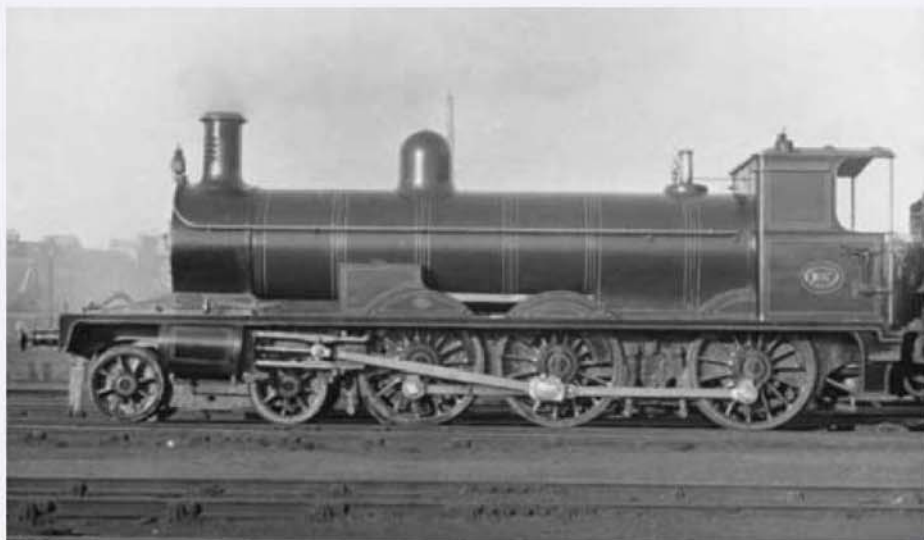
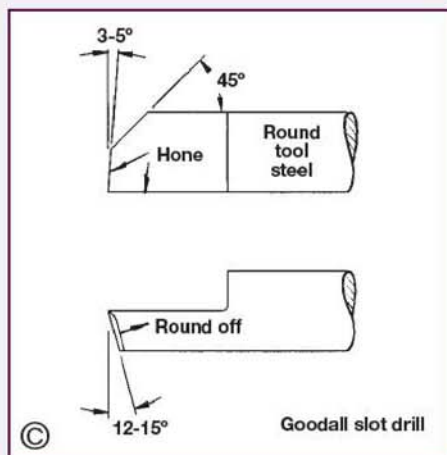
With the valve gear for the Big Goods now beginning to look very promising, Neville announced his intention that he would be doing the Loch as well, and that he had acquired a set of drawings of the valve gear which he wished me to evaluate. The layout of this valve gear had been prepared by Mr. A. W. Alcock who sought the advice of the late Don Young during the course of designing his award winning models of *Loch Inch* and *Loch Laoghal*. In *Locomotives Large and Small* (No. 19, May 1984) Mr. Alcock quoted a formula from *A Handbook on the Steam Engine* by Haeder and Powles, published in 1902, which claims to demonstrate a link between the proportions of the arms on the weigh-shaft and the lengths of the eccentric rods and valve rod. Mr. Alcock states that his Loch locomotive is an excellent performer on the track and that it can be driven well linked up in the desired fashion. Computer analysis of this valve gear indicated that there was room for some further improvement.

Neville and I concluded at this point that it might be possible to design a new set of Allan gear for the Loch which would share as many as possible components with the Big Goods. I was quite thrilled when I achieved this but Neville then informed me that the size of pins and bosses he had selected for the valve gear meant that I had to complete a further and final revision of the gear to give the necessary clearances.

The final version of the valve gears for the Big Goods and Loch might annoy the purists in that we have departed slightly from the internal dimensions of the original locomotive in order to get some benefit from longer lap, longer travel valves. Anyone investigating the events produced by this gear will rapidly realise that Allan valve gear is not just Stephenson's valve gear with a straight link. They will also develop a healthy respect for the skill of David Hendrie who prepared the original drawings for both of these locomotives.

Expansion link and die block

These are made from 1/4in. gauge plate. This material can be bought in 9in. or 18in. long bars, and a wide variety of sections starting from 1/8in. square. Your friendly neighbourhood steel



In fine, clean condition, Sharp Stewart No. 4026 (1894), one time Highland Railway No. 107 and LMS No. 17920 poses for the camera. (Photograph courtesy The Stephenson Locomotive Society).

stockist will keep it, or will tell you where to get it. While on the phone, order some 1/2in. x 3/16in. as well, because you are going to need some for the slide bars. While on the subject of slide bars, the motion bracket castings have just turned up. These are investment castings in bronze, require the minimum of work and look really authentic.

The expansion link is a part that repays careful, accurate machining. The only two operations that may cause a little concern are milling the 1/4in. slot and the heat treatment of the finished article. Accurate work starts with accurate marking out. I have a pal Bob Usher, who is one of the finest cabinet makers in Britain. When I first met him about 30 years ago, I was gratified to see that on starting a job he invariably first trued up and then marked the edge from which he was going to mark out. This is the 'face edge'. The side on which the marking out took place was the 'face side'. This took me back to my schooldays and the woodwork room, where the principles of marking out were drilled into us. The same principles apply to metal work. Always true up one edge first and mark it with marker pen then, to avoid turning the work over, mark the top side as well and always work on that side when scribing, punching or what have you.

1/4in. gauge plate is sawn down from a much wider sheet, and so the edges have to be trued up by belt sanding or by filing; just get them straight and reasonably parallel then mark the edge which you plan to use as a reference. You can then either scribe a line 1/4in. from the edge, or use the milling machine to measure it. My preferred method of performing this sort of operation is to hold the piece in the milling vice and to use the indexing dial to measure the offset. My first effort was with a 1/4in. slot drill. This came out about 5-6 thou. oversize which wasn't too bad, as it's easy enough to make the die block to match the expansion link.

However, I had occasion to visit headquarters to discuss the impending conversion of my Greenly *Royal Scot* to gas firing (of which much more later) with Deryck Goodall to find that he had milled three such slots in some scrap gauge plate with a D-bit cutter made from a short length of 1/4in. round tool steel. These slots were practically size-for-size with a 1/4in. square bar, the sides were dead parallel and well finished. I bore the tool home in triumph and cut a few slots myself just for the pleasure of doing it.

The following should be borne in mind when using this tool:

- 1: Use a high speed; 1100rpm or so for a 1/4in. bit.
- 2: Traverse quickly; I find that as fast as I reasonably can is about right, you can however traverse both ways, as the tool won't wander in the groove.
- 3: Use plenty of cutting oil. Take light cuts of around 5 thou. depth and keep the slot clear of swarf, using either a stiff brush, or an airline.

As for time, I can cut the slot right through the plate in about 4 minutes, which leaves plenty of time for self congratulation afterwards. The use of home made cutters in these days of high prices can only be recommended, as not only do they cost practically nothing, but they can do a far better job as well. Finish the job off by filing the corners square and gently polishing the inside of the slot with fine emery paper wrapped around a smallish file or somesuch.

As to hardening the finished link, the instructions on the packet say heat to 800deg. C., (dull cherry red), on a couple of firebricks and quench in oil. Don't worry about distortion, just make sure that you heat the job evenly and right through and you should have no problems. My experience has always been that it is better to quench in clean, cold water. We aren't worried about it being too hard, just so long as we remember to completely finish all the machining operations first. Remember to make two, polish them up and receive the plaudits of your peers.

●To be continued.



A superb precision lost-wax crosshead casting available from Practical Scale (call 01639-883741).

ROAD STEAM

BEYOND LITTLE SAMSON

Martin Wallis

reviews some of the *Little Samson* engines ready to steam, introduces the next *Road Steam* project and invites participants for another 'advance party'.

A consequence of this *Road Steam* series and *Little Samson* is that I currently correspond with folk around the world and have made many new friends. There are now very nearly more *Little Samson* models under construction than Savages built full-size engines.

It is indeed possible that by the time these notes are published, at least one *Little Samson* may have been steamed. Stan Nipper's beautifully made 3in. *Little Samson*, which is steadily going back together after painting, is all but complete. A photograph of Stan's engine was included with Part XVIII (*M.E.* 4151, 27 July 2001). David Hall's 3in. engine is just as far advanced,

but he is planning to steam his engine before the paint shop gets its hands on it.

The 1in. scale engine by Jonathan Milne-Fowler in Australia is a delight to behold and leads a group of smaller scale builders and, while I have not heard from Jonathan recently, the engine must be well on the way to completion. Making slower progress, (understandably) is the 12in. to the foot *Little Samson*, under construction by Richard Morgan in Kent, which is still a kit of parts, but among them there is a complete front end and all four of the wheels. As an aside, is this the first time a full-size engine been conceived from a *Model Engineer* design?

Looking back, the *Little Samson* project was introduced in December 1997 and the series began 25 months later in January 2000. The lead-time between flagging up the new project for an 'advance party' to make a start and the commencement of the construction series is obviously necessary if building is to keep a step or two

ahead of the writing. If a series beyond *Little Samson* is to be contemplated a start needs to be made very soon.

Extremely fortunate

I have always considered myself extremely fortunate with the group of *Little Samson* builders who formed the advance party or 'guinea pigs'. These good folk have provided all the illustrations for the series, furnished me with pages of notes, and offered comments and corrections to the drawings. So, would a similar formula work again? Should I consider another series?

I gently floated the idea with two or three of the *Little Samson* advance party and, of course, our Editor. My only concern was that while I was happy to make the patterns and arrange for the castings, the time needed to prepare all the drawings was certainly very daunting. However, the response was quick and unambiguous, a 'beyond *Little Samson*' should go ahead.



Stan Nipper's very handsome *Little Samson* approaches completion. Still to be fitted are the gear casings and motion covers. The canopy with its curvy sideboards transforms the engine.

THE WAGON THAT WINS!

Royal Automobile Club Commercial Motor Trials, September 9th to October 12th, 1907.

HIGHEST AWARD--GOLD MEDAL

TO

Savage's New Design Steam Motor Wagon,

which, during the trial, carried a load of five tons over about 700 miles, through difficult country, under the most exacting and stringers conditions and the close inspection of independent observers.



RELIABILITY—25 to 40 per cent. less stoppages in time than any other Steam Wagon in the trials.

ECONOMY—Both in consumption of fuel and wear and tear of working parts.

WORKMANSHIP—Of the highest class.

PRICE—Will compare favourably with that of any other wagon.

If you are Buyers, BUY THE VERY BEST, BUY—

Savage's New Design Steam Motor Wagon —The Wagon That Wins—

which was AWARDED THE GOLD MEDAL solely on account of its Reliable and Economical Haulage.

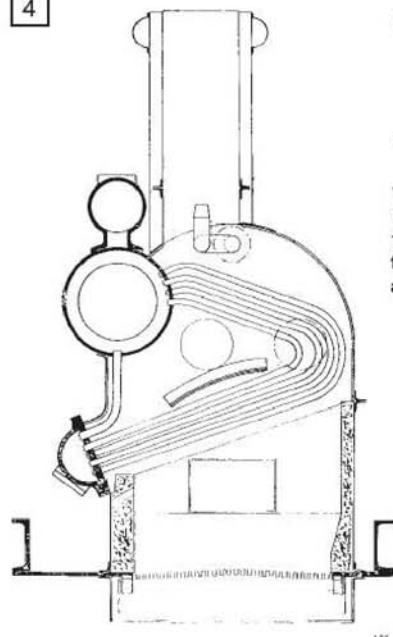
For further particulars apply:

SAVAGE BROS., Ltd., St. Nicholas Works, KING'S LYNN, Norfolk.

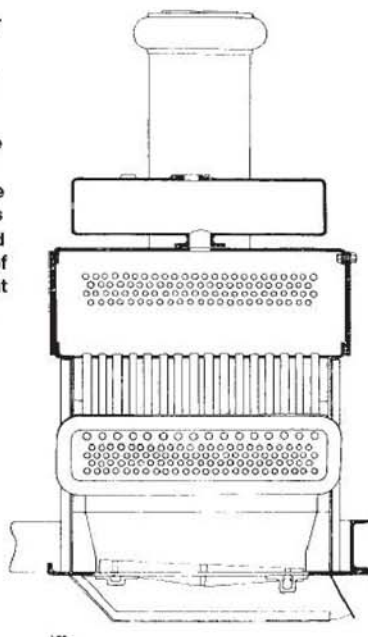
Telegraphic Address—SAVAGE, LYNN. Telephone No.—Natl. Tel. No. 9, LYNN. Cable code—Private and Lister's Standard.

Fig 3: An example of Savage's promotional material celebrating their Gold Medal victory of 1907.

4



Savage's water tube boiler. The top drum is for steam collection. The ends of the middle drum were removable to allow access for cleaning and the expansion of any replacement water tubes.



Water tube boiler

Three different types of boilers were offered to customers. The most popular was Savage's water tube boiler, an improved incarnation of the Musker design. Two views of this type of boiler are shown in fig 4. It has three drums, the bottom two hosted the water tubes which provided the large surface area needed for efficient steam production. The full-size boiler had 94 water tubes of $\frac{3}{4}$ in. diameter, together with 16 return tubes of $1\frac{1}{8}$ in. diameter.

The bottom drum is hemispherical in section. A substantial flat plate was drilled to receive the tubes and a hemispherical cover bolted to it. This has three important advantages over a circular drum. First, all the tube holes are drilled at 90deg. to the plate which is much easier to achieve than tangential arrangements. Secondly, the tubes are expanded into round holes rather than into 'elliptical' holes, and thirdly, the removal of the cover gives easy access for tube inspection and for any work on the boiler such as tube replacement.

Both drums are mounted in an angle iron framework which is clad in sheet steel and lined with firebricks. The full-size heating area was 90sq.ft., the grate area was 4sq.ft., and the working pressure 220psi. The top drum is a steam receiver which supplies steam to the engine. This type of boiler may be seen fitted in the wagon depicted in photo 5.

Vertical boiler

The second option Savage offered was a conventional vertical boiler, an example of which is fitted in the wagon shown in photo 6. The barrel was 2ft. 6in. in diameter and 4ft. $6\frac{1}{2}$ in. tall

A very kind offer

The die was eventually cast, not by me, but by Stan Nipper and Mike Chrisp. My worry was the time needed to prepare the drawings, so when Stan offered to draught some of the drawings on his CAD package, the appeal of the project improved considerably. Knowing just how long such drawings could take I was much relieved that Mike would see to it that Stan would be suitably rewarded for his long hours slaving over a hot keyboard and CAD screen.

Universal Carrier

The choice of a prototype for any future project had already been decided. I knew exactly what any future design might be about 30 seconds after opening a rather battered blue box last summer. The box, a little short of 3in. deep and somewhat over A3 in size, was stuffed full of folded drawings. They were of Savage's very own design of steam wagon. Inside were two dozen vintage copies of Savage's works drawings for their class C 'Universal Carrier' steam wagon. The gift of these drawings was completely unexpected and very generous.

What little I managed to gather was that some considerable time ago, probably in the early 1950s, someone, maybe a Savage employee, had decided to build a model of the Savage wagon. The Savage drawings were accordingly copied. Whether or not a model was built I have no idea. However, someone presumably following the *Little Samson* series knew of their existence and, via a roundabout means, they came into my possession.

Design options

I have been immersed in Savage steam wagons for some months now. Early in 1903 Savage Bros. bought the drawings, patterns and various parts from Messrs C. & A. Musker of Liverpool. As time passed, a number of changes were made and in total 27 wagons were believed to have been built. The first wagons were classed as 'OA', and evolved through five stages into the final 'C' class. In full, Savages built the 'OA', 'A', 'A1', 'B' & 'C' class wagons. A goodly number were exported, the rest obviously remaining in the UK.

The 'C' class, the subject of the drawings and hence the model, won a Gold Medal at the Royal Automotive Club Commercial Motor Trials in the autumn of 1907, beating all the other entrants from better known manufacturers. Reproduced in fig 3 here is an extract from some of Savage's promotional material based on this event.

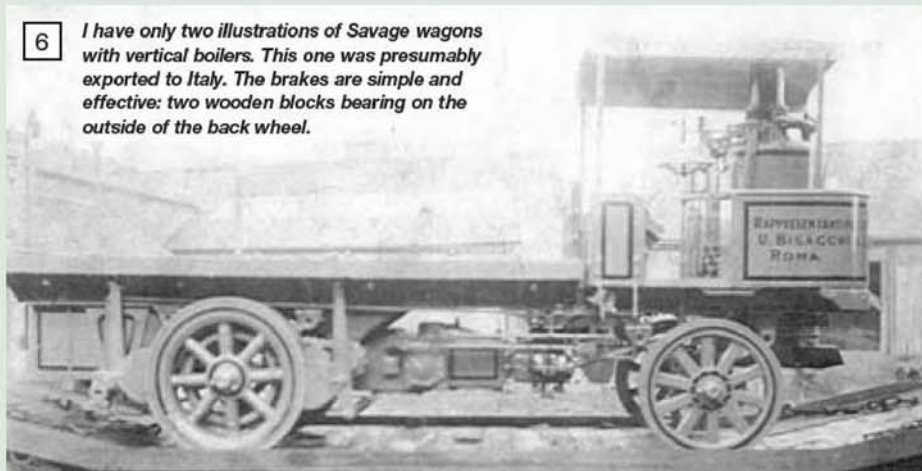
The crankcase, crankshaft, and cylinder drawings are well under way. By the time this issue is published, they will probably be complete. The cylinder patterns are ready to be trialed. Every effort has been made to make the cylinder and crankcase as prototypical as may be achieved. The plan is to cast the crankcase and covers in high tensile aluminium alloy.

5



The load is as interesting as the wagon. The bronze statue is of King Edward VII and is being transported on the two-mile journey from Lynne Station to Lynne Grammar School in 1907 by Savage wagon. Why it was necessary for the King to travel with a bag over his head is not recorded.

6 I have only two illustrations of Savage wagons with vertical boilers. This one was presumably exported to Italy. The brakes are simple and effective: two wooden blocks bearing on the outside of the back wheel.



excluding the chimney. It had 63sq.ft. of heating surface and a grate area of a fraction over $3\frac{1}{2}$ square feet. In brief, the firebox was circular at grate level but above the fire was pressed to a square. The square shape allowed banks of almost horizontal tubes, each bank arranged at 90deg. to the one adjacent. There were 64 tubes each of $1\frac{3}{4}$ in. outside diameter.

The works drawing I have of the vertical boiler is particularly difficult to read, but enough is decipherable to obtain the dimensions and necessary detail. For tube replacement, the whole firebox could be removed from the outer wrapper by undoing two rings of stout fixings.

Locomotive boiler

A locomotive boiler, looking very much like a reduced length *Little Samson* boiler with a slightly larger diameter barrel, completes the trio. It had a side door for raking the fire and a top shute for firing. The driver sat to one side of the boiler rather than behind it as on *Little Samson*. The adoption of this boiler gives the wagon the unusual combination of horizontal locomotive boiler and an undertype engine.

The first boiler of this type went through the works in January 1905. The heating area was 75sq.ft. and the grate area $3\frac{1}{2}$ square feet; 55 fire tubes connected the firebox with the smokebox each of $1\frac{3}{4}$ in. diameter. The barrel was 2ft. 4in. dia. compared to the 2ft of *Little Samson* and the boiler was pressed to a working pressure of 200psi.

Undertype engine

On the earlier OA, A, and A1 models the wagon had a separate engine unit with a small external flywheel which drove two-speed external gearing. On the subsequent class B and C wagons the two-speed gearbox and differential assembly

were incorporated within the engine crankcase, running in the same oil bath. According to Savages, this arrangement made the wagon very much more reliable and dependable. This claim appears to have been borne out in the wagon's receipt of a Gold Medal in the Royal Automotive Club Commercial Motor Trials in 1907 as previously mentioned.

The valve gear is of particular interest. It has a single eccentric which provides both forward and reverse motion for both the HP and LP valve gear. This will require some development as regrettably, one of the detail drawings is missing. Reversing was achieved by moving the engine's single eccentric relative to the cranks by means of making a portion of the crankshaft hollow.

The earlier engines had piston valves to both the HP and LP cylinders. The HP piston valve was on the same horizontal plane as the HP and LP cylinder, but the LP piston valve was placed underneath the LP cylinder. The later class B and C power units retained the piston valve for the HP cylinder but the LP cylinder was provided for by a slide valve above it. The 'C' class cylinders were $4\frac{1}{8}$ in. and $7\frac{1}{8}$ in. by 6in. stroke.

Photograph 8 is a works photograph of the engine showing the top view with the crankcase

covers removed. As illustrated, the crankshaft is amidships with the cylinder above and the gears and differential arranged below. On the photograph, the steam enters the cylinder on the top right. The small pipe running across the top of the cylinder is the oil feed from the mechanical lubricator. Note that the low-pressure valve chest cover is held with just two nuts for the picture, also the piston and valve rod glands have not been packed. To the left of the cylinder is the feed water heater, a very similar affair to that fitted to *Little Samson*.

Just below the feed water heater is the boiler feed pump, the plunger of which is used to drive the mechanical lubricator. A particularly handy feature is that the feed pump is geared down and can be run under power when the road gearing is in neutral. The drive for the pump is all internal and runs in oil. The wagon is 'double drive' to the two back wheels.

Great variety

True to form, Savage built a great variety of wagons. No doubt, the driving force was the customer's requirements. In addition to the three different boilers, there were a multitude of wheel options. It seems that wooden wheels were more popular with the home market, while steel wheels were favoured for export. Naturally, there were exceptions. Rather less than half the wagons built were fitted with a roof. While this must surely have been unpopular with the drivers, it has advantages for modellers. It is entirely correct to build the wagon without a roof, which will make firing and general access so much easier.

The wagon was turned out in a multitude of guises: as a sanitary wagon/gully emptier, as a flat bed lorry, as an electric lighting vehicle (photo 7), with a tipping body, with a fitted body for furniture deliveries, as a brewer's dray, and with an integrally mounted loading crane. The modeller is of course at liberty to choose from any of the different versions built by Savages, or indeed to invent a fresh one of his/her own! Sadly, as far as is known, no Savage wagon has survived.

The model

The scale for the moment is to be 3in. to the foot which, bearing in mind that the full-size wagon was not insubstantial, will give a decent sized model. In 3in. scale we will end up with a model some 4ft. 9in. long and $19\frac{1}{2}$ in. wide. The loading platform could be reduced if a shorter model is desired. Stan's vertical boiler will be $7\frac{1}{2}$ in. diameter and copper is the preferred material.

In the first instance Stan and I have picked out the eight-spoked cast wheels as seen in photo 5,

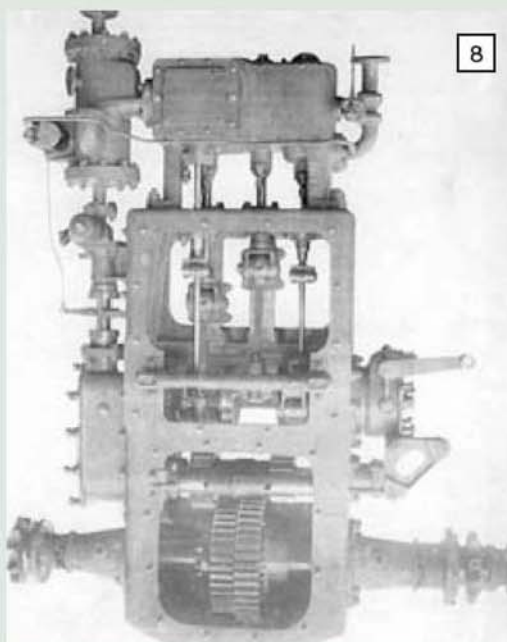


This wagon was fitted for electric light generation for the West Country showland proprietors Marshall Hill and photographed at the 1904 Smithfield show. Other pictures taken on the same occasion show an extension chimney to carry the smoke away and the globe lights above illuminated. This wagon has a locomotive boiler and a number of recognisable *Little Samson* fittings including the steering wheel and chimney cap. The engine for electric light generation was a duplicate to the engine underneath but direct coupled to the generator.

as the most practical and elegant. The back wheel diameter will be $10\frac{1}{2}$ in.; the front wheels 9 inches. The wheelbase will be 2ft. $5\frac{1}{4}$ in. so it ought to cope well with uneven ground. I am presently engaged in making the patterns for the wheels, which will be available in cast iron. If a builder could be persuaded to make the wooden wheels, as in photo 7, the pictures would be a great bonus for a future construction series.

Savage expert Dr. Middlemiss has been able to add to the works drawings in my blue box, and I now have 39 Savage wagon drawings from which to work, by no means a complete set but an exceedingly good start. I also now have a good number of works photographs and contemporary illustrations of Savage wagons at work.

It now seems a good time to extend an invitation to anyone interested in forming another advance party or, as it was put in December 1997, to be a 'guinea pig'. I believe the *Little Samson* advance party have all found the experience both rewarding and interesting. Experience is not essential; group work by its



A Savage works photograph of the undertype engine.

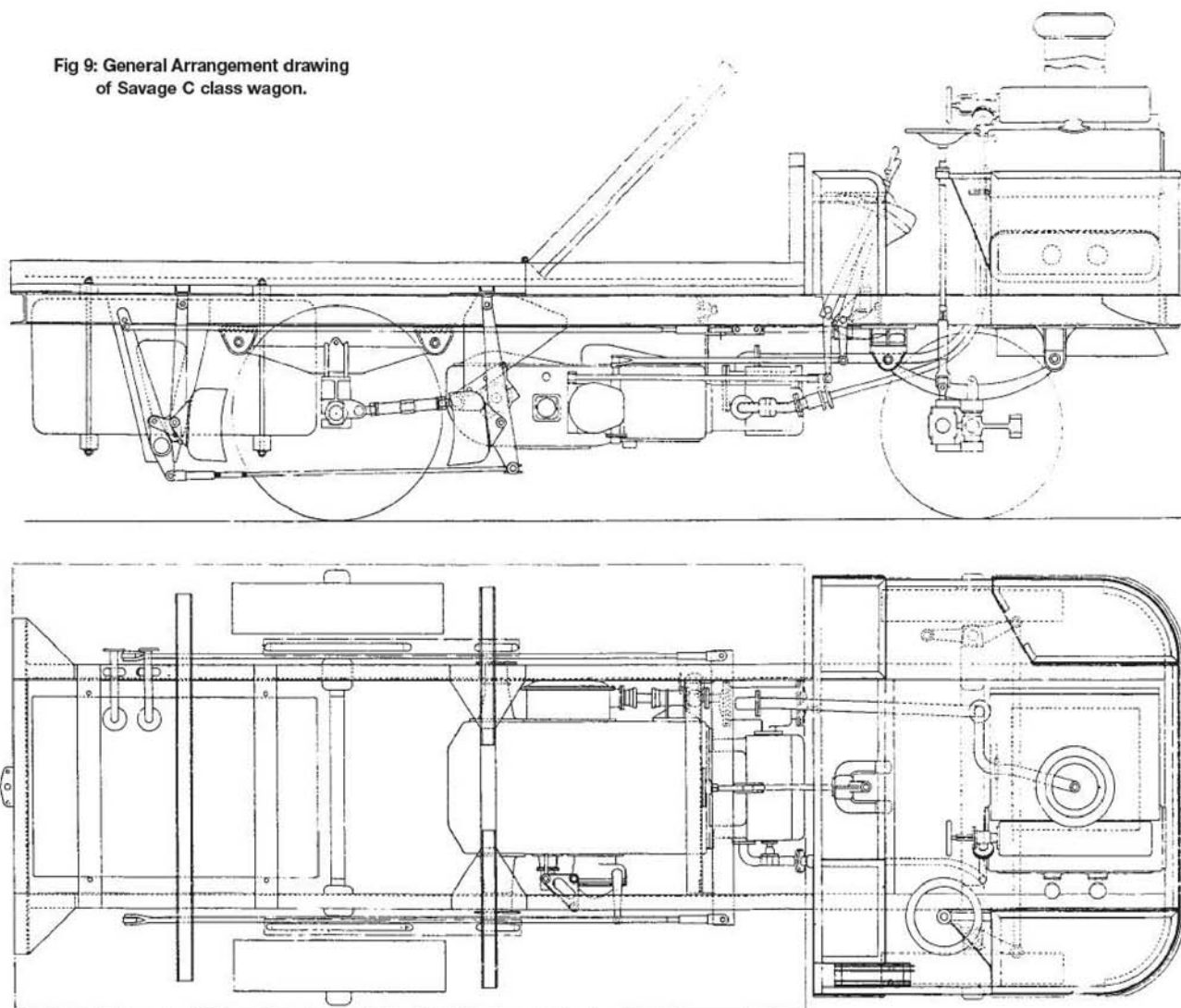
very nature is mutually supportive. Other builders are only an e-mail or phone call away. I hope the wagon will prove as appealing as *Little Samson* and am looking forward to some correspondence.

An ability to take sharp, clear photographs as construction progresses is a great asset. Remember, the potential constructor does not have to be the photographer; both David Hall and John Freeborn (whose *Little Samsons* have featured regularly in the construction series) have enlisted friends with the necessary photographic experience and skills to perform the deed. So don't be put off. I hope a range of scales will evolve as prospective builders become known, but in the first instance Stan has chosen 3in. to the foot. Enquiries by way of the editor please.

My grateful thanks are extended to Dr. John Middlemiss for most of the black and white illustrations accompanying these notes, together with his offer to make any copies from his own extensive Savage archives as required and, of course, a great deal of his time.

●To be continued.

Fig 9: General Arrangement drawing of Savage C class wagon.



Keith Wilson

describes his techniques for machining side rods and notes a few pitfalls which await the unwary.

●Part XIX continued from page 187
(M.E. 4153, 24 August 2001)

Although not necessarily applicable to Saints and 47s exclusively, the following is respectfully dedicated to our 'other halves'; long-suffering or not as the case may be. It was passed on to me from a fellow 'modeller' who at time of writing is engaged in making use of my somewhat heavier machinery than is normally available to the average model engineer. I understand it has been around for some 25 years. By now it is possible that was by one of the world's two most famous poets, 'Trad' or 'Anon'.

"Say Pet, I think I'll try to make a train,"
"Oh No! that's ambitious, you'll need a crane,"
"Not full-size, love, say, 5in. gauge,
Such hobbies now are all the rage."
"It sounds expensive, don't get too deep."
"Don't worry, I won't, a lathe's quite cheap.
I shall need a miller, but that's not much.
A few castings, nuts and bolts and such."
"How long will it take? There's lots to do."
"Not long, a few months will see it though."
The house is filled with pieces of frame,
Week by week, it's just the same,
Chassis, crossheads, smokebox, pump,
Cylinder, drills, rods and sump.
Valves and glands and 3-jaw chucks,
Hexagon rods to make the nuts.

Years later, and we're dressed in rags,
Jam butties for tea, and no more fags.
But in the workroom, in gold and green
THE TRAIN is waiting and ready to steam,
Beside it looking as proud as a mum,
He says "I think I'll make another one."

Any questions?

Connecting and coupling

By good luck, at the time of writing I have been machining some of these rods, hence the extra photographs. It is a deuce of a work-saver to get flame-cut blanks for these items, for there is a lot of swarf to be manufactured; no doubt most model engineers will have realised that finished parts are mostly by-products. Laser cut rods are not really worthwhile for it costs much more to punch through the thicker material needed, and all-over machining is a must anyway. For starters, the lengths of the rods need to be individually set; therefore, one end of the rod must be longer than the other (?) by which I mean that although the boss, complete with oilbox, may be done close to size at one end, the other end will need an oval boss to allow for this length deficiency.

In the case of the connecting rods, these of course can be profiled to finished size, for we know what this size is. In theory we also know the size of the coupling rods, but only in theory.

The first task is to get a couple of horizontal

SAINT CHRISTOPHER

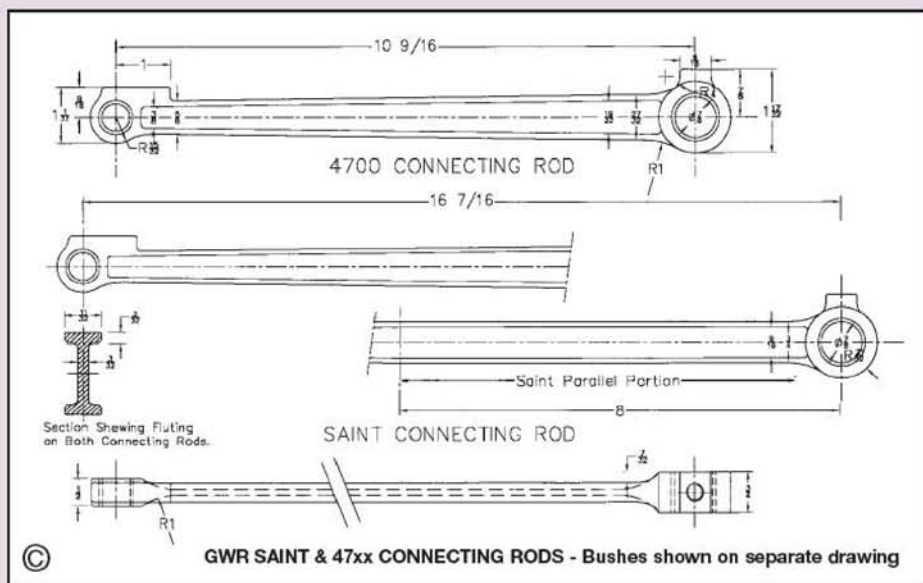
A GWR LOCOMOTIVE for 7 1/4 in. gauge



Regrettably, if not surprisingly, I have no close-up shots of Saint or 47 side rods; however a Hall is but a Saint with 6ft. wheels, and here is a good shot of such. It is of John Hancock's Thirlestane Hall a superb working miniature replica of the GWR Hall class locomotive.

centre-lines on the rod, one at each end at the correct distance from the top of the oil box. These tops can be the first item machined, just a light cut to see that they are good surfaces from which to work. It does not take much effort to prop up the

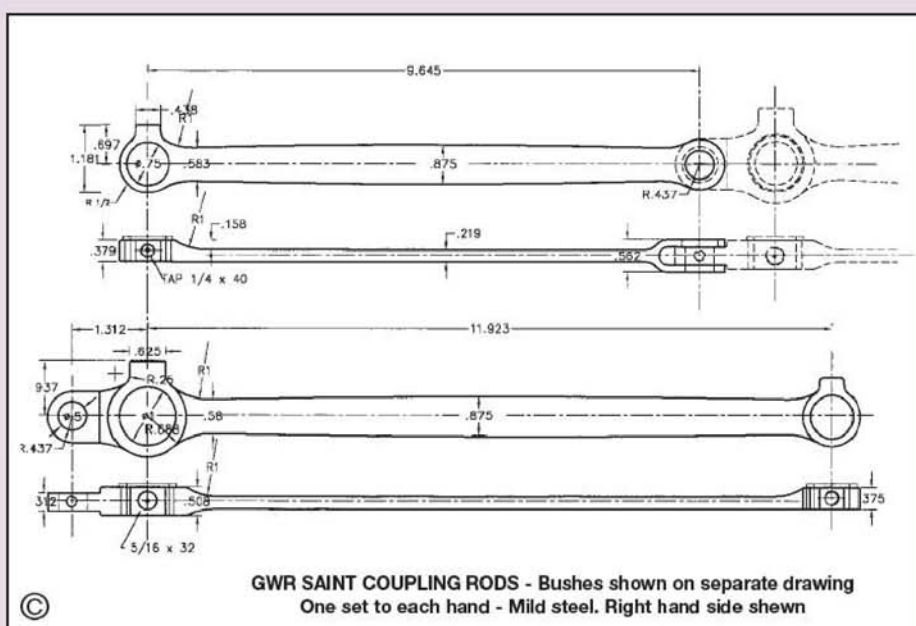
other end of the rod (the one without an oilbox) so that a height-gauge can be used to make a couple of centre-lines. Pop one of these where the first hole will be; this can be drilled and reamed right away: 'twill serve to locate one end of the jig.

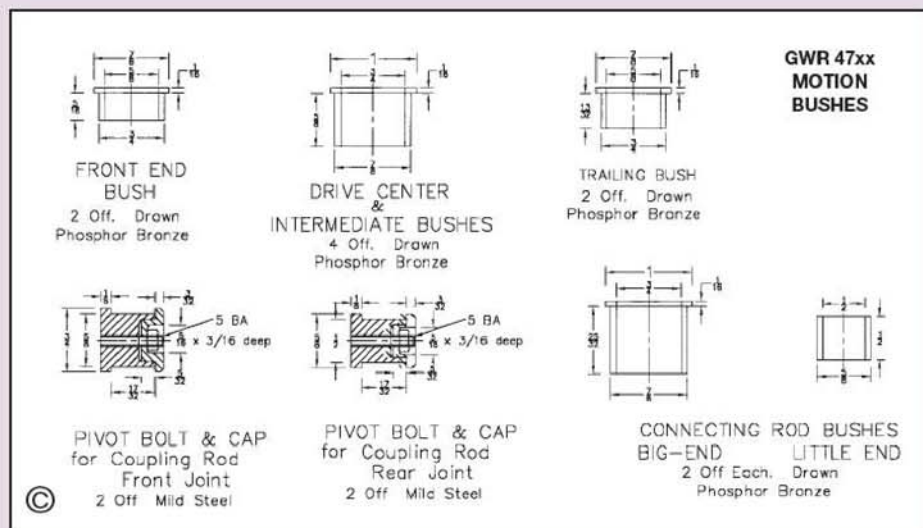
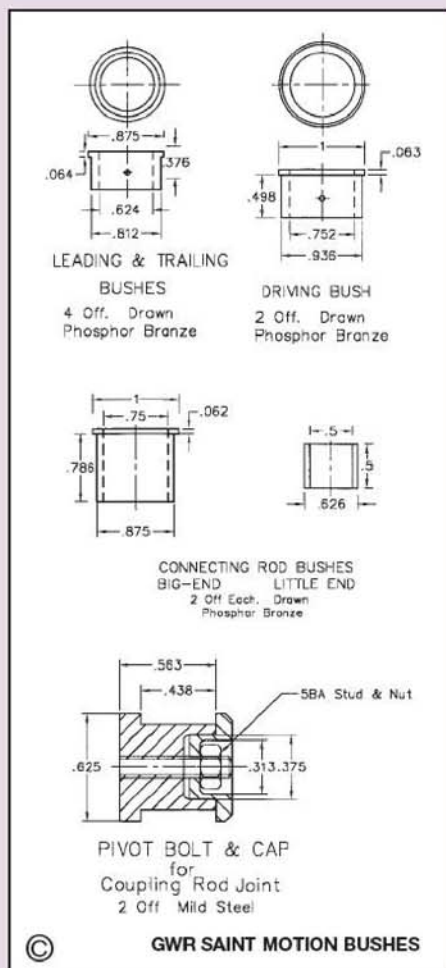




The finished lengths of the side rods are best determined by the use of an adjustable jig as shown here. Once set to suit the locomotive, the jig is used to position the holes in the rods themselves, as described in the text.

Jiggery-pokery





Left: Side rods are fluted to reduce their reciprocating mass without affecting their strength. A Woodruff key seat cutter or a home made cutter can be used to cut these flutes which, in the 'good' old days were produced by hand using a hammer and chisel.



The corners of the cutter used to cut them should be radiused to produce radii in the corners of the side rod flutes.

To get the rods to correct thickness, clamp them down onto the milling table and go ahead. It will be necessary not only to clamp the rods through the end holes but to add additional clamping along the rod; it is rather tricky to mill the ends flat while there is a bolt in the way!

Many years ago, a friend found a heap of toggle clamps (car boot sale?) and purchased a couple of dozen. He donated a dozen to me and I used them for a jig for just this purposes of clamping rods. A quick flick of a finger as the rod is traversed under the tender loving action of the cutter gets the clamping bit out of the way ready to be flicked down again when all is clear. It works very well, but it can be seen that the fourth clamp has not been too well controlled.

For rods that are fluted, it's no use trying the easy way with a slot drill for you cannot get the run-out at the ends. A special cutter will be needed; you might find a suitable (T-slot) cutter to be available but it is not hard to make your own out of a chunk of silver-steel. If used with plenty of 'juice' and not run too fast, it will last for years. The cutter shown in the photograph is made from 5/8in. silver steel, only the teeth are hardened and tempered. Note that the ends of the teeth are rounded off to get the correct shape in the bottom of the flute. Strictly, the connecting rods should be fluted on both sides; I have never bothered.

To hold the connecting rod for fluting, note that for the Saint the fluting is in two parts to match the outline, the 47 is less complicated. If the rod be pivoted at the small end and clamped on the big end, swivelling it to get the required flute profile is then easy.

Don't beat about in the bushes

The bushes are from drawn phosphor bronze, although there are other suitable materials (aluminium brass for example). Both are easy to turn, but absolute pigs to drill and ream, even using machine reamers. Being very tough, it tends to grip the drill or reamer and once it has, tends to stay gripped. Many a time have I taken a bush out of the lathe with the reamer still in it and actually had to hammer the reamer out of the bush.

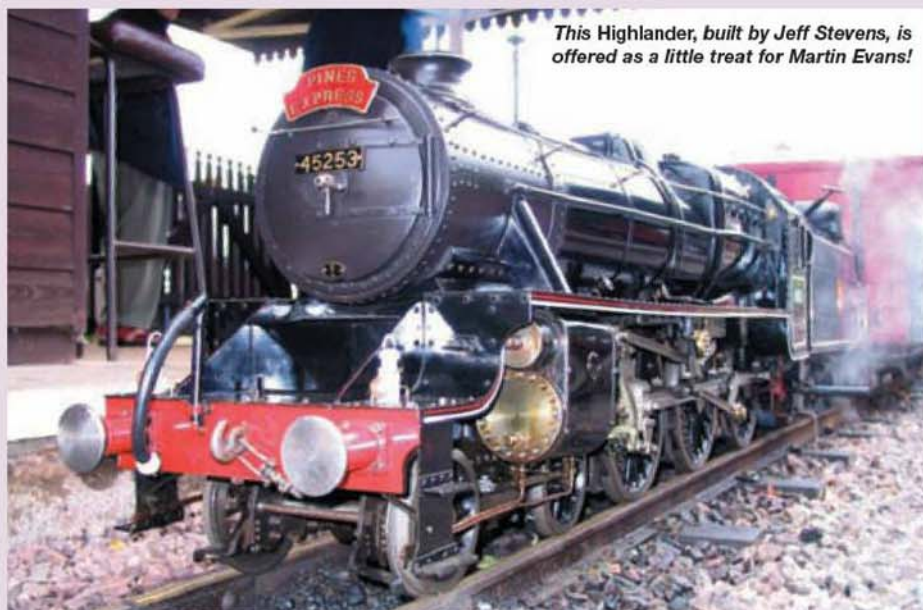
It is best not to part off the bush from the stock material until after the bush is reamed. No way can the bush be held firmly enough for reaming, although when it is pressed into its housing and

pinned in the with the 7BA bolt tapped into it through the housing it will stand reaming out little by little with an expanding reamer. Quartering and crankpin throws seldom all line up perfectly, and quite often one side of the engine is longer/shorter than the other!

I usually put the bush flanges on the inside, i.e. against the wheel face, but I know of no good reason one way or the other.

Connecting and coupling rods were not polished; an eggshell finish is about right for 'us', but ensure all edges are rounded off—they hurt less that way.

●To be continued.



PETE'S PAGE

Peter Spenlove-Spenlove

continues with a D-bit for one-off working before discussing the safe use of compressed air and appropriate ancillary devices.

●Part II continued from page 171 (M.E. 4143, 24 August 2001)

Toolmakers, mechanics and model engineers have made simple single flute D-bits by simply using a small round file to cut a notch to simulate a flute which, when hardened, is sufficient to cut one or two flat bottoms in a special job (fig 1). This tool can be used to convert a cone ended hole into a flat-bottomed valve seat.

Such a tool is simply made. First obtain or turn a piece of silver-steel to fit the drilled hole. Face the end square and as smooth as possible. Use a file to cut a single short flute, the cutting edge being represented in my diagram by a thick line. This edge can be curved or straight according to file shape used.

Carefully grind or use a fine flat file to form a clearance on the end. Aim for about 2deg. but don't touch the cutting edge. Remove the burrs in the flute then harden and temper to a light straw colour. Use a slip stone to sharpen the cutting edge (A slip stone is a small hand-held stick of fine abrasive material used to sharpen cutting tools.)

If the filed flute is small, it could become clogged with swarf during use. If this happens, stop the machine and clear the swarf then insert the D-bit again before re-starting the machine to finish the job.

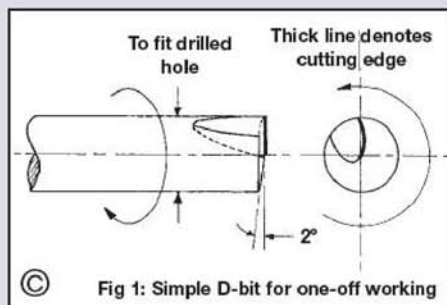


Fig 1: Simple D-bit for one-off working

Safe use of compressed air

Model engineers have always used compressed air, but it was air at a very low pressure from bellows or a centrifugal fan. Used to augment a gas flame and to help good combustion in a home forge, it was safe. In recent years, various electric compressor units have become available at relatively low cost and which can be fitted under the bench out of the way. Originally made for the small repair workshop, these units were intended to inflate car tyres, drive air tools and spray paint and vehicle sealant. These tools required pressures up to some 100psi and for spraying, a reducing valve of a suitable type for the work was required. A manifold on the air reservoir allowed users to fit a flexible hose with a push button air jet used to direct air at 100psi, usually at items to be cleaned of swarf, dust and liquids.

COMPRESSED AIR in the HOME WORKSHOP

A pressure of 100psi, as used in industry where strict safety regulations are enforced, is serious air pressure and can be dangerous unless used properly. If a garden hose is left on a lawn, sooner or later children will start squirting water at each other on a hot day; it's fun. But if they find a compressed air hose and press the button to blow air at each other, expect trouble. Such an action could result in a serious accident, or even death. During a training course in the safe use of compressed air, our Works Safety Officer warned us:

- *Never use compressed air without wearing goggles,*
- *Never use compressed air to blow dust off clothing,*
- *Never blow compressed air towards the face, hair, eyes and other body orifices,*
- *Never blow swarf from work when other unprotected persons are nearby,*
- *Never test the air pressure, at times such as switch-on at the start of a working period, by putting a finger on the nozzle to check that the air is up to pressure. This is a potential killer. Sweat emerges from pores and air can get in as well; it can enter the blood and reach the heart and brain. Dirt on the skin can be forced into the bloodstream too.*

At the time (1970s), all of our compressed air blow gun nozzles had to be scrapped to be replaced by one of two approved types. Furthermore, our air pressure was reduced to 80psi for general use which included die grinders, pistol drills and the like; these portable tools could be plugged into the air main as could a blow gun hose, just as electric tooling can be plugged into local sockets.

The blowgun nozzle for the metal working area consisted of the usual axial hole but an addition circle of eight slightly smaller holes each directed air at about 60deg. away from the central jet (fig 2). Its purpose was said to cause swarf and grit to be blown sideways and not back towards the user, and it seemed to be reasonably effective.

The second nozzle, for the woodworking department, consisted of a central jet blowing down a short tube about 1/2in. dia. and 3in. long (fig 3). The wall was perforated with a ring of holes. The central jet passed down the holes with the result that a greater volume of air at a low pressure could clear sawdust more efficiently and much more safely than the old simple nozzle. Woodworking is a very dusty business and if no one was looking, staff insisted on blowing dust off their clothing with whatever nozzle was provided! So this tubular type could reduce the incidence of accidents due to stupidity.

Air hoses

These come in plastic and rubber, both having reinforcing material within the structure. Plastic hoses, except those of the best quality, tend to be stiff when the home workshop is cold. They do not lie flat on the floor during use and can cause trips. The small sizes of rubber hoses, say 3/16in. bore, are better behaved and more suitable for blow guns in our small workshops. Some air tools require a larger hose to pass the necessary air, but the compressor is of course the limiting factor.

Hose end fittings which can be plugged, not screwed into a socket on the compressor manifold, can be purchased. This is useful if several air tools are available. Simply unplug the hose and tool, roll up the hose and put it away. No straggling hoses, and the way is clear to plug in another tool.

When buying hose ask the supplier to fit the terminations as they have the proper tools to do this safely. Don't underestimate the length of hose between your compressor your point of working. Extension hoses can be easily made up by fitting male and female plug-in connectors just as for electric tools.



A complete workshop compressed air system should include a pressure reducing valve. It is similar in principle to valves seen on ox-acetylene gas welding bottles. It receives high pressure air but delivers low pressure air. A hand control knob (behind the red pipe) is used to set the required output pressure for, say a spray gun or brazing torch. A single inlet (top left arrow) accepts air from the compressor. Three outlets are available; an output pressure gauge with its 2in. (50mm) diameter dial, and two plug-in hose couplings occupy this (bottom centre and bottom right).



Air line jets. Top: a plain rubber tipped jet, useful to clear pipes, etc. and to avoid damage to polished work. Centre: so-called safety air jet; eight sideways jets deflect grit and swarf from the user. It is not, however, foolproof. Bottom: this two-part jet can provide a variable flow and is also suitable for spraying liquids.

The plug-in socket does not have to be on the compressor. Mine is fixed to the leg of the lathe bench with a permanent connection to the compressor in another room. Above this socket is the compressor starting switch and pressure gauge.

Choice of compressor

The manufacturer of a good compressor should fit a safety valve, a pressure switch and an unloading valve. The pressure switch cuts off the electric supply when the tank reaches a pre-set pressure. It also isolates the compressor from the tank. A motor cannot always start a compressor from stationary against the tank pressure. When the motor is up to speed against no load, the unloading valve operates to allow the compressor to start pumping again.

The pressure switch can be set to maintain the tank at, say between 100 and 80psi. Good units can be set by the user by adjusting a couple of screws. The compressor supplier should be informed of the range of pressures required so that a suitable switch may be fitted.

Failing the availability of a low pressure range switch, a reducing valve should be obtained. This adjustable valve receives high pressure and delivers it at your chosen low pres-

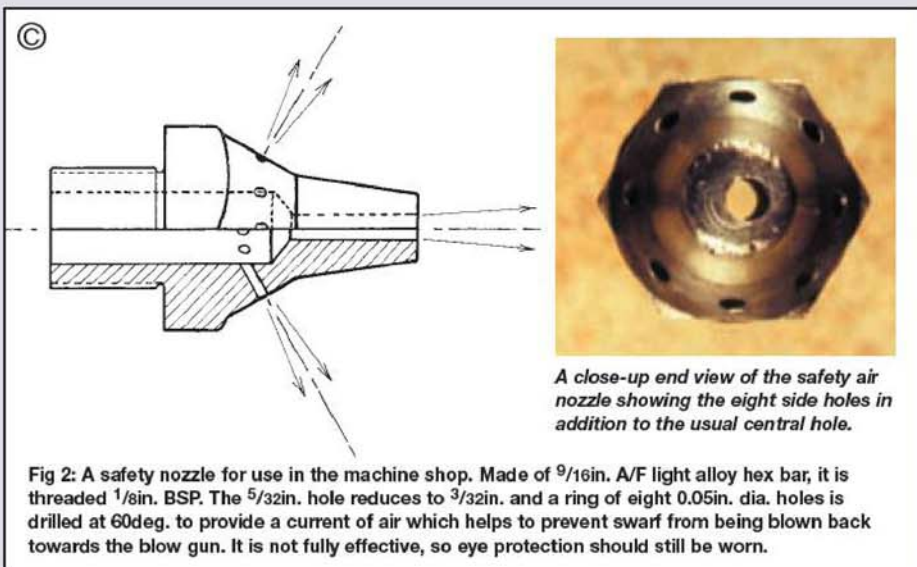


Fig 2: A safety nozzle for use in the machine shop. Made of $\frac{9}{16}$ in. A/F light alloy hex bar, it is threaded $\frac{1}{8}$ in. BSP. The $\frac{5}{32}$ in. hole reduces to $\frac{3}{32}$ in. and a ring of eight 0.05in. dia. holes is drilled at 60deg. to provide a current of air which helps to prevent swarf from being blown back towards the blow gun. It is not fully effective, so eye protection should still be worn.

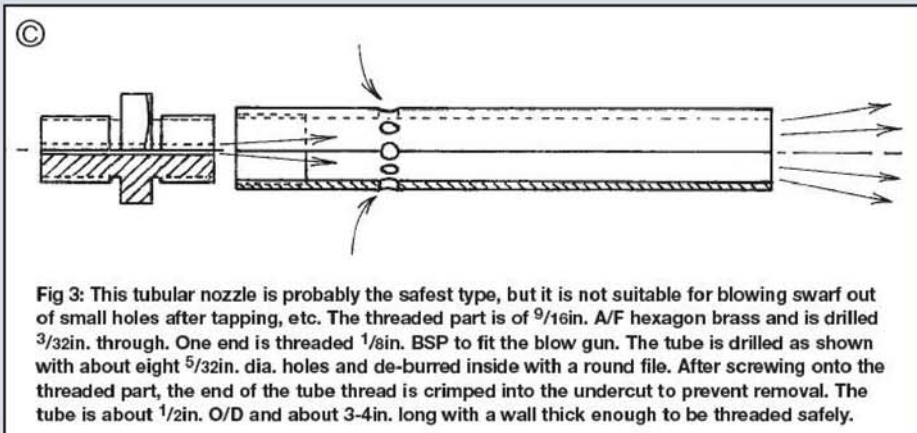


Fig 3: This tubular nozzle is probably the safest type, but it is not suitable for blowing swarf out of small holes after tapping, etc. The threaded part is of $\frac{9}{16}$ in. A/F hexagon brass and is drilled $\frac{3}{32}$ in. through. One end is threaded $\frac{1}{8}$ in. BSP to fit the blow gun. The tube is drilled as shown with about eight $\frac{5}{32}$ in. dia. holes and de-burred inside with a round file. After screwing onto the threaded part, the end of the tube thread is crimped into the undercut to prevent removal. The tube is about $\frac{1}{2}$ in. O/D and about 3-4in. long with a wall thick enough to be threaded safely.

sure, much like the regulator valves on a fuel gas bottle. Again, tell the supplier what pressure you need so that he can supply the most suitable reducing valve.

When I bought my compressor, it was set to 120-100psi, far too high for home use, so the pressure switch was re-set to 80psi maximum to suit a small grinder, and an additional plug-in reducing valve was obtained to supply air to a natural gas brazing torch. The lower top pressure saves on electricity, vee belt wear and mechanical wear.

Don't forget to drain the air tank of condensed water regularly and to lubricate the compressor as required, matters which tend to be forgotten.

Water vapour can be carried over with humid air. This might be detrimental to small precision air tools and spray painting. Various water traps

are available for installation in the air line. It is a simple metal unit with an 'in' and 'out' port below which is fitted a clear plastic bowl with a finger screw in the bottom to drain any water collected. My inexpensive device is about 3in. tall and 2in. diameter.

A similar looking unit is filled with oil with the purpose of adding a very fine but meagre mist of oil to lubricate the air motor and gears inside the air tools.

The oil mist device has its own socket into which air motor tools are plugged. Obviously one could not use this socket for 'clean air' jobs such as paint spraying, blowing dust off wood-work, and the like!

These foregoing points have been prompted by the ready availability of air tools for use where electric tools might be hazardous. 



Left: Air line couplings. Two sockets are fitted to the 'Y' fitting which is connected to the air supply. The needle valve can be used to reduce the rate of flow, useful to supply an air/reducing valve or an air/gas muffle furnace.

Right: Air line couplings. Top, push and twist; bottom, an 'Enots' brand push and click. Many types are available, both larger and smaller.



CLUB CHAT

With Stan Bray

UK News

Virtually since the formation of the Southern Federation MES, the AGM has been held at the Model Engineer Exhibition at the turn of the year using accommodation provided by the various owners of the magazine. A declining attendance at the meeting in recent years was considered to be due to a number of reasons which include a decline in attendance at the exhibition itself, inclement weather, and the fact that visitors had no wish to spend a large proportion of their time at a meeting, having paid to attend the exhibition. Previous organisers used to provide SoFed delegates with complimentary exhibition passes, a concession which appears not to have been available in recent years. The situation deteriorated to the extent that in 1999 only six clubs were represented and so the date and venue for the 2000 SoFed AGM were changed to March at the Rylands Hotel in Coventry. This encouraged a good attendance and resulted in a meeting more representative of the Federation. It is probable that future venues will be chosen to give all delegates the opportunity to attend and member clubs will be informed in due course of the location of the next meeting. This year's SoFed Spring Rally was hosted by Brighouse & Halifax ME and attracted a good number of participants, some who stayed overnight in their caravans and others who travelled to visit the track for the day. With breakfast available for those who stayed over and a Saturday evening barbecue plus a good attendance, those present thoroughly enjoyed their visit. Many remained on site for the host society's Open Day held on Sunday.

Good progress is being made on the construction of the new Tyneside SMEE track; members' enthusiasm is so great that they are turning up to work in the evenings as well as at weekends to dig the holes for the supporting posts. The manufacturing process for the concrete beams has been improved thereby ensuring that these will be available earlier than originally thought. A photographic progress record is being made and pictures of members enthusiastically working with shovels are currently on display in the clubhouse for all to see.

After several false starts Norwich DSME has now received planning permission for their new

building in Eaton Park. They are also in discussions about a new lease and,

although this has not yet been finalised, the signs are good. When agreed, the club will be in a position to plan for the future and to extend the existing track, although what land will be available for this does not yet seem to have been finalised. An increase in income from summertime passenger rides has allowed the club to donate an extra sum to charity this year. An announcement in the club newsletter notes that the date of the forthcoming annual Model Engineering Exhibition at Forncett Steam Museum has been moved from its normal November slot to the first Sunday in May 2002.

The first Open Day organised by members of North London SME with an interest in marine matters resulted in a good turnout from nearby Welwyn Garden City SME but unfortunately none from other societies. Being the first event on a relatively new boating pond, perhaps this not surprising and like most such events, attendance will gradually increase as it becomes more widely known. During the afternoon, non-nautical members of the host society were encouraged to try their hand at controlling a boat and acquitted themselves very well. On a subsequent occasion some 30 folk attended an enjoyable evening at the track organised by members of the video group in the society; the barbecue, in particular, was much appreciated.

Having fitted the carriage shed with doors which were thought to be impregnable, members of Wigan DMES were dismayed to discover a break-in. The passenger cars had been taken out and had obviously provided the culprits with some amusement for the result was that considerable damage had been caused. It took a major effort on the part of members to refit and make the doors secure, and to repair the wagons in time for the club Open Day the following weekend. However, they accomplished it and we are pleased to be able to report that more than 100 visitors signed the visitors' book and brought along 28 locomotives between them. Most were from the North West area but one intrepid soul came all the way from Edinburgh. The weather remained fine throughout the day ensuring that everyone had a chance of a good run on the track and making it a pleasant day for the spectators.

The midlands group of the National 2 1/2in. Gauge Ass'n held their annual Rally in late June at the Erewash Valley MES headquarters, now a regular venue for this event. Some speculators seemed astonished at the performance of the good number of locomotives which ran. Next year's Rally will be moved forward by a week to avoid clashes with other events for both societies; such a change of date is expected to encourage even more people to attend with their locomotives. A barbecue evening organised by members of Erewash Valley MES was also well attended by members and guests. The fine weather encouraged several members to run their models on the track while others were content to just enjoy the company, the visuals, and a chat. Local councillor Bill Camm, a staunch supporter of the society, attended the event and, having ridden around the track, posed with the club President for a photographer from a local newspaper.

An unfortunate lack of support from member societies caused the cancellation of the Northern Association ME Exhibition. Notwithstanding fine weather, the turnout for the association Rally hosted by Lancaster & Morecambe MES was also very disappointing with only 6 locomotives in attendance. Despite low attendance it was decided to proceed with the awards and the 5in. gauge Cup went to Dave Robson for his Beyer Peacock 0-6-2 tank locomotive and the 3 1/2in. gauge Cup to Alan Bibby for his Hunslet 0-4-0 tank locomotive. The new Lancaster club signalling system is nearly complete, the signals together with pointwork, being operated from an impressive signal box. With the intention of reducing the possibility of damage by vandalism, when not in use the removable signals will be stored in the clubhouse.

Progress appears to be very rapid on the various projects under way by members of Saffron Walden DSME, with the track extension taking priority. Three sets of welding equipment are in use and so far the only snag seems to have been the fact that it has been found difficult to fully maintain the proposed 50ft. radius. Improvements continue to be made to the tram which seems to be the pride and joy of some of the members. It has now been fitted with headlights and provision is being made for it to be decked out with fairy lights, in the style of the Blackpool vehicles, for use at Christmas.

The annual Model Steam Road

Vehicle Society Rally was arguably the most successful yet with 40 engines taking part in the Road Run on Saturday and 20 on Sunday. The Saturday evening Get-Together went on until late, and that too was well attended. The only (minor) complaint came from members of the host Rugby Club who claimed that the modellers had drunk all the beer! The society is now looking for ways of providing additional attractions for future events. Enthusiasm for society matters appears to be on the increase as demonstrated by the fact that for some of those attending the monthly meeting following the Rally it turned out to be standing room only, there being insufficient seating for all present.

Summer 2000 has been unpredictable in the UK. Many clubs that had arranged rallies early in the year suffered very poor attendances while as the summer wore on, with only the odd exception, attendance seems to have increased. Understandably, the location of the clubs concerned has had much to do with this; those in high-risk foot and mouth disease regions reporting the lowest turnouts. There was certainly a very large attendance at the annual Sweet Pea Rally organised this year by Chesterfield DMES, despite poor weather. During the course of the weekend 40 locomotives from 23 societies were present. Heavy rain spoiled the barbecue, most people opting to stay indoors and keep warm and dry. One special item that earned high praise from everyone was a Sweet Pea cake made by Karen Robinson and used for a Guess the Weight competition. It is pleasing to learn that a number of letters of appreciation from those who attended have been received by the club.

The Old Locomotive Committee (OLCO) AGM was held at its now regular venue, the Manchester Museum of Science and Technology. As usual, members were given full access to Lion prior to the meeting, but this year due to the absence of some of the museum staff, were unable to obtain the materials to give the engine a thorough clean. It was, however, another opportunity to examine the locomotive in detail and to discuss the finer points of its construction. During the day there was also a chance for members to examine the gauge 1 model of Lion which, together with coaches, is being marketed by Aster. The general opinion was that, taking account of the constraints necessary to produce a commercially viable model, it was very good.

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.

Max Dearnley
Walter Gulson
Henry Kruger
Maurice Leeding
Ken McKay
Jack Prince

Hutt Valley MES
Sheffield DSMEE
Rand SME
Sutton MEC
Tyneside SMEE
Durban SME

World News

South Africa

Much work has been taking place on the Bloemfontein SME tracks during recent months. This includes a considerable change to the layout of the station area as well as the installation of 12 new points and an additional 10 metres of steaming bay. The clubhouse has had a makeover with fresh paint, new curtains and ceramic floor tiles, all ready in time for the Open House weekend, which was very successful. Some 25 visiting locomotives ran at various times despite several regular visitors sending their apologies for being unable to attend. There were also hundreds of members of the public who came

along to watch proceedings and to have rides. The catering section, organised by the ladies, kept everyone well fed with tea, pancakes and wors-dogs (will someone please explain: what are wors-dogs?)

The Gauteng Steam Meet 2000, a 3-day event, was hosted by Rand SME at their headquarters in Rutter Park in late April. In total, 32 steam locomotives and a single road vehicle in the form of a Clayton wagon, most of which came from visiting societies, were to be seen during the event. A couple of weeks

before this, the stationary engine preservation enthusiasts in the club attended a garden party given by Gerald Buitendach at which there was an opportunity to see a number of smaller engines in operation. A vertical Blackstone engine, examples of which are very rare, was particularly admired.

Canada

During the annual Train Festival, British Columbia SME carried 3600 passengers. A good turnout of visiting club members, some of

whom travelled very long distances to be present and many of them bringing locomotives, was augmented by Mike Johns of Taunton ME who flew in specially for the event and Ralph and Jane Nuttal from Kings Lynn DMES who arrived in time to share in a pancake breakfast. Most of the visitors stayed overnight; a dinner was organised on Saturday, the menu for which included barbecued chicken and a dessert made from blackberries picked on site. Additional interest was provided for the public with two model railway layouts which were erected in the clubhouse while Robin Quirk, a member of the host society, demonstrated his skill as a face painter for the children.

JAPAN COUPLERS FRIENDS CLUB

Kimio Hoshino

reports on some recent activities.

The Japan Coupler Friends Club opened their season when 10 members paid a visit to the Shikahama Miniature Railway, all taking locomotives with them. It was Buddhist Souls Day and a public holiday, so the railway was kept busy with children wanting rides. The railway caters for 5 and 7 1/4 in. gauge locomotives, is about 400 metres in length and operates every weekend as well as on the fourth Wednesday of every month. The visitors spent a lot of time on the track running a variety of locomotives. However, as far as the children were concerned, Hirohiko Motoyama's *Maxitruk* 0-4-0 painted in bright colours and complete with a face resembling that of *Thomas the Tank Engine* was the star of the day. The Japan

Model Railway Exhibition (Jam Convention) was held in Tokyo in mid-August and this too attracted many visitors. As well as miniature railways from gauge N to gauge O, there was a considerable live steam content with tracks for 3 1/2 and 5 in. gauges as well as gauge 1. The Japan Coupler Friends Club presented a static display of 3 1/2 in. gauge Japanese National Railways prototypes, while the Ichikawa Live Steam Club displayed a selection of 5 in. gauge models. Some of these were still under construction and were shown with a selection of boilers, some of which were also under construction. Both societies were running engines on the passenger carrying 3 1/2 and 5 in gauge track laid outside. There was also an auction, a flea market and several commercial stands including Aster who showed, amongst other items, the latest addition to their range: an LNER A3 *Flying Scotsman*.



This *Maxitruk* locomotive complete with its face was the major attraction for children at the Shikahama Miniature Railway.



Locomotive shed and steaming bays at the Shikahama Miniature Railway.



A scene on the Shikahama Miniature Railway.



A fine model LNER A3 nearing completion by Kimio Hosino.



A selection of models by the Japan Coupler Friends Club of Japanese National Railway prototypes at the Japan Model Railway Exhibition.



A 3 1/2 in. gauge Pennsylvania class 01-B and an unfinished coach on another Japan Coupler Friends Club stand.



5 in. gauge locomotives and a selection of boilers on the Ichikawa Live Steam Club stand.



The outdoor track with a selection of locomotives in use for passenger hauling.



This view of the outdoor track reveals that traffic cones are as familiar in Japan as they are in the UK.



The gauge 1 layout with a Japanese National Railways locomotive in operation.



Two gauge 1 locomotives on the Aster stand



The latest addition to the Aster range is this gauge one LNER A3 Flying Scotsman.



Our Japanese correspondent Kimio Hosino with a vintage gauge 1 LBSC tank locomotive made by Bing.

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.

NOVEMBER

- 2 **Vale of Aylesbury MES. AGM.** Contact Clive Ellam: 01296-623433.
2 **Carvey R&MEC. Guy Fawkes Steam-Up.**
Contact David A. Clark: 01375-846921.
2 **Maidstone MES. 2001 A Train Odyssey (Review of the Year).**
Contact Martin Parham: 01622-630298.
2 **Portsmouth MES. Sean Cullen: Hollycombe Steam Collection.**
Contact Bob Aldred: 023-92-523366.
2 **Rochdale SMEE. Doug Hewson: Constructing Rolling Stock.**
Contact Mike Foster: 01706-360849.
2 **Romford MEC. Competition Night.** Contact Colin Hunt: 01708-709302.
2-4 **Hornsby ME. Wagga Invitation Run.** Contact Ted Gray: 9484-7583.
3 **Chelmsford SME. Bonfire Night, Barbecue and Steam-Up.**
Contact D. Blake: 01376-324205.
3 **Elmdon MES. Bonfire Night.** Contact Chris Giles: 0121-458-1291.
3 **Malden DSME. Bonfire Night, Fish & Chips and Films.**
Contact J. Mottram: 01483-473786.
3 **Romford MEC. Fireworks Night.** Contact Colin Hunt: 01708-709302.
3 **Romney Marsh MES. Bonfire Night Barbecue & Steam-Up.**
Contact John Wimble: 01797-362295.
3 **SM&EE. John Martin: Southwold and other N.G. Locomotive Models.**
Contact David Boote: 01202-745862.
3 **Stockholes Farm MR. Bonfire Night Open Day.**
Contact Ivan Smith: 01427-872723.
3 **West Riding SLS. Bonfire Night.** Contact Margery Bradley: 01977-685782.
3 **York City & DSME. Bonfire Steaming Event.**
Contact Ken Bateman: 01904-421445.
4 **Bedford MES. Boiler Blow-Down Day.**
Contact Alan Guildersleve: 01525-383010.
4 **Gas Turbine Builders' Ass'n. Engine Efficiency Competition**
at Midland Air Museum. Contact: Tom Wilkinson: 01508-570977.
4 **Hereford SME. Hereford Leisure Centre Exhibition and Swapmeet.**
Contact John Arrowsmith: 01432-265151.
4 **Pinewood MRS. Guy Fawkes Run.** Contact J. Ephithite: 01344-885049.
4 **Reading SME. Running.** Contact Graham Bustin: 01189-615450.
5 **Cardiff MES. Bonfire Night Get-Together.**
Contact Trevor Jenkins: 029-20755568.
5 **Historical MRS (London Area). The History of Permanent Way.**
Contact John Millbank 0208-948-0556.
5 **Leicester SME. Auction Night.** Contact Raymond Wallis: 0116-285-8824.
5 **Manx Steam & MEC. Meeting.** Contact Mike Casey: 01624-861613.
6 **Auckland SME. AGM.** Contact Steve Berkley: 416-6619.
6 **Oxford (City of) SME. John Woolley: Memorabilia of the Great Train Robbery.**
Contact Graham Toplis: 01235-771180.
6 **Romney Marsh MES. Bob Frost & David Dore: Train Protection.**
Contact John Wimble: 01797-362295.
6 **Stamford MES. Bits & Pieces.** Contact David Ash: 01780-751211.
6 **Taunton ME. Peter Triggs: 40 Years of Transport.**
Contact Don Martin: 01460-63162.
7 **Birmingham SME. Bits & Pieces.** Contact John Walker: 01789 266065.
7 **Bristol SMEE. Jim Wilkie: I/C powered Agricultural Tractors.**
Contact Trevor Chambers: 01454-415085.
7 **Tyneside SMEE. Bits & Pieces.** Contact Malcolm Halliday: 0191-262-4141.
8 **Cardiff MES. Meeting.** Contact Trevor Jenkins: 029-20755568.
8 **High Wycombe MEC. Meeting.** Contact David Savage: 01494-527402.
8 **Leyland SME. Sam Bates: Volume II.** Contact Alan Wilson: 01942-715072.
8 **N. W. Leicester SME. J. Thornton: Long Case Clocks.**
Contact C. E. Handley: 01509-413473.
9 **Colchester SMEE. David Sogge: Railway Wanderings Through East Anglia & Elsewhere.** Contact L. G. Hammond: 01376-511686.
9 **Hereford SME. David Hudson: Experimental BR Class 2 Locomotive.**
Contact John Arrowsmith: 01432-265151.
9-11 **Meridienne Exhibitions. The International Model Boat Show** at the
Warwickshire Exhibition Centre, Fosse Way, near Leamington Spa.
10.30am-5pm daily. Adults £5.50, Senior Citizens £4.50, Children £3.50,
Family (2+3): £14.50. Ample free car parking. Enquiries: 01926-614101.

- 10 **Chesterfield MES. Pie & Pea Supper Running.**
Contact Mike Rhodes: 01623-648676.
10 **Erewash Valley MES. Bonfire Evening.**
Contact Jim Matthews: 01332-705259.
10 **Sutton Coldfield MES. Bonfire Party.** Contact Roger Timings: 0121-308-5875.
11 **Leighton Buzzard NG Rly. Remembrance Day.** Enquiries: 01525-373888.
12 **Bedford MES. Bits & Pieces.** Contact Alan Guildersleve: 01525-383010.
12 **Erewash Valley MES. AGM.** Contact Jim Matthews: 01332-705259.
12 **Frimley & Ascot LC. Club Evening.** Contact Bob Dowman: 01252-835042.
12 **Melton Mowbray DMES. Meeting.** Contact Phil Tansley: 0116-2673646.
12 **Saffron Walden DSME. Club Night.** Contact Ken Archer: 01763-852911.
13 **Basingstoke DMES. Bring & Buy.** Contact Ian Shanks: 01420-561741.
14 **Birmingham SME. David Hulse: James Watt's Lamp Engine, 1788.**
Contact John Walker: 01789-266065.
14 **Bournemouth DSME. Meeting.** Contact Mike Baker: 01202-383653.
14 **Harrow & Wembley SME. Photographic Competition.**
Contact Dr. Roger Greenwood: 020-8427-2755.
14 **Hull DSME. Auction.** Contact Chris Parsons: 01964-630563.
14 **Norwich DSME. John Lee: The Railway Poster.**
Contact Barry Steel: 01603-743372.
15 **Cardiff MES. Forum.** Contact Trevor Jenkins: 029-2075-5568.
15 **Halesworth DMES. Chat Night.** Contact Chris Wallman: 01362-695735.
15 **Warrington DMES. Simon Chaddock: Professor Chaddock.**
Contact Bill Underwood: 01606-891225.
16 **Carvey R&MEC. Seen on the Table.** Contact David A. Clark: 01375-846921.
16 **Rochdale SMEE. Auction.** Contact Mike Foster: 01706-360849.
16 **Romford MEC. Photo Talk.** Contact Colin Hunt: 01708-709302.
16 **Romney Marsh MES. Video Evening.** Contact John Wimble: 01797-362295.
17 **SM&EE. Visit to Thames Barrier.** Contact David Boote: 01202-745862.
17 **Historical MRS (Scottish Area). Des Norman: Building a Model American**
Railway. Contact Richard Crockett: 01896-750730.
17 **Reading SME. Club Running.** Contact Graham Bustin: 01189-615450.
17 **SM&EE. Rummage Sale.** Contact David Boote: 01202-745862.
17 **York City & DSME. Richard Radcliffe: Rebuilding & Renovating a Lathe.**
Contact Ken Bateman: 01904-421445.
17/18 **Kew Bridge Steam Museum. Model Steam Weekend.**
Information: 020-8568-4757.
18 **Frimley & Ascot LC. Club Run.** Contact Bob Dowman: 01252-835042.
18 **Vancouver Island ME. Club Run Day.**
Contact Dennis Dalla-Vincenza: (250) 480-7042.
18 **York City & DSME. Running Day.** Contact Ken Bateman: 01904-421445.
19 **Leicester SME. Ladies' Evening. George Gamble: Medals and How they are**
Won. Contact Raymond Wallis: 0116-285-8824.
20 **Chesterfield MES. Fuzz Jordan: Darjeeling Railways.**
Contact Mike Rhodes: 01623-648676.
20 **Nottingham SMEE. Nick Harrison: Slide Show.**
Contact Graham Davenport: 0115-8496703.
20 **Romney Marsh MES. Des Adeley: All about 2 1/2 in. gauge.**
Contact John Wimble: 01797-362295.
20 **Taunton ME. Dave Rose: Amateur Radio.** Contact Don Martin: 01460-63162.
21 **Birmingham SME. Gauge 1 Evening.** Contact John Walker: 01789-266065.
21 **MELSA. Meeting.** Contact Graham Chadbone: 07-4121-4341.
22 **Cardiff MES. Cyril Chandler: Recollections IV.**
Contact Trevor Jenkins: 029-2075-5568.
22 **Frimley & Ascot LC. AGM.** Contact Bob Dowman: 01252-835042.
22 **Leyland SME. Quiz Night.** Contact Alan Wilson: 01942-715072.
23 **Colchester SMEE. Ralph Hull: The Restoration of Vintage Aircraft by the**
Spitfire Man. Contact L. G. Hammond: 01376-511686.
24 **Chesterfield MES. Running Day.** Contact Mike Rhodes: 01623-648676.
24 **Historical MRS (Bristol Area). Arthur Turner: Northallerton in 1953 and**
M&GN journeys in 1949. Contact Gerry Nichols: 0117-973-1862.
24 **Hornsby ME. Family Day.** Contact Ted Gray: 9484-7583.
24 **Mashonaland SME. Meeting.** Contact Ian Andrews: 263-4-882893.
25 **Elmdon MES. Steam-Up.** Contact Chris Giles: 0121-458-1291.
25 **Hornsby ME. Special Running Day.** Contact Ted Gray: 9484-7583.
25 **MELSA. Sunday in the Park.** Contact Graham Chadbone: 07-4121-4341.

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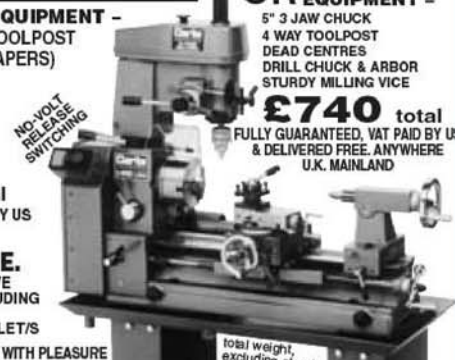
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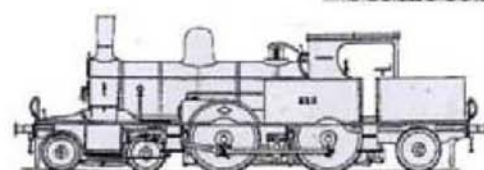
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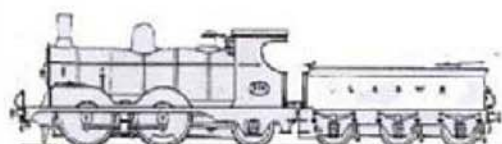
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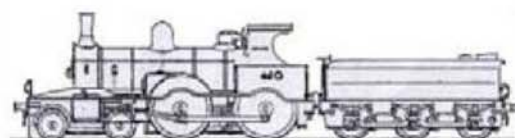
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LSWR A12 Class 0-4-2 Jubilee - W. Adams 1887
Based on first series of engines built at Nine Elms Works
utilizing the large Beyer tender
Engine length 31.1/4" - Tender 22.3/16" - Driving wheels 6.3/8" Dia.
Cylinders 1.1/2" Bore x 2.15/16" Stroke - Hydrostatic lubrication
Slide valve - Stephensons valve gear - Screw reverser



"NINE"

5" Locomotive by K.S. Moonie
LSWR 460 Class 4-4-0 - W. Adams 1884
Based generally on Neilson built engines 1884
Engine length 33.1/2" - Tender 22.1/4" - Driving wheels 7" Dia.
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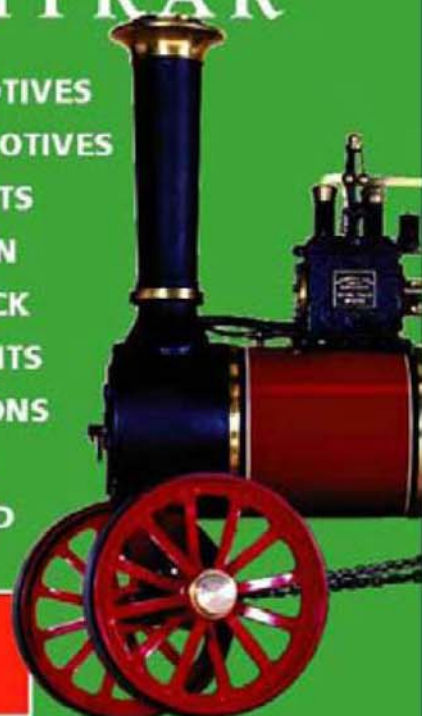
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These notes are written purely for guidance. Full information is contained in the Competitors' Information booklet which is sent to every entrant as part of the information package. If you have an item and are unsure as to the Class into which it should be entered, leave that section blank and we will take care of it. The Judges have the right to move any competition exhibit into another class if they feel that by doing so its chances of gaining higher marks or a more appropriate award are improved.

If the item is offered as a Loan exhibit please indicate this by writing Loan on the form in the box identifying the Class. Loan models are not judged but carry all other privileges associated with competition entries.

Part built models are particularly welcome in the Loan Section; visitors like to see work in progress, and entry does not preclude the item being entered in competition when completed.

The classes listed below are those associated with mainstream model engineering.

Club exhibits

Where a club is exhibiting, each model should be entered on a separate entry form and clearly identified as a club exhibit by entering Loan/Club in the class section box. This ensures that we have a full record of all models on display during the show and facilitates matters of administration and insurance.

Additional forms

If you do not wish to deface your copy of the magazine we are happy to receive photocopies of the entry form, one for each model. We will be pleased to send out extra forms if required, so if you know of a modeller who is not a reader of one of our magazines but who you think may wish to participate, please advise them to contact our Exhibitions Office (01322-660070), or simply photocopy the entry form for them.

The success of the show depends largely on the number of models on display. Your work could well be the stimulus which inspires someone else to start in the hobby. There can be no doubt that this event is our showcase on the world of modelling in all its aspects. Every modelling discipline needs more and more participants, and it is by displaying not only the crème-de-la-crème, but also examples of work of a more achievable standard, that people are encouraged to join into the wonderful world of modelling, in whatever aspect.

We look forward to seeing a sample of your work at the show!

Engineering Section

- A1 Hot air engines.
- A2 General engineering models (including stationary and marine engines).
- A3 Internal combustion engines.
- A4 Mechanical propelled road vehicles (including tractors).
- A5 Tools and workshop appliances.
- A6 Horological, scientific and optical apparatus.
- A7 General engineering exhibits – not covered by the above

Railway Section

- B1 Working steam locomotives 1" scale and over.
- B2 Working steam locomotives under 1" scale.
- 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.
- B4 Scratchbuilt model locomotives of any scale, not covered by classes B1, B2, B3, including working models of non-steam, electrically or clockwork powered steam prototypes.
- B5 Scratchbuilt model locomotives gauge 1 (10mm scale) and under.
- B6 Kitbuilt model locomotives gauge 1 (10mm scale) and under.
- B7 Scratchbuilt rolling stock, gauge 1 (10mm scale) and under.
- B8 Kitbuilt rolling stock, gauge 1 (10mm scale) and under.
- B9 Passenger or goods rolling stock, above 1" scale.
- B10 Passenger or goods rolling stock, under 1" scale.

- B11 Railway buildings and lineside accessories to any recognised model railway scale.
- B12 Tramway vehicles.

Note:

Kitbuilt: any model containing a preponderance of commercially produced parts.

Scratchbuilt: wholly made by the entrant except wheels, gears, motor, engraved plates and small turning, etc. not exceeding 5% of the whole.

Rolling Stock: Where a rake is entered, competitors are asked to nominate one vehicle for judging purposes.

Marine Section

- C1 Working scale models of powered vessels (from any period). Scale 1:1 to 1:48.
- C2 Working scale models of powered vessels (from any period). Scale 1:49 to 1:384. Excl. miniatures as classified in C8.
- C3 Non-working scale models of powered vessels (from any period). Scale 1:1 to 1:48.
- C4 Non-working scale models of powered vessels (from any period). Scale 1:49 to 1:384 excl. miniatures as classified in C8.
- C5 Sailing ships and oared vessels of any period – working.
- C6 Sailing ships and oared vessels of any period – non-working.
- C7 Non-scale powered functional models including hydroplanes.
- C8 Miniatures. Length of hull not to exceed, 15in for 1/32 in. to 1ft scale or larger, 12in for 1/25 in. scale, 10in. for 1/16 scale; 9in. for 1/8 scale. No limit for smaller scales.
- C9 For any model boat built from a commercial kit. Before acceptance in this competition the kit must have been readily available for at least 3 months prior to the opening date of the exhibition and at least 20 kits must have been sold either by mail order or through the retail trade.
- C10 Functional Model Yachts

Supporting documentary evidence of accuracy may be submitted by entrants in large and clearly identified envelopes.

Model Horse Drawn Vehicle Section

- G1 Carriages & other sprung vehicles. (Omnibuses, trade vans etc.) Wagons, carts and farm implements. Caravans.

Junior Section

- J1 For any type of model, mechanical or engineering work, by an under 14 year old.
- J2 For any type of model, mechanical or engineering work, by an under 16 year old.
- J3 For any type of model, mechanical or engineering work, by an under 18 year old.

All entries will be judged for standard of craftsmanship, regardless of the modelling discipline, i.e. a boat will not be competing against a military figure. Providing a model attains sufficient marks it will be awarded a gold, silver or bronze medal.

Model Vehicle Section

- K1 Non-working cars, including small commercial vehicles (e.g. Ford Transit) all scales down to 1/42.
- K2 Non-working trucks, articulated tractor and trailer units, plus other large commercial vehicles based on truck-type

- chassis, all scales down to 1/42.
- K3 Non-working motor bikes, including push bikes, all scales down to 1/42.
- K4 Non-working emergency vehicles, fire, police and ambulance, all scales down to 1/42.
- K5 Non-working vehicles including small commercial vehicles (e.g. Ford Transit,) scale from 1/43 or smaller.
- K6 Any available body shells including Concours, in any scale or material, to be judged on appearance only.
- K7 Functional model cars/vehicles which must be able to move under its own power of any type. Can be either free-running, tethered or radio controlled or slot car, but must represent a reasonable full size replica.

Duke of Edinburgh Challenge Trophy

Rules and Particulars

The Duke of Edinburgh Challenge Trophy is awarded to the winner of the Championship Award at the Model Engineer Exhibition.

The trophy remains at all times the property of Nexus Special Interests.

The name of the winner and the date of the year in which the award is made will be engraved on the trophy, which may remain, at the discretion of Nexus Special Interests Ltd, in his/her possession until required for renovation and display at the following Model Engineer Exhibition.

Any piece of model engineering work will be eligible for this Championship Award after it has been awarded, at The Model Engineer Exhibition, a Gold or Silver medal by Nexus Special Interests Ltd.

No model may be entered more than once. Entry shall be free. Competitors must state on the entry form:

That exhibits are their own bona-fide work. Any parts or kits which were purchased or were not the outcome of their own work.

That the model has not been structurally altered since winning the qualifying award.

7. Nexus Special Interests Ltd. may at their sole discretion vary the conditions of entry without notice.

Loan Section

The Loan Section is for anyone wishing to display models on a non-competitive basis. Unfinished models will be eligible providing a good standard of engineering workmanship is displayed. FREE entry by normal competition application.

Self Delivery

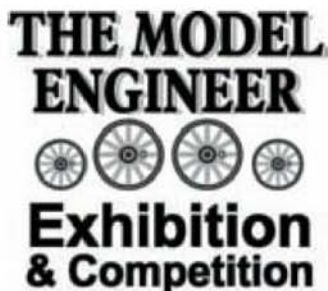
If you intend to bring your model to the show personally please take note of and comply with the delivery times and instructions contained in the Competitors' Information pack.

UNDER NO CIRCUMSTANCES CONSIGN YOUR EXHIBIT DIRECT TO SANDOWN PARK EXHIBITION CENTRE. The staff there have no facilities to deal with them, and no insurance cover for such items.

The Early Bird

If you intend to visit the show on your own, with friends or as a member of a party, substantial savings on tickets may be had and queuing avoided by ordering your tickets in advance. A special Hotline is in place: Tel: +44 (0)1858 438897, Fax: +44 (0)1858 461739. The Hotline is open Monday-Friday 8am-9.30pm; Saturday and Sunday 8am-4pm. Call and place your order after 2nd October.

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A separate form is required for each entry.
Please send to:
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Tel: 01322 660070 Fax: 01322 616319

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CLASS	ENTRY NO.

PERSONAL DETAILS (Please print clearly)

Surname _____ Forename(s) _____

Address _____

Post Code: _____

Home Tel No: _____ Daytime Tel No: _____ Age: _____

Model Club or Association membership _____

Value of Model (Nexus takes no responsibility if the value is not entered) £ _____

N.S.I. plan used? (Y/N) _____ How many years have you been a modeller? _____

Name and address of your local newspaper _____

Publicity? (Y/N) ☐

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Are you supplying notes? (Y/N) ☐
Have you supplied a photograph? (Y/N) ☐

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Date: _____

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Do you subscribe to a Nexus magazine? (Y/N) ☐

MODEL DETAILS

Title of model: _____

Description _____

Machinery used: _____

Type of construction: _____

Parts not made by you and commercial items: _____

Name and address of your local newspaper _____

Scale: _____ Length: _____ Width: _____ Height: _____ Weight: _____

N.B. Please make copies including photographs of all information relating to your model as Nexus will not accept liability for any loss.

CLOSING DATE FOR ENTRIES: 17TH DECEMBER 2001

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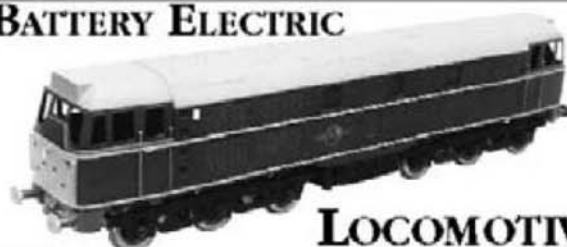
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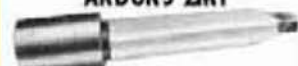
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- Swing over bed: 125
- Spindle bore: 8 1/2
- Tailstock travel: 20
- Speed range variable: 100-2500
- Range of threads (inch): 16-40TPI (metric) 0.4-1.25mm
- Model: 250W
- Net weight: 25kg
- Distance between centers: 200
- Tailstock taper: MT1
- Cross-slide travel: 70



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Conquest Lathe

- Swing over bed: 180
- Spindle bore: 19
- Tailstock travel: 60mm
- Speed range variable: 100-2500 rpm
- Range of threads (inch): 12-52TPI (metric) 0.25-1.5mm
- Model: 74W
- Net weight: 30kg
- Distance between centers: 300
- Tailstock taper: MT2
- Cross-slide travel: 70mm
- Dimensions (LxWxH): 770x254x300



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920 Lathe Deluxe

- Swing over bed: 229
- Swing over cross slide: 133
- Distance between centers: 500
- Spindle bore: 19
- Taper in spindle bore: MT3
- Model: 74W
- 6 Speed: 100-1000
- Net weight: 100kg
- STANDARD EQUIPMENT:
 - 4" 3-jaw chuck with 2 sets of jaws
 - 7 1/2" 4-jaw chuck with reversible jaws
 - Steady rest • Follow rest
 - MT#2 Dead centre
 - MT#3 Dead centre
 - 4-way tool post
 - Face plate
 - Tool Box & Tool Bit
 - 1st & 3rd gear



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Model B-Super

- Swing over bed: 420
- Distance between centers: 500
- Mill drill spindle taper: 19
- Tailstock barrel travel: 80
- 7 speeds: 60-1300
- Swing over cross slide: 160
- Spindle taper: MT3
- Draw bar: MT2
- Cross slide travel: 180mm
- Model: 74W
- Net weight: 155kg
- STANDARD EQUIPMENT:
 - 4" 3-jaw chuck
 - 2 dead centers
 - 6" backplate
 - 1/2" drill chuck
 - Change gears
 - MT#3 chuck adaptor



£665

Comet Lathe

- Swing over bed: 250
- Swing over cross slide: 133
- Distance between centers: 550
- Spindle bore: 19
- Taper in spindle bore: MT3
- Model: 74W
- 6 Speed: 125-2000
- Net weight: 130kg
- MILL ATTACHMENT:
 - Spindle taper: MT3
 - Head travel: 215
 - Speed variable
 - Range: 0-3000rpm
 - Model: 74W
 - Net weight: 45kg



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Centurion

- Swing over bed: 420
- Distance between centers: 520
- Mill drill spindle taper: 19
- Tailstock barrel travel: 80
- 7 speeds: 160-1360
- Swing over saddle: 160
- Spindle taper: MT3
- Draw bar: MT2
- Cross slide travel: 200mm
- Model: 2 x 74W
- Net weight: 230kg
- STANDARD EQUIPMENT:
 - 4" 3-jaw chuck
 - 2 dead centers
 - 6" backplate
 - 1/2" drill chuck
 - Change gears
 - MT#3 chuck adaptor



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Craftsman Precision Belt Drive

- Swing over bed: 300
- Swing over gap: 450
- Swing over saddle: 170
- Distance between centers: 570
- Spindle bore: 36
- Spindle bore taper: MT5
- Cross slide travel: 150
- Compound travel: 89
- Tailstock barrel travel: 92
- Range of speeds: 1250-12000rpm
- Model: 11/2 HP
- Net weight: 390kg

STANDARD EQUIPMENT:

- 6" 3-jaw chuck with reversible top jaws
- 8" 4-jaw chuck with reversible top jaws
- Steady rest • Follow rest
- Stand • 12" face plate
- Spigot chuck • Threading dial
- 4-way tool box post
- MT#2 dead center
- T-slotted cross slide



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Cub 620/630/640

- Swing over bed: 300
- Swing over gap: 430
- Swing over saddle: 174
- Distance between centers: 500/750/1000
- Bed width: 190
- Spindle bore: 38
- Spindle bore: DN-S
- Spindle bore taper: MT5
- Cross slide travel: 160
- Compound travel: 75
- Tailstock barrel travel: MT3
- Tailstock barrel travel: 70
- Range of speeds: 9 60-2000rpm
- Number of inch threads: 33
- Range of inch threads: 4-72 TPI
- Model: 11/2HP 24W PL 2hp415v
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STANDARD EQUIPMENT:

- Hardened and ground gears in headstock
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