MODEL ENGINEER

Vol.199 No. 4312

9-22 November 2007

COVER STORY

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- Back gear for maximum torque • Tilting head

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- Digital depth gauge
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- Table size: 27 1/2" x 8"
- Traverse: 16 3/4" x 8 5/8"
- Motor: 1.5hp

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New

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IN THIS ISSUE

Vol. 199 No. 4312 9 - 22 November 2007

ON THE COVER...

A finely made and finished one inch to the foot model of the Stothert & Pitt beam engine of 1886, built by R. L. Waines, and winner of a Gold Medal at the Centenary Model Engineer Exhibition. The original of this engine was displayed at the Paris International Exhibition. It still exists and can be found at Bath University. Report on page 573.
(Photograph by Justin Lambert)

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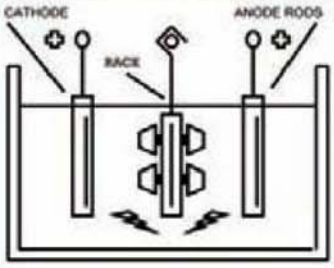

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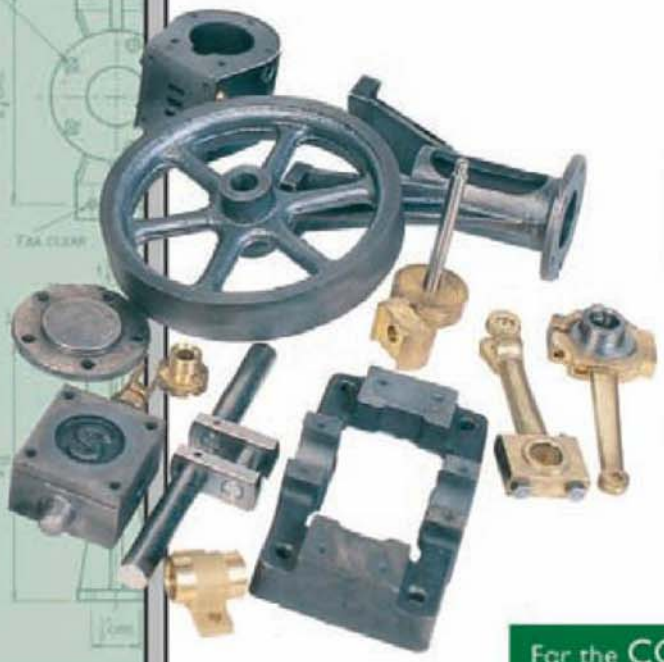

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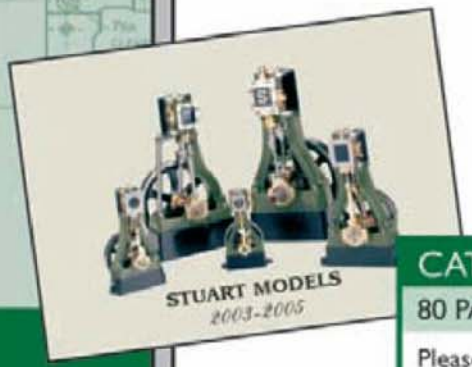

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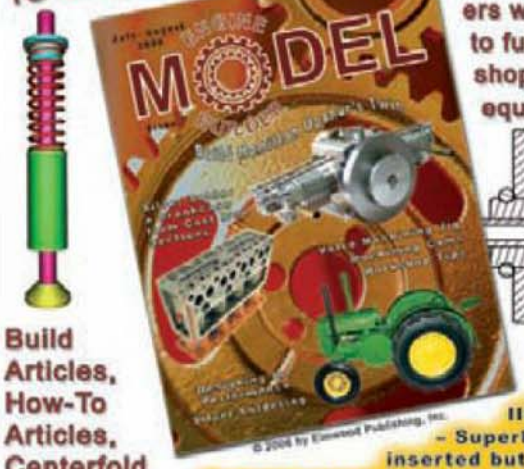

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"Digital Machinist" • SAMPLE COPY • £6.35

Model engineering tends to be one of the last refuges of the old skills, but many model engineers are now enthusiastically embracing the modern era in the form of CAD design, and CNC for machinery. It is the latter which is the main subject of this quarterly magazine from the publishers of the *Home Shop Machinist* and *Machinist's Workshop*. If you are into, or considering installing CNC machines, you will find this very interesting!

How to Run a Lathe
• 1942 • South Bend • £8.00

For years we sold 1000s of copies of the latest edition of this book - then "South Bend" put the price through the roof.... Now the 1942 edition has been reprinted, and it costs less! The main text is identical - most of the changes are in the photos. As a book to keep by your lathe for everyday use, this has no equal. 128 page illustrated paperback.

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• Peck • £16.70

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Making Simple Model Steam Engines • Bray • £22.45

Here Stan Bray tackles the subject of simple steam engines for the beginner. The Introduction covers general points, and then follow 10 chapters each covering a simple engine of varying configurations, and including oscillating and double acting engines, as well as an unusual 'Clapper' engine. 8 chapters then follow on boiler designs and boiler construction, before the final chapter covers building an 'O' gauge vertical boilered De Winton type locomotive. The full drawings for each item are dimensioned in both Imperial and Metric, and there are numerous photos of parts and machining set-ups. 'Tis good! 158 pages. Loads of drawings and photos. Hardbound.

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John Snell has been involved in preservation since 1951, when he accompanied the late Tom Rolt and David Curwen to Towyn as the only permanent (English) staff on the *Talyllyn Railway*, before it opened as the very first preserved railway in the world, and he retired in 1999 after 28 years as General Manager of the *Romney, Hythe & Dymchurch Railway*. In the intervening period, whilst he has not always been professionally involved with railways or preservation, he has been actively involved in both.

In particular he has travelled, inevitably perhaps given he was born in Fiji in 1932, spent the war years in New Zealand, and returned to Britain for further education thereafter. It is his travels which are recounted, and especially illustrated in this wonderful book; if you were into the railways of that strange place 'abroad', from the late 1950s to the mid 1970s especially, this book is incredibly nostalgic and will bring the memories flooding back. If you are too young, see what you missed!

The text is a delight, being informative and interesting, with a dry humour, and, the photographs will take your breath away. Whilst the locomotive or train is usually the centrepiece, these are not sterile photographs of lumps of machinery, but are full of life with lots of incidental details, which is why we have gone for a large format - 245 mm x 297 mm, with over 50 photographs printed full page. And there are a lot of photographs of railways worldwide - 386 in full colour and 48 in black & white, the earliest taken in Fiji in 1945

Given the large landscape format, and its 256 hardbound pages this is a BIG book in every way. If you love the steam locomotive, be it running on rails broad, standard or narrow gauge, you will enjoy this book immensely for many, many years to come. Buy a copy and give yourself a huge treat!

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• Gingery • £7.75

Interest in Tesla turbines is high, possibly helped by the fact they are pretty simple to make. Whilst it does give some historical background, the main purpose of this book is to show you how to build your own Tesla turbine, in this case a fairly big machine having eighteen 3" diameter discs, and measuring 3½" wide by 6" long x 4" high. This may not sound large, but these fascinating machines pack quite a wallop, Tesla himself aiming for "ten horsepower to the pound of weight". As a guide to a straightforward and quick project, which results in something quite spectacular, this excellent book from Vince Gingery is hard to beat. 48 pages, 46 drawings and photographs. Softcover.

Development of Piston Aero Engines
• Gunston • £15.49

Second edition of Bill Gunston's definitive technical history of the piston aero engine. In the first section Gunston explains clearly how the various types of piston engine work, and then, in the second section describes how the engines developed, essentially taking the subject chronologically. If you are interested in the subject, and don't already have a copy of this book, you really should treat yourself! 231 densely illustrated pages. Paperback.

Model and Miniature Locomotive Construction
• Bray • £33.60

This is a major and modern book on the construction of model and miniature locomotives from Gauge 1 to 7¼" gauge, with the accent on the passenger hauling gauges. The bulk of the book is the author passing on hints, tips, ideas and practices he has picked up over fifty years as a model engineer, and he covers the subject with chapters on each major part, such as frames, axleboxes, valve gear, cylinders, boiler, platework etc. Stan also covers electric and I.C. powered locomotives, a subject not covered before in a book on this subject. Each chapter is illustrated with drawings and photographs of the relevant parts of the locomotive, and there are eight pages of Appendices of useful charts. Whilst especially useful for the beginner, the ideas, hints and tips within the pages of this book make it one every model or miniature locomotive builder should have on their bookshelves. Quality hardbound A4 format book. 208 pages. 158 drawings. 300 B & W, and 32 colour photographs.

Rule of Thumb
• Curwen • £13.95

David Curwen is best known as a major designer of miniature railway locomotives, but he had served his apprenticeship in the garage trade in the 1930s then, after wartime service in the RAF, maintained generating plant and steam cars, using a Sentinel steam wagon as the works transport. Along with the late Tom Rolt and John Snell (see above centre), he was one of the three full-time employees of the *Talyllyn Railway* when it first emerged in preserved form although, by then, he had already built some 10¼" gauge miniature railway locomotives and subsequently went on to design a whole range of steam or IC powered locomotives up to 15" gauge, including all of the motive power of the present Fairbourne Railway. This book of autobiographical reminiscences is written in an easy-to-read and humorous style, which reflects this most genial of men very well. 56 A4 format pages, full of B & W and colour illustrations. Paperback.

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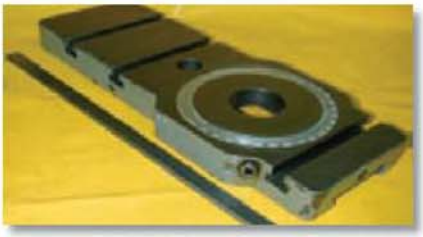

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Vertical boilered locomotives

SIRS, - Following the letters from Peter Spenlove-Spenlove, Paul Abbey and Peter A. Penning (M.E. issues 4293, 4303, and 4306) may I add my contribution. The only working engine I am aware of is *Chaloner* at the Leighton Buzzard Narrow Gauge Railway but I understand that a new example has been built by Alan Keef and both ran at Wicksteed Park recently. They also are sometimes referred to as "Flying Tea Urns". There was, of course, *Tom Thumb* built in 1830 with musket barrels used as tubes, and *Phoenix* (1831) in America, and, also *Old Pepperass* on Mount Washington. The only other such locomotive I have a reference to is a rack locomotive on the Rigi railway in Switzerland.

My own interest is in 7¼in. gauge and I have built a model *Joanne* which runs at East Herts Miniature Railway. There have been a small number of other examples built and generally they seem to be very free steamers, but because of the small water line are quite tricky to manage.

The de Winton Company were the manufacturers of *Chaloner* and some 30 other examples which all operated in the slate quarries in North Wales. Other books published by Oakwood Press are by J. I. C. Boyd on *Narrow Gauge Railways in North Caernarvonshire*. Altogether a most fascinating subject.

G. N. Nixon, Hertfordshire.

A tale of woe

SIRS, - Needing a 12BA die to thread completely to a shoulder, I rejected the idea of grinding half a millimetre from the top face of an existing die which would have got rid of the tapered lead-in threads. I decided to be 'ever so clever' and make a die without any tapered lead-in. I parted off a piece of 1$^{3}/_{16}$in. dia. silver steel, faced off both sides and counter bored one side so that the resulting threaded portion would be about $^{3}/_{32}$in. long. In order to ensure that no flats were left on the thread, I drilled the hole smaller than the normal tapping size.

Of course, when tapping the thread, after a minute or two and some squeaks and clicks, it broke flush with the top face. However, I had cut four or five threads so not to be outdone I managed to loosen the broken tap with the aid of some Plasticine, a plastic funnel and an overnight soaking in some nitric acid. Next day, using a new tap (and much perspiration) the thread was completed. Armed with a rotary table and some slot drills, three equally spaced holes were carefully drilled so that they just encroached into the edge of the thread to form the cutting faces.

Success was now within reach, just a saw cut needed followed by heat treatment. I held the die in the vice with one of the three holes uppermost and with a new hacksaw blade started cutting. The blade quickly cut through the top edge of the disc, jumped through the drilled hole and cleanly removed every vestige of 12BA thread!

With hindsight, I should have clamped the disc in the vice with the thread below the level of the vice jaw.

Dave Bramwell, Sheffield.

3-phase motors

SIRS, - Having for some time been investigating similar problems to those recorded in James Wells' letter (*M.E.* 4308, 14 September 2007) I would like to share my own findings.

When I moved into my present house, the previous owner had left a Tom Senior *Major* milling machine in the workshop. It was fitted with a Brook 2hp 3-phase motor whereas the house and all my other equipment is single-phase.

The data plate stated that the motor absorbed 3-4amps at 380-440volts when connected in star mode and 5-9 amps at 220-250volts connected in delta mode.

After speaking to a number of specialists in such matters I consulted the two books by Jim Cox (*Workshop Practice Series Nos. 16* and *24* published by Special Interest Publications) on electric motors in the workshop. Mr. Cox states that the internal motor connections must be changed from star to delta configuration to enable the motor to run on single-phase supplies. He shows how to do this by changing the connecting strips across the six terminals. Not all motors have this feature, but my Brook motor does.

The next step is to connect a running capacitor, which must be of the dielectric type for continuous running. For 2hp motors, he advises 80 microfarads, but two of the specialists I have talked to have said that 40 microfarads could be tested out on a trial and error basis. If this is not satisfactory, others can be added in parallel steps until successful. The starting torque is high and one motor agent implied that the current required may blow fuses.

Jim Cox further advises that an additional starting capacitor will be required, but if of the electrolytic type, must be isolated manually or by time delay relay for running. However, I understand that a suitable value of the dielectric type would suffice.

Ray Ellwood, Sussex.

Superheating – a waste of time?

SIRS, - The case against superheat in models by D.A.G. Brown, *M.E.* 4307, 31 August 2007, is unconvincing to say the least and runs against the fundamental laws of thermodynamics. If *Model Engineer* is to get into thermodynamics and heat transfer then it must do so accurately.

He falls at the first fence in his assumption that dry saturated steam enters the cylinder even in the unlikely event that it left the boiler in that condition. From the boiler dryness can only drop to the point that a value of say 0.98 might be optimistic at entry to the cylinder, the effect on efficiency being dramatic.

The reasons for this drop in steam quality are the heat losses in the cylinder valve, its steam passages and the cylinder itself. The cylinder as a whole achieves an equilibrium temperature under steady running but the surfaces and a thin layer into the metal are continually being heated and cooled by the live steam and then by the exhaust with every cycle. Saturated steam is very effective in doing this thus losing condition. On the other hand, as he states later, the heat transfer properties of superheated steam are very poor being more akin to a gas and therefore loses very little.

The late Jim Ewins carried out a series of carefully control experiments in which he achieved 170deg. C. of superheat using radiant superheaters. The late Professor W. B. (Bill) Hall showed, however, that 100deg. C was all that was necessary to prevent condensation and avoid putting superheated steam wastefully up the stack. As you might imagine his experiments were meticulously performed and went further than the study of our locomotives including engines with separate inlet and exhaust valves. Efficiency was a prime reason for the experiments clearly demonstrating the advantage of superheat on efficiency, superheat being very far from a waste of time. He also demonstrated, both practically and theoretically, that cylinder filling in model scale is near perfect even at short cut-off and therefore the indicator diagrams are near ideal, totally unlike full-size prototypes.

Those who have converted to superheat from previously saturated steam are amazed at the decrease in water consumption and you only have to be behind a saturated engine to witness how much spray and hence latent heat goes up the chimney. Practically realising the thermodynamic advantage of superheat is another matter altogether and there is perhaps a long way to go. The thermodynamic design of superheaters is not a trivial matter and much experimental evidence is still required. It would be useful to know which engines in the various IMLEC competitions employ superheaters and what type they use but this information is not recorded and published which is a pity.

Don Broadley, Cheshire.

Adjustable boring bar

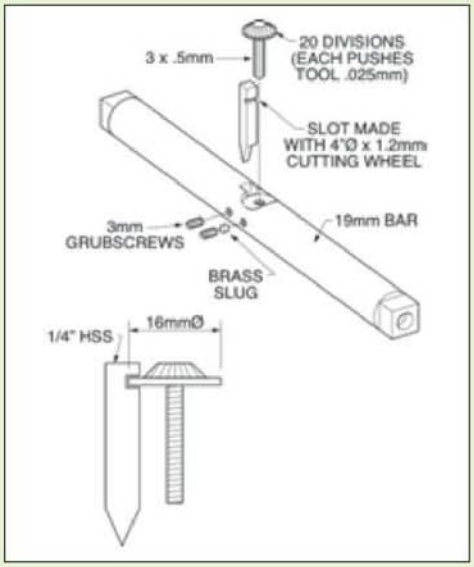
SIRS, - While making some tooling for my lathe, I came up with an idea for an adjustable between centres boring bar. I can't find one in any of my machining books, past issues of *M.E.* or *M.E.W* or even the Chronos catalogue.

Perhaps some of our readers may benefit from, or even improve on the design. I have also included a tool which fits the headstock Morse taper to drive the boring bar without the need to set up a faceplate and dog.

This tool also drives expanding reamers which I have converted into expanding mandrels by making some mild steel blades to replace the normal cutting blades.

I hope these ideas may be of some assistance to readers.

Ken Brooks, Victoria, Australia.



The adjustment mechanism for Mr. Brooks' boring bar.

The locking screws and tool tip on Mr. Brooks' boring bar.

Mr. Brooks' neat boring bar driver.

Cross head screw supplier

SIRS, - Reference the letter from Peter Spenlove-Spenlove (*M.E.* 4308, 14 September 2007) the supplier is Jaycar, not Jaycor and they have a website at www.jaycarelectronics.co.uk Catalogues are available from www.jaycarelectronics.co.uk/catalogue Yes they do ship to the UK and postage charges are quite reasonable. I've paid more to receive items posted in the UK.

Alan Jones, by e-mail.

Tungsten filament lamps

SIRS, - Your correspondent Brian Eldred (*M.E.* 4307, 31 August 2007) has no need to fear the impending demise of the standard filament lamp. The proposal to phase out tungsten filament lamps would only apply to mains voltage types. He has two alternatives. First, he can use a low voltage transformer and 24 volt lamps which are available from various electrical wholesalers (RS Components stock them, RS Stock no. 568-764). These lamps are actually safer for use in a workshop where they may be splashed with aqueous-based cutting fluids. There is no proposal to phase them out.

Secondly, he need not fear the new energy-saving fluorescent light bulbs and any stroboscopic effects. The Philips range of compact fluorescent lamps operate at 28kHz (see their application note AN99065, available for download from www.nxp.com/acrobat_download/applicationnotes/*AN99065*_1.pdf), and since the operating frequency is much higher than their persistence time, there is no flicker or stroboscopic effect. I use them in my workshop. Hopefully Brian will now rest assured that the new energy saving fluorescent light bulbs do not present a stroboscopic hazard at all in the workshop.

Graham Astbury, Cheshire.

Report from the Model Engineer Exhibition by **David Carpenter**
Photographs by **Neil Read**


1

THE ENGINEERING MO


2

This year saw an extraordinarily high standard of entries in classes A1 and A2 at Ascot in September. There were 14 entries and no less than half of them were awarded Gold Medals.

Beyond doubt, the Gold Medal winner that was universally admired was that won by Ron Jarvis for his Michell's Whim of 1889. This was Ron's eighth's Gold.

Visitors were treated to much more, as Ron brought his entire collection of models to Ascot. These are mainly steam models from the earliest days, from the early 18th Century to the early 19th. We will feature these in a future issue.

Meanwhile, his new model, Michell's Whim, or Cornish mine winding engine, can be seen in **photo 1**.

Bodmers Sliding Cylinder Engine is an unusual design of steam engine in which the cylinder moves and the piston stays still. Not a practical idea in full-size, but fascinating to modellers, including regular *M.E.* contributor, Anthony Mount, who described his model of the engine in 2000.

The Patents show the main use of the engine was meant to be (it's not certain that any were actually built) a marine paddle engine, although the Patents also mention land-based use. It was Anthony's interpretation of the latter, which he described.

This type of piston and cylinder arrangement makes for an unusual valve arrangement. Steam enters the engine at crankshaft level, and passes down a central column to a piston valve. As the valve moves upwards it opens an upper port and steam enters the cylinder and raises it. Meanwhile, another port opens allowing steam to escape to the lower part of the central column to move the cylinder downwards. Another port then opens and to allow exhaust from the upper part of the cylinder into the lower end of the central column. The valve is actuated by an eccentric on the crankshaft.

The Gold Medal-winning

model on show at Ascot was built by P. Law. It was finished to a high standard as can be seen in **photo 2**.

Subject to continuous visitor interest throughout the exhibition was the 1:76 scale Ruston-Bucyrus dragline constructed by R. Turner in **photo 3**. This superb model was not just shown, it was in operation throughout the exhibition moving its scale rocks.

This model was judged an excellent piece of work containing a mix of mechanical components and electronic control equipment. The control seat is fully operational in full-size. Judges awarded a Gold Medal.

A much smaller model, but very fine, was the 1/4in. scale side lever paddle engine of 1850 by J. Dobbing. This model is exquisite and won the Tom Nevins

DELS - Classes A1 and A2

Memorial Trophy as well as a Gold Medal. Plenty of 14 BA threads, and some amazing pipework are testament to the craftsmanship of the builder, This engine runs in forward and reverse and is pictured in **photo 4.**

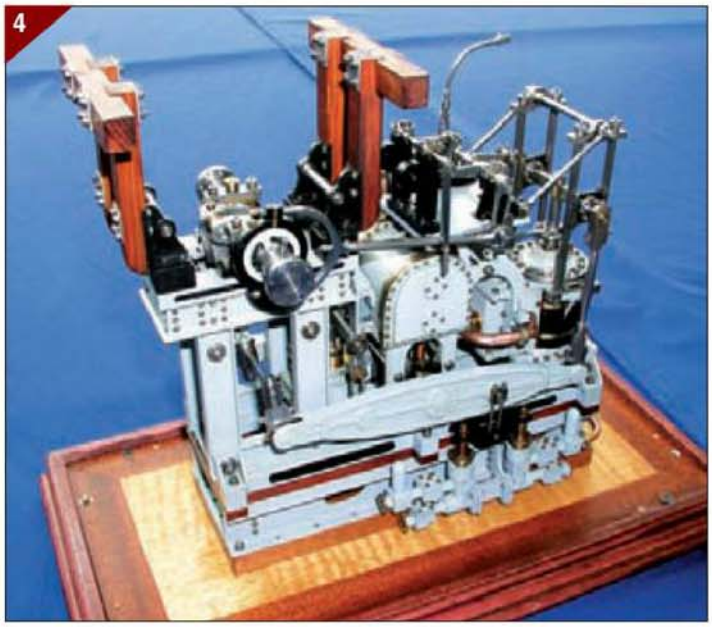
P. L. Waines exhibited a 1/12 scale Stothert & Pitt beam engine dating from 1886, and displayed at the Paris International Exhibition of 1889, (**photo 5**). The original still exists and can be found at Bath University.

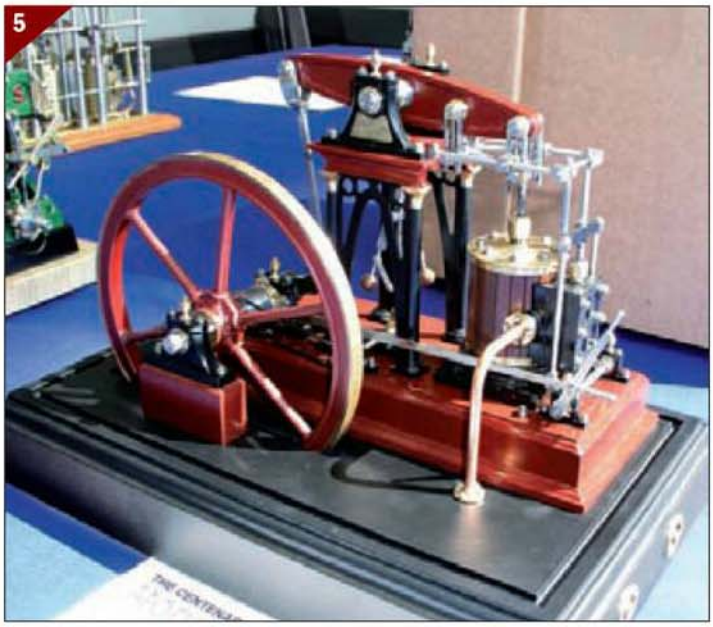
The engine is set on a massive cast iron base with the beam supported by an entablature set on four columns with decorative bronze capitals. Fretted arches add to the pleasing design. A Watt governor is located between the columns.

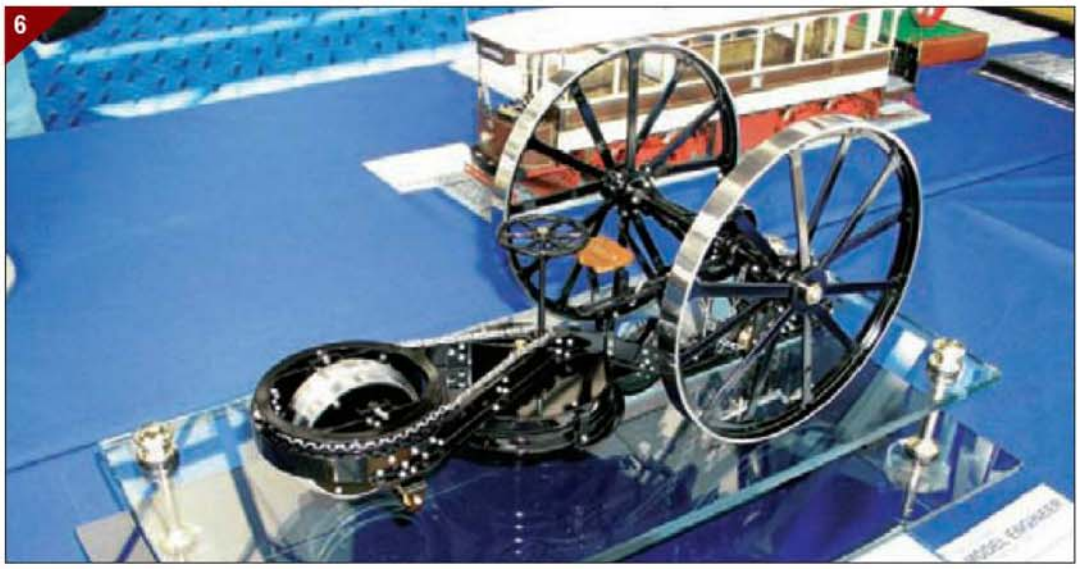
This engine is machined from a set of castings and some pre-formed materials available commercially, but the quality of the work by the builder was enough to secure a Gold Medal.

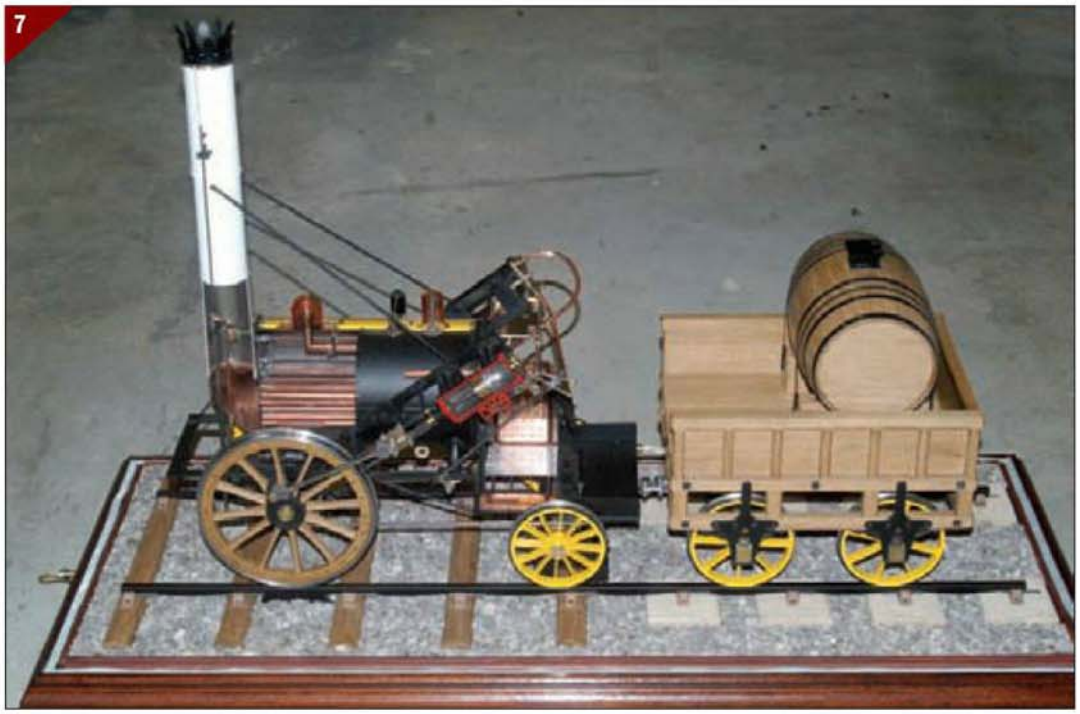
The Fowler Mole Drainer by R. Thurston (**photo 6**) was a real head turner, a fine model, beautifully displayed. This is an unusual model, although mole drainers are still in use today, especially on heavy soil. What they do is create an underground 'pipe' or tube by dragging a cutting foot (mole) through the earth. The resulting tube allows water to drain.

The mole drainer was invented by Adam Scott in 1829. John Fowler took up the idea in 1849 while working in Ireland on draining boggy land. Fowler won awards at the Great Exhibition of 1850 for the system. >>









The mole drainer was used with a pair of ploughing engines at opposite ends of a field across which the drain was to be bored. One ploughing engine dragged the mole one way to cut the drain and the second engine was used to return it.

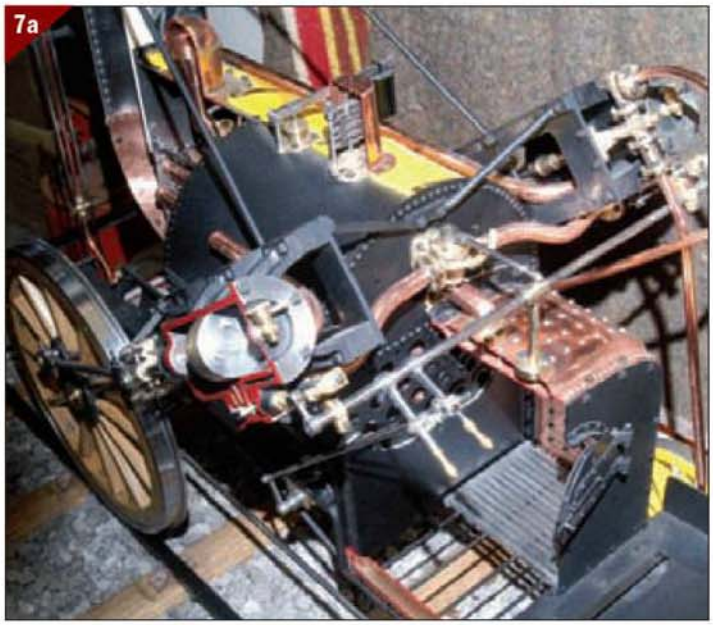
The earth was cut first in the top surface by a revolving coulter wheel, which traversed ahead of the bullet or mole. The mole was 4in. dia. with a slightly larger trailing diameter to consolidate the walls of the drain. Drain depth could be up to three feet, and the drains produced could last for up to 10 years.

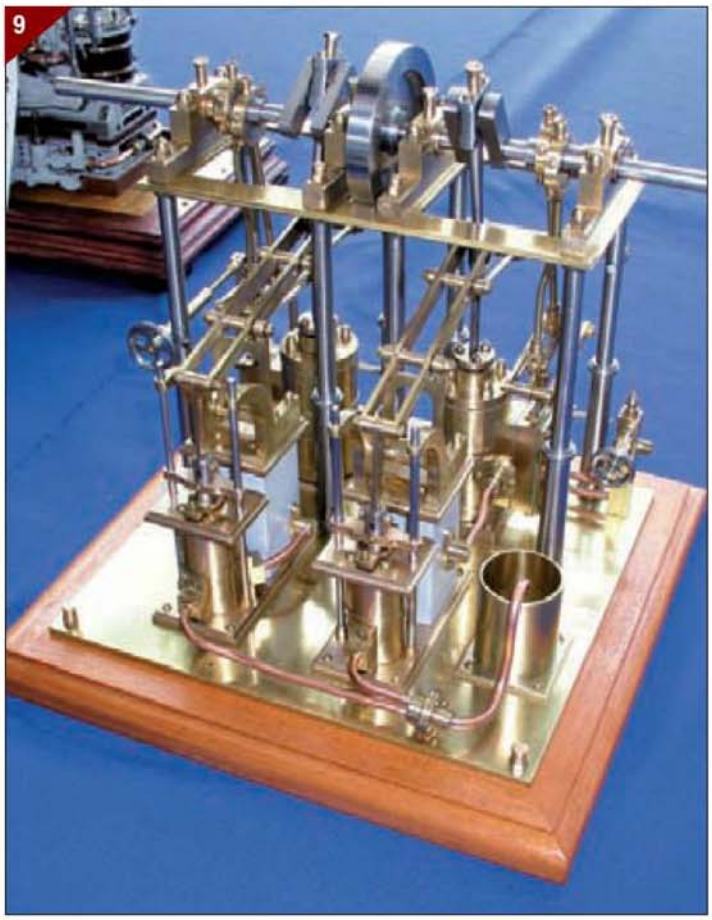
Rear wheels were 7ft. dia. The drainer was operated by a steersman, who sat on the drainer as it was dragged across the field.

The model is almost entirely scratch built. As can be seen from our photo it is also very nicely finished in cellulose paint. It was awarded the Bill Hughes Cup as well as a Gold Medal.

Our final Gold Medal winner in this section was the *Rocket* built by P. Hamm. This is a finely detailed model of a well-known subject. It is a half-section model, see **photos 7** and **7a**, an interesting change from the usual live steamers. A fine piece of work in ⅛ scale.

A most unusual steam engine model by P. Boscott is shown in **photo 8**. This was constructed to find out how a flexible rotary

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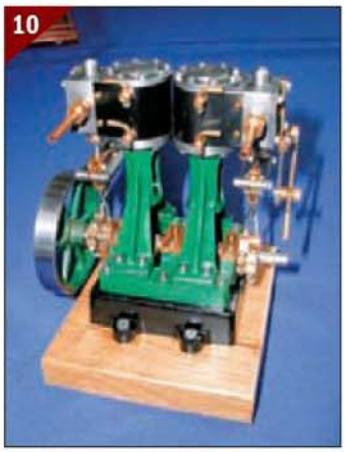
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13

to liner drive works, the subject of a US Patent.

As a result he has figured it out and is building a 3½in. dia. bore self-starting machine, with reverse, to be operated via a radio controlled servo. The result should fit well in a steam power boat.

As a piece of working kit, this was not finished to exhibition standard. Indeed unlike most on display visitors were encouraged to touch and to rotate the flywheel to observe the motion. The designer was Highly Commended for his work.

The Gorgon steam ship engine will be familiar to *M.E.* readers, as it featured in these pages just last year, designed by Guenther Kallies. The Gorgon is an elegant design going back to the very earliest days of steam power for ships. Indeed it powered the very first steam vessel for the Royal Navy, *HMS Gorgon*.

The model is a somewhat simplified version of the full-sized original to help either with manufacturing or for safety reasons. It is made entirely from bar material – no castings are used. It is also designed to be made in a modest workshop with a small lathe, drilling machine and hand tools.

Shown in **photo 9**, it will be seen that this is a most attractive model which was awarded a Silver Medal for B. Gasson.

The Stuart Model D10 is one of the enduring models popular with steam engine and boat modellers. This one was made by P. Boscott from a Stuart kit. The good finish, seen in **photo 10**, plus extra reversing gear and nicely made small fittings earned it a Bronze Medal.

An unusual but attractive model was the 5in. gauge smoke box front for a C38 NSWGR locomotive. Some very good detailing earned B. Glover a Bronze Medal, see **photo 11**.

Even more unusual was the 1/10 scale semi-public spiral stair by M. Constantine (**photo 12**. Architectural models have always graced the Model Engineer Exhibition, though have been few a far between in recent times. It was good to see this excellent piece of work drawing many admiring glances and it was awarded a Bronze Medal.

The steam engine launch by G. Mahoney has the purposeful look of an engine that has been built to be seriously used. A prodigious amount of work had gone into this engine, and the finish is for a working engine. Shown in **photo 13**, it won a Bronze Medal.

Photo 14 shows a 1/10 scale Rider Ericcson hot air engine made by B. Marshall, and awarded a Very Highly Commended Certificate. This is a neat working model of a popular prototype, always good to see at the Model Engineer Exhibition.

All in all 2007 produced a diverse range of models with plenty of interest, and some excellent craftsmanship. **M.E.**


14

SUPER SEQLEC 2007

Michael Jones reports that seasoned campaigner, John Painter, took the honours again at Sutton Coldfield.

The Seven and a Quarter Locomotive Efficiency Competition was organised this year by the **Sutton Coldfield Model Engineering Society**. Five entrants from around the UK took part during a most enjoyable day's steaming.

As usual for this type of event, all contestants pulled a dynamometer car equipped with various recording devices. It was also equipped with an electric water pump providing extra water for the locomotives during the run. Every train included a brake car.

Drivers could choose the number of riding cars and passengers for their run and, following an initial familiarisation lap, the train returned to the station where the fire was made up sufficiently so that full pressure was showing on the steam gauge. The level of the coal in the firebox was checked with a gauge and the driver issued with measured coal supplies for the run.

On completion of each run, the fire was built back up to a the initial level, checked, and the remaining coal removed and weighed.

The dynamometer car recorded the other competition data such as the distance run, drawbar horse-power developed, and other measures as shown in the table.

Run No.	Driver	Locomotive	Run Duration (min:sec)	Distance (ft)	Coal Used (lbs)
1	James Duncan	GWR 2-8-0T 42xx	29:47	19,624	5.250
2	John Painter	GWR 0-4-2T 14xx	30:00	21,693	2.938
3	Peter Goodman	GWR 2-8-0 38xx	32:26	21,747	7.125
4	Dennis Mulford	Baldwin 2-4-2T L&B 'Lynn'	31:46	16,454	6.125
5	George Finnemore	0-4-0T *Romulus*	30:10	18,572	5.625

Note: Coal used had a specific calorific value of 14,000 BTU/lb.

1. James Duncan.
2. John Painter.

James Duncan

First on the track was a mechanical engineering apprentice, James Duncan, a member of the **Bristol Society of Model and Experimental Engineers** (BSMEE), with a GWR 2-8-0T 42XX class locomotive (**photo 1**). In two previous SEQLECs, he competed with a 'Pug' 0-4-0, but this year he drove a much larger locomotive owned by Anthony Newberry.

James chose to pull six carriages and 14 adults. He started off well and had an uneventful run which ended 31 minutes later.

On return to the start, a technical fault was discovered with the dynamometer car and the performance readings for his run were not available. The judges decided he would be given another chance and in short order he set off on another timed run with the same load.

His second try was as evenly run as his first, unrecorded one, although there was some blowing off of the safety valves which was not the case during his first run. James achieved a 1.11% thermal efficiency, a fine effort of concentration for an hour's worth of running.

John Painter

Next in the competition was the GWR 0-4-2T 14xx class *Dart* driven by John Painter (**photo 2**). He is also a BSMEE member and stalwart supporter of SEQLEC having competed in every event since it began. He has been a winner twice and runner-up several times.

The 0-4-2T locomotive looked positively diminutive compared to the load that was initially attempted. After several attempts including backing up to get a better run out of the station, the locomotive was unable to start this load and a successful start was made with a reduced load of ten carriages and three passengers. As he explained after the event, his strategy was to have a long train in case there were not enough passengers available.

The start wasn't fast, but once on the mainline, the engine moved along very well, somewhat to the surprise of the spectators. At one point in the run, the train was timed going 9.2mph and the locomotive was consuming about 2 pints (1.13 litres) of water per lap.

He made the best of the downhill sections of the track >>

Work Done (ft.lbs)	Thermal Efficiency (%)		Average DB Pull (lbs)	Average DBHP (hp)	Coal Consumption Rate (lb/hr)	Specific Coal Consumption (lb/dbhp/hr)	Final Position
632,076	1.11 %	7.49	32.21	0.643	10.576	16.446	2
578,521	1.81 %	8.22	26.67	0.584	5.876	10.055	1
743,704	0.96 %	7.62	34.20	0.695	13.181	18.969	3
631,515	0.95 %	5.89	38.38	0.602	11.569	19.204	4
567,682	0.93 %	7.00	30.57	0.570	11.188	19.619	5

and showed skill coaxing the load up the hill towards the high point of the track. His run ended after 30 minutes and, as for all the competitors, the spectators warmly welcomed him into the station on his return. He achieved a 1.81% thermal efficiency.

Peter Goodman

A GWR 2-8-0 38XX tender locomotive was next in the competition. The engine, owned by Anthony Newberry, was built in 7 ¼in. gauge from the scaled up 5in. gauge design of Martin Evans for *Swindon*.

Peter Goodman, the driver, is a long time member of the Bristol Society of Model and Experimental Engineers (**photo 3**). He works as an engine designer for Rolls-Royce and somehow finds time to work on full-size locomotives and has a 5in. gauge locomotive under construction.

After Peter's test lap he proceeded into the competition with 12 adults on the train. Shortly into his run, after experiencing some slowing on the hill, he reduced the passengers by two, continuing on with 10. Thereafter his run was swift with only a little slowing at the top of the hill.

Overall, Peter's run was steady and fast and he managed to maintain good boiler pressure without the safety valves blowing off. He achieved a thermal efficiency of 0.96%.

Denis Mulford

Now, it was the turn of the narrow gauge locomotives. First up was Denis Mulford, chairman of the **City of Oxford S.M.E.** (**photo 4**). He ran a Lynton and Barnstable 2-4-2 Baldwin, 'Lynn' design, aptly named *Per Ardua*. This started as a Winson's kit. However, when the company folded, he was left with a partially completed locomotive, no drawings and only 14 of the 18 promised kits in hand. Most of the parts for the locomotive were made, or re-made, without drawings and the engine first ran in April 2006.

A load of 12 passengers on 10 coaches set off the competition run. On the second lap the engine nearly came to a stand-still at the top of the track, but he was able to recover.

There was a bit of slipping going up the hill on the track and occasionally some blowing off of the safety valves, but he successfully completed a good, steady run of 31 minutes and 46 seconds. His overall thermal efficiency was 0.95%.

George Finnemore

Fifth contestant was George Finnemore from the **Leicester Society of Model Engineers** (**photo 5**). He was driving his 0-4-0 narrow gauge 'Romulus' design which was built as one of a pair to the drawings of Roger Marsh, and completed in 1989. It now has over 2,000 miles on the clock. George describes himself as an "elderly person just having fun."

He had a good, steady run with nine passengers and six coaches. There was some blowing off during his run. His whistle signals added to the ambiance of the event.

4


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At the end of his run he added 3.51 miles to his locomotive's odometer and achieved a thermal efficiency of 0.93%.

Results

John Painter was this year's winner of the Seven and a Quarter Locomotive Efficiency Competition. The runner-up was James Duncan.

On behalf of *Model Engineer*, Neil Read, Technical Editor, presented the Bristol Trophy to the winner . The first three places, John Painter, James Duncan and Peter Goodman were presented replica cups of the Bristol Trophy courtesy of their Sutton Coldfield MES hosts (**photo 6**).

The editors of *Model Engineer* extend their congratulations to all who participated and look forward to next year's event. **M.E.**

3. Peter Goodman.

4. Denis Mulford.

5. George Finnemore.

6. The SEQLEC 2007 top three finishers, left to right, Peter Goodman, John Painter, and James Duncan.

ISSUE NEXT ISSUE NEXT ISSUE NEXT ISSUE NEXT IS
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- Model Engineer Exhibition report
  - I/C engines
  - Traction engines
  - Workshop tooling
  - Clocks
- Peter Rich - Sandwich frame 4-4-0 locomotive
- Turbinia by Ron Isted
- Hacksaw review
- Dividing head
- Ayesha II
- I/C Topics

Plus all your regular favourites

Contents subject to change

ON SALE 23 NOVEMBER 2007

PETE'S PAGE

MORE ADVICE ON TINSNIPS

Peter Spenlove-Spenlove re-visits the subject of tinsnips with more advice on their use and selection.

Readers who look up my previous article on tinsnips (page 97 in *M.E.* 4304, 20 July 2007) will see a standard example of the type. These are often the only ones available in the small workshop. However, just as there are left-handed scissors so there are tinsnips especially made for left-handed users. Furthermore, curved tinsnips are available for cutting concave curves in sheet metal (**photo 1**).

Duck billed

The ordinary curved tinsnips have today been largely replaced by a revised pattern termed 'duck billed' (**photos 2** and **3**). The blades are straight but the design allows one to cut convex and concave curves in thicker metals. For small light work a pair of the old curved tinsnips of approximately 6in. length will still be useful.

Mine are a right-hand pair but, although I am right-handed, I sometimes wish I had a left-handed pair. This is because it is often convenient to snip a concave curve from both of its ends with the two cuts meeting up in the middle.

I also own right and left-handed duck billed snips. They were useful to me when I worked on racing car body panels cut from 16swg magnesium and aluminium alloys. However, it was most important that the edges were sharp and the pivot pin kept free from 'slop'. Not so tight that the tools were uncomfortable to use but free from play.

Most of the body panel department personnel I worked with had their own tinsnips. Usually these were 12in. long and of both the standard and duck billed pattern. They were carefully maintained and one did not use someone else's snips!

Testing

If you are choosing a pair of tinsnips, and the shop allows it, test a few different types and sizes to see which suit you best. Take along a piece of cereal packet marked out with some curves (produced by drawing round a cup and a plate). Try the standard type and the duck billed variety in both left and right-hand forms. The usual advice applies - buy good quality items and do not use them to cut spring steel or hard music wire. The latter may indent the cutting edges ruining them for the work for which they are designed. **M.E.**

1. Traditional curved tinsnips, which are available in left and right-handed versions from 6 to 12in. long. Sometimes difficult to find, consider good used items.

2. Duck billed tinsnips of an American pattern. The double lever action gives a powerful cut. The spring loaded handles have a latch to keep the snips closed in the tool box.

3. A modern style of duck billed tinsnips in both left and right-handed forms.

Model Engineer Exhibition PHOTO COMPETITION 2007

Malcolm Stride guides us through the top 10 entries from this very first competition.

The Model Engineer Photography Competition attracted 34 entries covering a wide range of subjects related to model engineering. For various reasons, it was not possible to display the entries at the exhibition as planned but the judging did take place and we are reproducing the top 10 entries here. Judging was carried out by selecting a short list of 10 and then each judge ranking that list according to their preferences and then combining the totals to give the final positions.

As you can imagine, the judging was quite difficult because of the wide variety of subjects and the judges had to try to keep their personal preferences for a particular subject out of the process. For the judging, I printed out the top 10 at identical A4 size on good quality photo paper to provide a 'level playing field'.

The top three places in particular were very evenly matched, with only one point between them.

The quality of the entries was good, although a couple of very good photographs were more 'people' shots than engineering subjects and one entrant sent in prints on ordinary paper which rather let the photographs down.

The worthy winner was Chris Perkins (**photo 1**) from Weston-Super-Mare with his superb photograph of Welshpool & Llanfair Light Railway No. 823 *Countess* heading the 2ft. 6in. gauge vintage train away from the Llanfair Caereinion Terminus heading for Welshpool.

The photograph was taken using a Canon 20D DSLR Camera with a Sigma 24-70 *f*2.8 Lens.

I thought this was a very atmospheric photograph of a very representative model engineering subject.

Second place went to Tony Wiese (**photo 2**) from Yorkshire for the photograph of his own 2in. scale Scammell Scarab and trailer photographed above Scammonden Water, near Huddersfield using his Leica >>

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Digilux 1 camera. The choice of location for this photograph showed some imagination.

Third place was awarded to Craig Heeley (**photo 3**) also from Yorkshire of John Heeley's 1:4 scale de Havilland *Goblin* 35 Centrifugal-flow Turbo Jet photographed using an Olympus C-700 Ultra Zoom.

Fourth place went to Sue Cookson (**photo 4**) from East Sussex with her photograph taken at the Great Dorset Steam Fair, showing two traction engines from New Zealand hauling a locomotive boiler. The boiler belonged to GWR 0-6-2T No. 6695.

Fifth in the pecking order was Chris Berry (**photo 5**) from Leicestershire with his photograph from the Leicester Society of Model Engineers Open Day in June 2007. This fine study of a typical model engineering activity (chatting!) was taken with a Canon PowerShot G5 at 1/50sec at an aperture of *f*3.5.

The next placing (sixth) was a subject that readers will know, Stephen Atkinson's 1:8 scale MG TC car (**photo 6**) photographed in his home workshop in Belfast, using a Casio Exilim digital camera (5.0 mega pixels, 3 X optical zoom).

Seventh place went to Chris Gooch (**photo 7**) from Amersham for his imaginative "Little to Large" photograph of a group of three traction engines taken at Woodcote Steam Rally in Oxfordshire. The engines are, from right to left, a 3in. scale Fowler A7 Traction Engine, a 3 Ton Tasker Tractor The Horses Friend and the Burrell Showman's engine Britannia. The photograph was taken with a Sony Cyber-shot DSC-W100 camera.

Also in joint seventh place was the photograph by Mr. P. A. Clist from Ayrshire (**photo 8**) of Ingvar Dahlberg's well-known Mercer T35 Raceabout taken at Harrogate Model Engineering Exhibition. The camera was an Olympus C-765 4 mega pixel used on the 'Auto' setting.

Ninth was another joint placing with Kent based Barry Gasson's (**photo 9**) photograph of his 3in. scale model of

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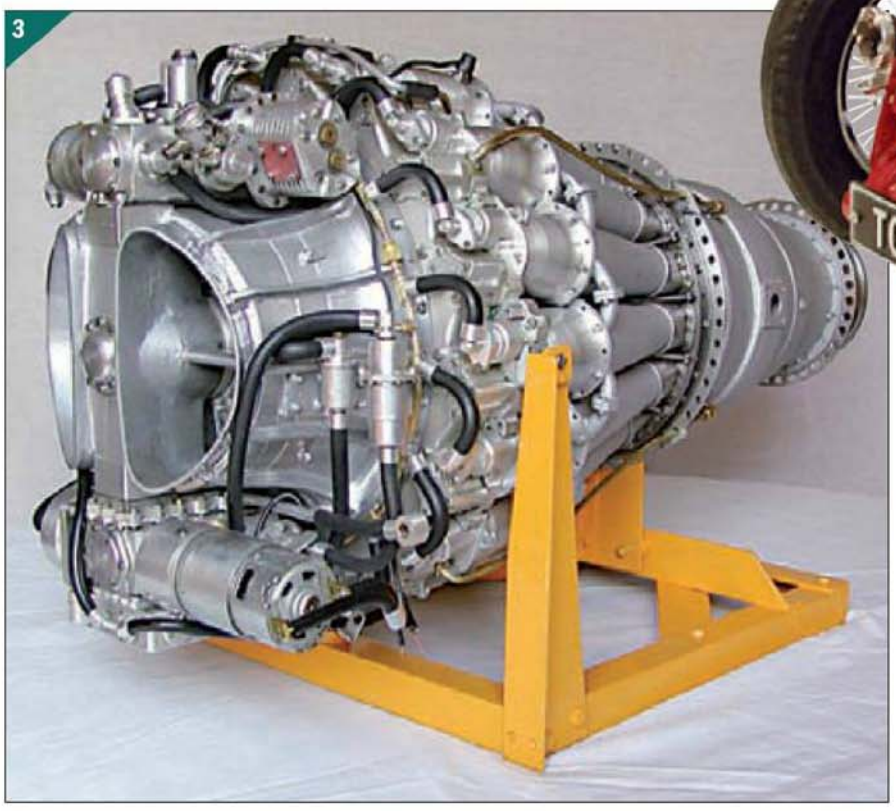

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a Fowler 7NP road going compound traction engine. The photograph of the just completed model was taken with a Premier FS-5080 single fixed lens 5 mega pixel camera, which was mounted on a tripod.

Joint ninth was Raymond Calleja's photograph of his attractive Combers Rotary Engine (**photo 10**). Raymond is based in Malta and used a Ricoh 6 mega pixel camera for his shot.

The winners will be receiving their awards shortly and I would like to thank all those who entered the competition. We do not have the space to publish all the entries but I hope we will be able to run the competition again next year (Editor willing) so get out and take those photographs. In the mean time, if you have any interesting photographs, remember that we are always pleased to receive good quality (minimum 2 mega pixel) images for publication. **M.E.**

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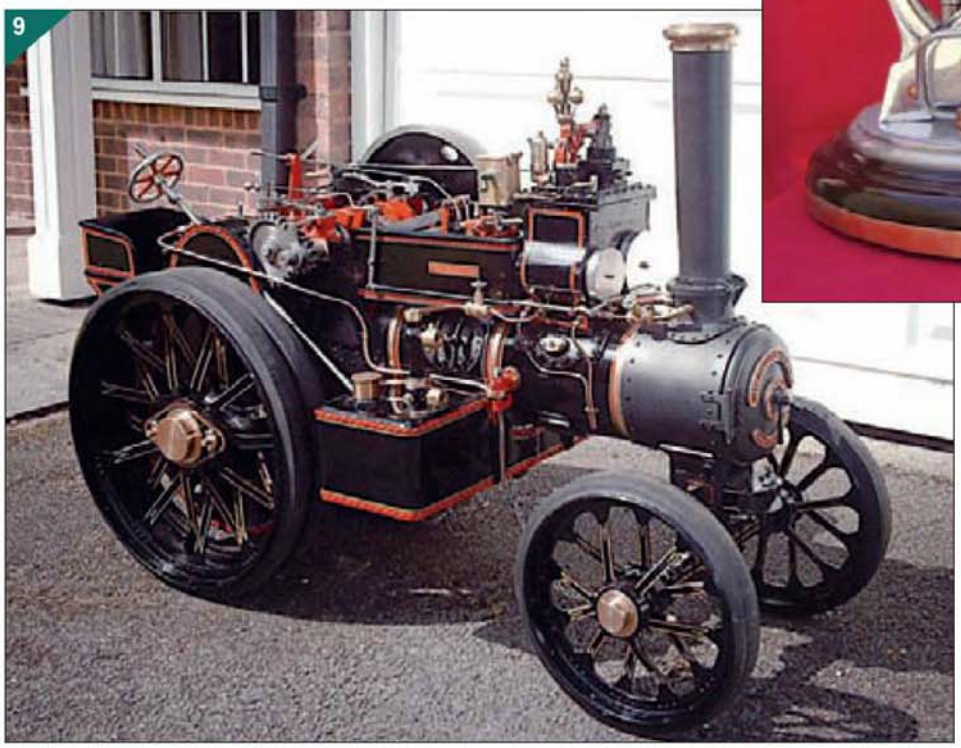
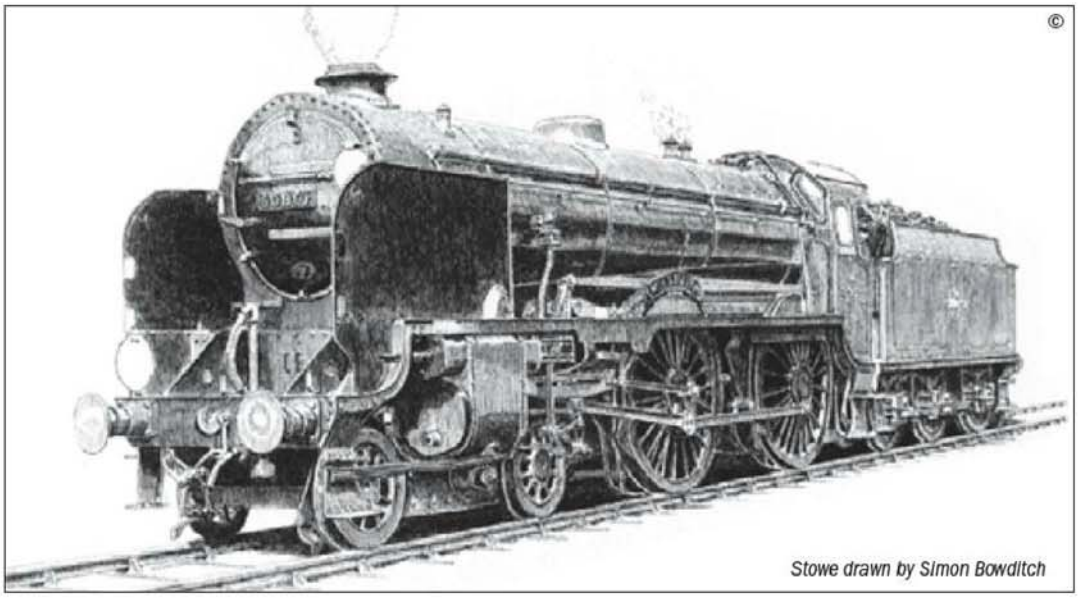


STOWE - Southern Railway Schools class locomotive

PART 16

Continued from page 448 (M.E. 4310, 12 October 2007)

Neville Evans continues the description of the boiler for this detailed model before providing additional information for builders of his Highland Railway locomotive.



Stowe drawn by Simon Bowditch

One point that I feel should be emphasised concerns the seam at the bottom of the barrel, which I have drawn as a butt joint with an external strap. The only real alternative is a castellated joint, which has the advantage that, in the event of a split in the seam, the resultant disruption is progressive, rather than the disruptive split that would occur were it to take place the length of the barrel. It goes off with a hiss rather than a bang. In other words, as the boiler seam is staggered along the length of the barrel, the longest split that can occur is only the length of one castellation.

Whether or not the advantage is real, or the sort of thing the health and safety people come up with, is extremely debatable. While we are discussing joints in boiler shells, I feel that I must point out an oversight on my part, which arises from the possible non-availability of 6in. seamless tubes. If you have to roll up the barrel from flat plate, there is no point in thinking about using a single strap above the frame as I have drawn it. In this case you will have to use two straps, inside the firebox. Which is a pity.

A small point

Another small point that is worth bringing up is that of the inclination of the boiler tubes. The prime reason for this is that it enables the firebox crown to be set a little lower. It also makes the tubes a little easier to clean as they are a bit higher in the smokebox. While on the subject of tubes, I have spaced them, as usual, in a rather higgledy piggledy formation, (what in the RAF we called a 'loose gaggle') because one of the most important features of tube distribution lies in the spacing thereof; all the tubes are therefore at least $^{1}/_{8}$in. apart, allowing free circulation of water between them, just be certain that all the bottom tubes lie above the 2.555in. radius mark, which is set from the centre of the middle superheater flue. The free gas area through the tube bank and flues is over 15% of the grate area so our little piece of Eastleigh should perform in the approved manner. Another equally important point is that the tube plates will be stronger and firmer with the holes a bit further apart and won't look like a piece of lace.

The thermodynamic layout is of course vitally important to the well being of the locomotive, as it is designed to be a very effective and efficient engine. Simon Bowditch has run the whole system through his 'confuser', using a programme sent to us by Tom Jones (no, the other one!) who was a friend of Bill Hall. The whole thrust of Bill's argument was that the most important thing is to try to deliver really hot steam to the cylinders in order to eliminate condensation as much as possible. The steam circuit therefore includes a double bend in the superheater element, on top of the fire so as to get in as much radiant heat as we can. The pipe may seem to be on the small side at $^{5}/_{16}$in. outside diameter, but I'm certain that it will deliver as much steam as the cylinders can use, or the boiler can make. I would have liked to have placed all the superheater flues on

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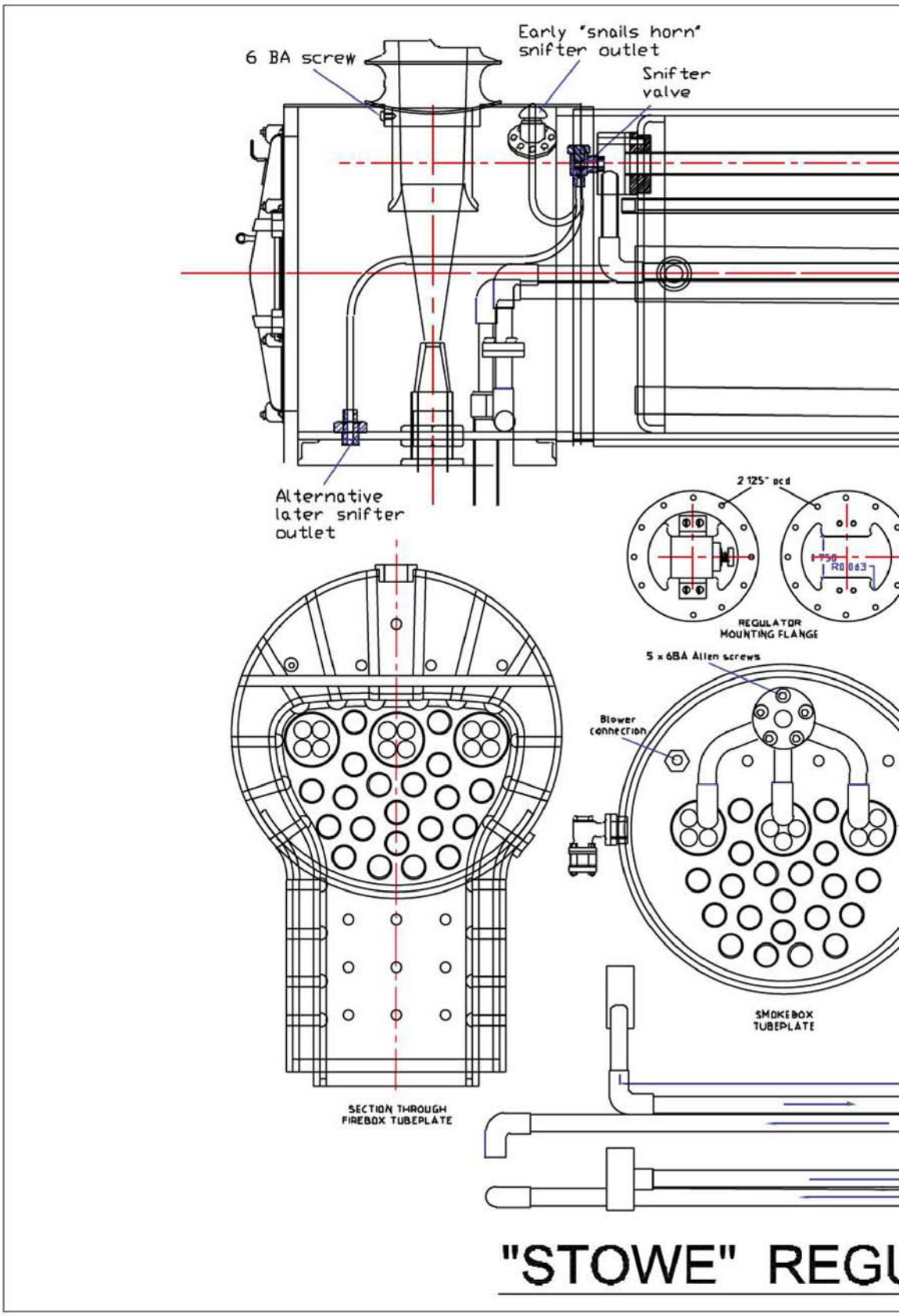
the outside of the firebox so as to ease the task of tube cleaning, this is of course impossible as we have to have three flues one for each of the three elements. The whole assembly can be withdrawn for inspection however, complete with regulator, by removing the lower part of the petticoat pipe, to allow the wet header to slide past it, undoing the five screws in the header and breaking the three steam pipe joints. Removing the superheater flues allows us to withdraw the steam pipe, which plugs into the regulator and is sealed with an O-ring. The regulator fits inside the inner steam dome in a readily accessible position, and the all-important flat faces on the regulator body and slide, are accessible for inspection and re-lapping if necessary.

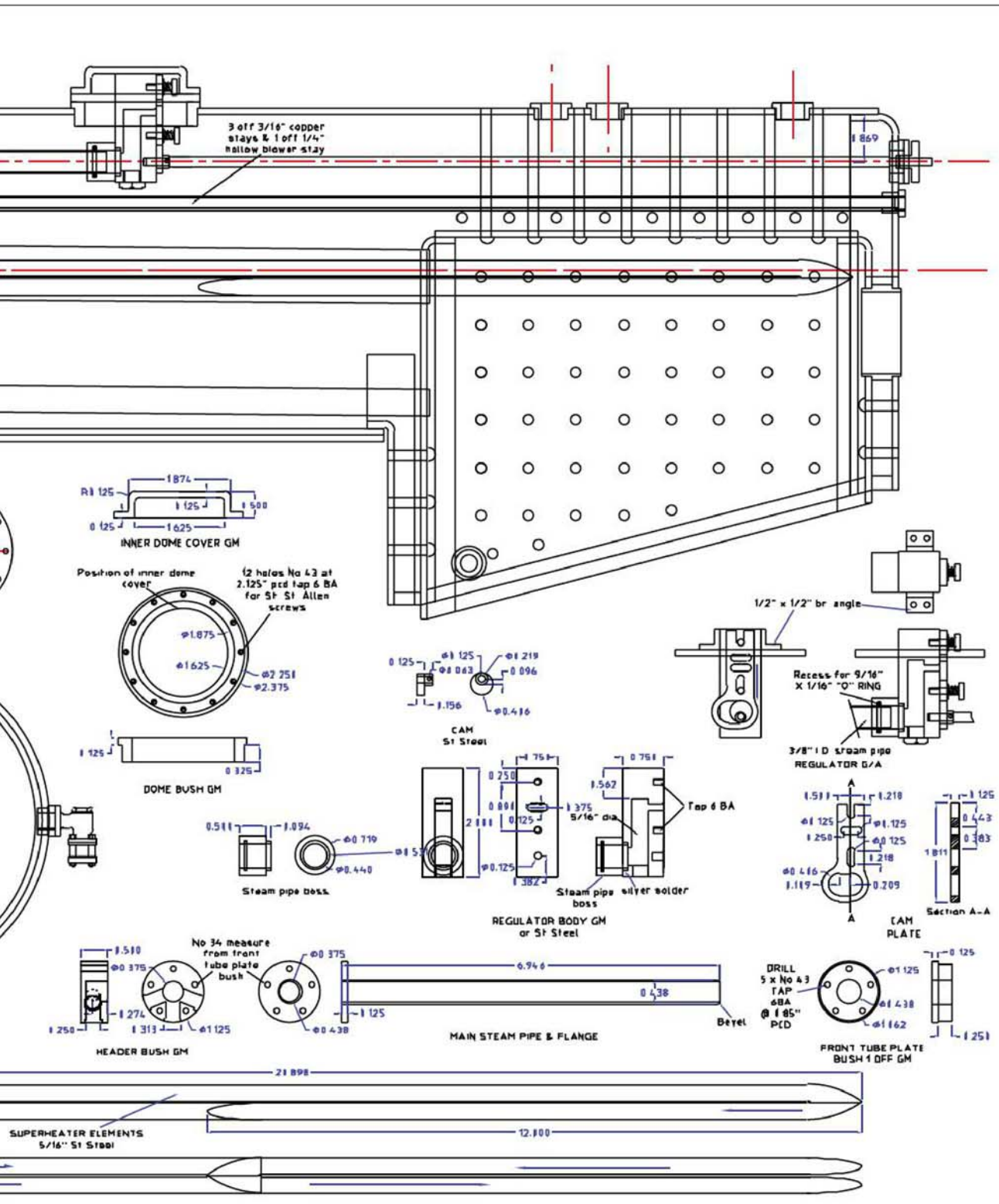
The safety valves have been designed by Gordon Smith. Personally I wouldn't dream of using a safety valve that hadn't, at the very least, passed through his hands for inspection. A pal of mine a short while ago had a problem with his *Hielan' Lassie*, in that the two safety valves couldn't cope with the requirement of the standard boiler test of not exceeding 10% over blow off pressure, with the regulator shut and a big fire in the grate. I passed his troubles on to Gordon, who was able to supply valves that were I believe smaller than the previous ones and yet one valve kept the pressure within limits, where two of the previous design had failed.



Lapping

I feel that I must dwell on the all-important subject of lapping, possibly to the point of boredom. As I have said a few times in the past, the steam tightness of the regulator slide valve depends upon the care with which the slide is lapped to the port face. I have relieved mine about 0.010in. with a smooth file, in places where a seal is not necessary (or even desirable) in order to facilitate movement of the handle and to make it easier to lap in. Remember, the smaller the face that has to be lapped, the easier it is to achieve a good seal. Don't overdo this relieving bit, or the obvious will happen, the engine will have a will of its own, and 'go walkies' by itself, due to steam leakage.

There are on the market nowadays diamond faced steel laps, usually with magnetic handles. These laps are obtainable in three grades of abrasive, and the finest of these will give an almost perfect surface for the final lapping. The last operation is performed with lapping paste against a purpose made lap. Don't whatever you do try to lap them one against the other. A suitable lap can be made from a piece of aluminium alloy. Mine is about 4 x 4 x 2in. which I faced across in the lathe. An important feature is



ULATOR & STEAM CIRCUIT

that circular grooves 0.015in. or so deep and of the same width, were turned in the face of the lapping plate, at 1/4in. intervals, so as to hold a greater quantity of lapping paste. The face was re-turned smooth with a very light cut, and charged by rubbing paste into it with a piece of newspaper. I know that lathes are not supposed to face off perfectly accurately, all I can say is that it works for me. Over the years I've re-turned the lap lightly, in the 4-jaw chuck, and tested it against my posh, as opposed to my rough, surface plate with satisfactory results. An important point is to get some proper lapping paste. This commodity is available in any engineer's merchants. If you haven't got one near you, (*Yellow Pages*), then your friendly neighbourhood hardware store will be pleased to obtain it for you. Buy a tin and share it with your friends. Practise a bit of lapping, by trying the effect of smooth up and down strokes, followed by a figure of eight movement. When you >>

are reasonably happy with your efforts, try the piece on your surface plate. Spread a thin film of engineers blue on the plate, and rub the job up and down on it. If you get a perfect blue covering first time, it means that you've used too much of the blue, so clean it off with a touch of white spirit and start again. If you can't get engineer's blue, then a blue or black marker pen will probably do just as well. The test of any lapped surface, is that you should be able to wring the surfaces together, without oil, and they should then stick together, held by vacuum pressure alone. If they aren't too heavy.

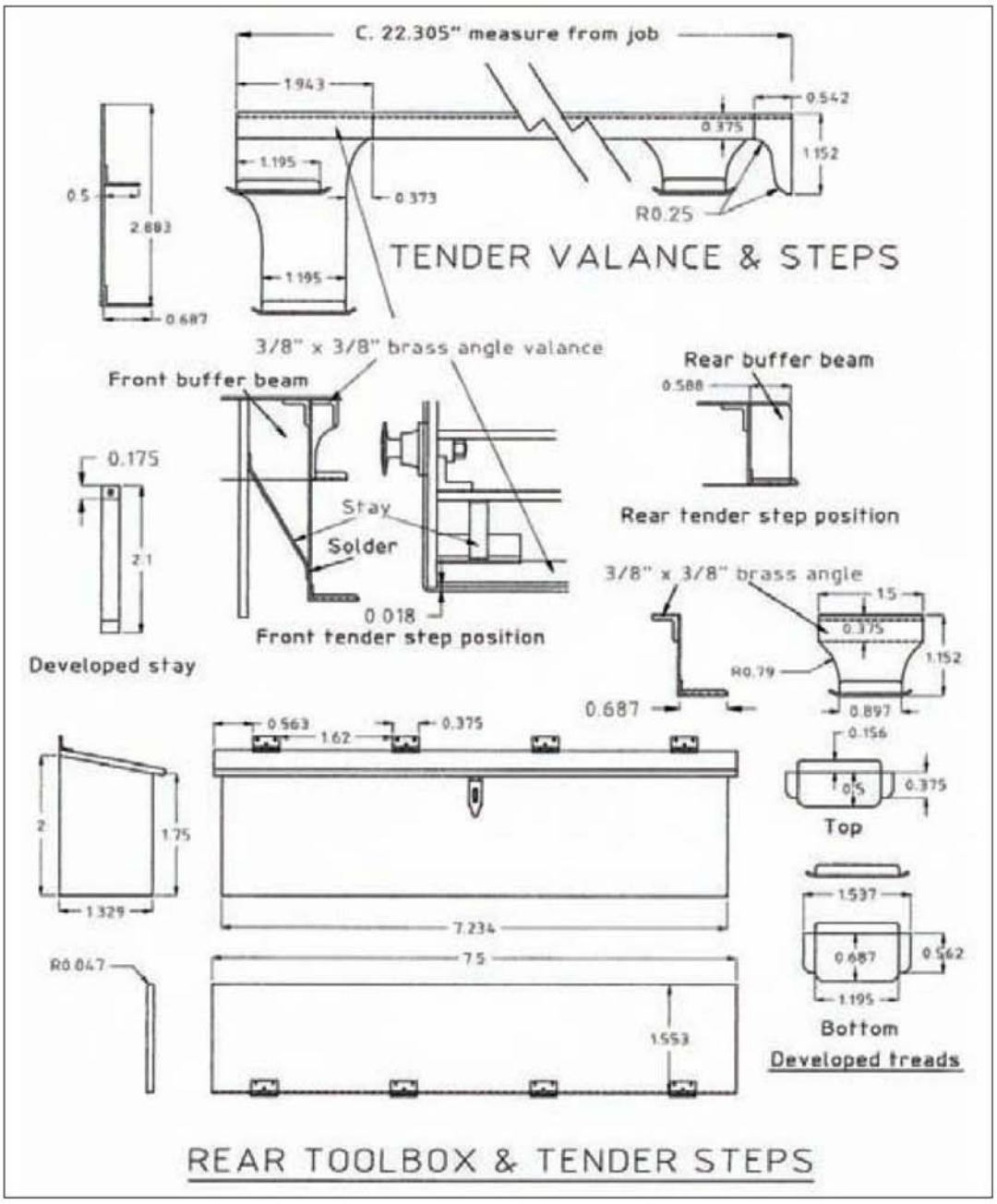
To facilitate the lapping process and to aid construction generally, I've made the regulator body from $^{3}/_{4}$in. square bar. Favourite would be a lump of gunmetal, though I must admit that I found a piece of lovely, free turning stainless steel in the scrap box and decided to use that, together with a stainless cam plate. If you decide to use brass you'll get a lot of wear on the part where the regulator shaft enters the body. A solution might be to bush the hole with a bit of gunmetal or phosphor bronze. The steam pipe boss, which is the bit that the main steam pipe sticks into, can be turned in the lathe complete with O-ring groove and silver soldered to the body. Don't make the steam pipe a tight fit in the hole otherwise you'll find it rather difficult to push it home blind when you have to assemble the boiler. Allow about three or four thou' around the pipe and let the O-ring do the sealing. While you've got the valve body nice and hot you could also silver solder on the two mounting brackets, which are simply brass angles. An alternative would be to use four 6BA screws. Please yourself.

Highland Railway tender (cont.) toolbox and steps

I was adding some details to my own tender the other day, when I realised that although I had drawn these particular items, I hadn't in fact published the drawings in *Model Engineer*. This omission has been remedied as can be seen from the accompanying artwork. I don't think that any explanation is needed. For those of us who don't wish to spend hours in the cutting out of sheet brass, Peter Thomas has fretted out the parts with his customary skill and they go together with the greatest of ease. The hinges on the toolbox lid are dolls house items as supplied by many of our advertisers.

If any trouble is experienced in drilling $^{1}/_{32}$in. dia. holes for these mini gadgets, try a solid carbide drill, obtainable in the smaller sizes from the advertising tool sellers. Mike the 'magic modeller' gave me a couple and the way that they can whistle through $^{1}/_{8}$in. brass has to be seen to be believed. I generally first fix the piece on with a drop of instant glue, drill, give it a light tap to remove it, clean off the dried glue, clean up the hole and lightly countersink (important), push through the rivets and solder with Carr's No. 145 low melting point solder to fix the rivets and seal the joint. Probably more quickly than writing this 'blurb'. While on the subject of hinges, tiny rivets, soft soldering of minute parts and allied subjects may I point out that our comrades who model in the smaller gauges of O and OO know a thing or two about the affixing of tiny, fragile and highly meltable objects to one another and to larger bits of engine. A word to the affable and ever helpful Jim McGeown of Connoisseur Models (T. 01384-371418) will bring forth a copy of his book on O gauge locomotive building which is a mine of invaluable information, advice on where to get low melting point solder (Carr's Modelling Products on 01275-852027) and a whole lot more.

To be continued.



SENTINEL DG8 WAGGON

PART 2

Continued from page 330 (M.E. 4308, 14 Sept. 2007)

Alan Beasley continues the story of the rebuild of his technically interesting Sentinel DG8 waggon.

I had two main concerns regarding the proposed model. Would a boiler of the Sentinel water tube type work in a model, and could I build a Sentinel style engine, bearing in mind that I had never cut gears or done any castings, let alone designed a steam engine (I am an electronics engineer by profession.) Thus I proposed to tackle the model in stages, starting with a basic chassis and running gear with the boiler driving a simple single cylinder Joy valve gear engine. If this were successful, then it would be worth expending the large amount of time and effort needed to design and build the poppet valve engine, and then to complete the model with the cab, load platform, braking system etc.

By 1984 I had the basic running chassis with boiler and Joy valve gear engine. This worked quite well, and I had satisfied myself that I could solve all the main manufacturing problems for the Sentinel engine. There was a problem with the boiler in as much as it would not stand more than about 110psi hydraulic test pressure, so I was limited to only 50psi of steam pressure.

The proper Sentinel engine was completed by 1985, along with the basic cab structure and load platform, and the waggon had its first public rally that year. The uprated 90psi working pressure boiler was fitted the following year, which improved the performance somewhat! The following years saw the braking system made and the cab properly fitted out and sign written by means of water-slide transfers. Lots of other little detail tasks were done like the engraved hub caps, diecast cover plates and fitting an engine dynamo and headlights.

I entered the model in the 1988 Model Engineer Exhibition where it gained a Silver Medal. The following years it was rallied quite extensively, and being a small model it had a fairly hard life. The main problem was the front wheel bearings, which being fairly heavily loaded and subject to irregular lubrication and plenty of dust and grit wore out fairly rapidly. I fitted a cab mounted forced lubricator, manually operated, which was flexibly piped to the front axle kingpins and this solved the lubrication and wear problem.

However, the model suffered from the same problem as the full-size one that on soft ground the front wheels would get bogged in and somewhat restrict progress. **Photograph 7** shows me on the waggon showing the seat arrangement and illustrates that there is a fair load on the front wheels. By this time I had got a copy of *The Sentinel, 1930-1980* by Anthony R. and Joseph L.Thomas (ref. 2), and this covered the DG series of waggons. It would have been a very useful book to have had back in 1982 when I was first designing the model. Anyway it had an excellent photograph and drawings of the four-wheel all steering front wheel bogie fitted to the DG8 waggon, so at the end of the 1992 rally season I decided to do a conversion job and convert my model to the DG8 format.

The conversion inevitably turned out to be more complex than initially thought, and involved literally sawing the waggon in half behind the cab and extending everything by about 3.5 inches in order to create enough space between the boiler and engine for all the bogie parts. However, it was successfully completed by mid-1993 in time for a few rallies that year and the conversion proved to have been very well worthwhile. It was rallied in this form for the next few years until being retired at the end of 1997 due to the model needing a complete rebuild and repaint, and due to the fact that I had a new toy to play with, namely my Z7S ploughing engine.

Rebuild

Well, what was wrong with it? The model was still runnable, nothing was mechanically broken, but it did not go as well as it used to, and was beginning to look somewhat scruffy. The main problems that I knew about were;

1. Worn engine half shafts and bearings, leading to >>

7. The author enjoying the fruits of his labour at Barleylands in 1991.

8. A new firing chute was required. The old one is on the right.

9. A top view of the model's boiler showing the superheater coils.

considerable crankcase oil leakage that got onto the main drive chains and thence into the rear brake drums, and generally created a mess. The main drive chains were also worn and or stretched, sometimes causing a jam on the rear wheel sprockets.

2. Worn engine poppet valve stems and guides, which allowed steam leakage and thus coated everything under the load platform with steam oil.

3. The boiler also needed a new grate (again!) and firing chute, and the tinplate lagging sheet had finally corroded through in places.

4. The paint work was generally showing its age, the cab needed a new 'canvas' roof, and the cab floor was beginning to rust in places.

I expected to find all sorts of other little problems as the dismantling and checking proceeded, needless to say I was not disappointed!

The first item to receive attention was the boiler. This was designed to be removed from the model with only minor dismantling of the cab. The boiler was stripped, the fittings removed, washed out and given a thorough hydraulic test. This was successful, so I then proceeded to completely dismantle the waggon and refurbish all the parts.

The following sections give an illustrated description of the design and implementation of the various sub-assemblies of the model, and the remedial work needed.

Boiler

The boiler is of the proper Sentinel style top fired and cross water tube design, but in copper. The outer shell is 6.5in. in diameter by 9in. tall. The inner firebox and tube shell is 4in. in diameter. There are eight banks of four water tubes, being $^{5}/_{16}$in. outside diameter. A twin coil superheater is fitted above the water tubes, the regulator being on the superheater outlet. The inner shell can be removed from the outer as per full-size practice, with a ring of fixing studs at the top and bottom of the assembly.

When I made the initial boiler, I shaped the central portion of the outer shell to a square section, as per Sentinel practice, which also made it easier to drill and silver solder in the cross water tubes. In spite of fitting substantial stiffening ribs over the flat portions of the shell not supported by the tubes, I found that the inner shell would not take more than about 110psi before bending of the inner shell flat areas occurred. Annealed copper is an absolutely useless material where compressive forces are involved! Hence the initial boiler was limited to a 50psi working pressure, which was adequate to run the waggon, but made it difficult to manage the boiler conditions compared to a more normal model boiler pressure of 80psi plus.

After a year or so, I remade just the inner shell to fit the outer shell. This time I retained a circular section throughout, with the tubes fitted at an angle to the shell, which doesn't really make much difference when they are silver soldered. However, on hydraulic test, I still found the inner circular shell had a distinct preference not to remain circular once higher pressures were reached. The thickness of the shell was perfectly adequate for an internally pressured vessel of that diameter. The solution I adopted was to roll some corrugations into the circular shell both above and below the tube bank. These were quite shallow, about a millimetre deep, but served to make a stiffer cross section and, I suspect more importantly, work hardened the copper so raising its yield point. I found I also had to bash some grooves into the shell between the tube banks. This was done by making a die block that could be inserted between the tubes on the inside and supporting it by a steel bar passed through the firing space between the tubes.

After all this I landed up with a kettle rated at 90psi, which really steams. As with most boilers it is sensitive to getting the exhaust blast just right, I have a set of exhaust blast nozzles that can be easily changed with the boiler in steam to suit the coal or driving situation, i.e. working hard or just standing in steam most of the time.

Because the steam space is fairly small, and the boiler has to produce a lot of steam for its size, semicircular steam collector pipes are fitted right at the top of the boiler for both the feed to the superheater and for the safety valve. This helps to prevent lifting large quantities of water on sudden steam demand, or venting.

For this rebuild I had to remake the firing chute as it had become rather ragged at the bottom and had actually got holes in it. **Photograph 8** shows the new and the old, the old one was made originally of the same stainless steel sheet at the new one. **Photograph 9** shows a view into the top of the boiler before the top cover is fitted showing the twin coil superheater, the outlet to the regulator assembly is to the left. **Photograph 10** shows the stainless steel top cover plate with the firing chute attached.

Photograph 11 is a view into the firebox, the eight tube banks can be seen and the firebox tube corrugations are just visible, as is the superheater coil above the tubes. The grate pivots on the brackets to the right. **Photograph 12** shows the state that the cast iron grate had got to, it gets a pretty hot fire in there, note the repair strips holding it together. Anthracite is the only coal I can use, anything a bit smoky would soon clog up the tube spaces.

References

2. *The Sentinel 1930-1980* by Anthony R. & Joseph L. Thomas, published by Woodpecker Publications, 1987.

To be continued.

10. The firing chute fitted to the top cover plate.

11. The firebox end of the boiler. Note the barrel corrugations.

12. The grate is of cast iron and needs repairing from time to time.

3-CYLINDER RADIAL ENGINE

PART 3

Continued from page 453 (M.E. 4310, 12 October 2007)

Les Kerr
from Australia

concludes work on this neat engine, starting with the stop pins (Item 21).

Two stop pins are required and are made from 1/16in. dia. brass rod.

Washer (Item 22)

This is a standard, off the shelf crinkle washer with a 1/4in. internal diameter.

Pipe 1 - 3 off (Item 23), pipe 2 - 3 off (Item 24) and pipe 3 - 2 off (Item 25)

These are all made from 1/8in. O/D dia. pipe. After cutting to length clean up the ends with emery cloth.

Steam connector (Item 26)

The connector was turned from a length of 3/32in. dia. round section brass rod.

Stud (Item 27)

These were made from 1/8in. dia. round 304 stainless steel.

O-ring (Item 28)

Standard 1/8in. internal diameter O-ring.

Pipe 4 - 3 off (Item 29)

These were made from 1/8in. O/D dia. pipe. After cutting to length clean up the ends with emery cloth.

Cylinder sub-assembly

Using Loctite 320, attach the collars (item 7) to each of the cylinders (item 3) so that the top of the collar is flush with the top of the cylinder. Be careful to remove any excess Loctite as we don't want the piston to bind in the cylinder. Fit the cylinder heads (item 6) to each of the three cylinders. Set up the 3-jaw chuck in the rotary table and bolt it horizontally on the milling machine. Mount each of the cylinder assemblies in turn in the 3-jaw chuck and drill and tap the six 8BA holes for the cylinder bolts. Next extend the 1/8in. dia. hole in the collar all the way through the cylinder wall. Carefully de-burr this hole on the cylinder side taking care not to mark the cylinder surface.

Engine assembly

For drawing see page 320 *M.E.* 4308, 14 September 2007. Using Loctite 320 attach item 29 pipe 4 (3 off) and item 25 pipe 3 (2 off) to the engine

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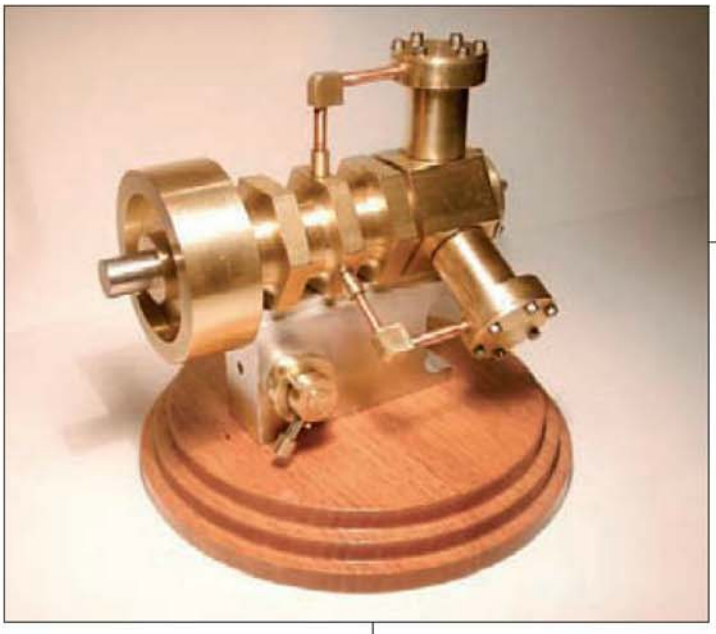


ITEM 20 BASE DRILLING DETAILS

housing (item 1). Next Loctite the cylinder sub-assemblies in place. Make sure that the inlet hole aligns with the housing centre line and points towards the flywheel end.

Again using Loctite, attach to item 16 (elbow - 3 off) the two pipes item 23 and 24. Carefully remove any excess Loctite. Slide the pipe collar (item 15) over the pipe (item 24). The next operation is to Loctite this sub-assembly from the cylinder inlet hole to the inlet pipe (item 29). The pipe collar (item 15) connects pipe 2 to pipe 4 by sliding over the top of both of them. Using compressed air and tissues remove any excess Loctite from the pipes and the engine housing.

Lightly oil the crankshaft (item 2) and slide it into the engine-housing (item 1). Fit a 3mm grub screw to the flywheel (item 14) and attach it to the crankshaft. If all is well the crankshaft should rotate freely in the engine housing.

To one gudgeon block (item 5) attach the connecting rod flat (item 8). Hold it in place with the gudgeon pin (item 11). Screw the assembly into a piston (item 4). Use a thread locking compound to hold it in place. Add a drop of light oil to the gudgeon pin. Repeat for the other two pistons only this time use connecting rods (item 9).

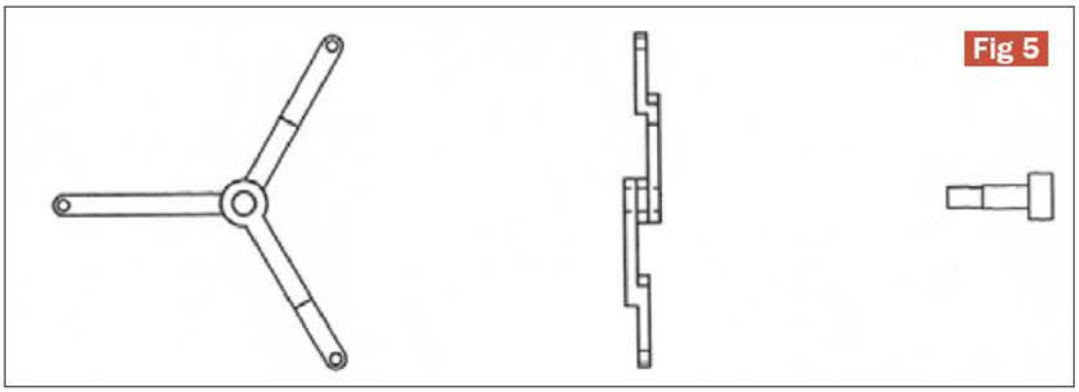


Fig 5

Slide the piston assemblies into the top of the cylinders and using the crank pin (item 10) connect the connecting rods to the crankshaft as shown in **fig 5**. Add a tiny drop of light oil to each cylinder and the crank pin. Once you are happy that the pistons run up and down smoothly as you rotate the flywheel, lock the crank pin in place with thread locking compound. Using 8BA x ¼in. hexagon bolts and cardboard gaskets 0.010in. thick attach the cylinder heads.

The engine is now ready for a test. If you attach an air hose with pressure of about 30psi to one of the inlet pipes (item 25) the engine should run smoothly. Connecting it to the other pipe should reverse the direction of rotation. When you are happy with the performance, using 8BA x ¼in. bolts and a gasket attach the sump cover (item 13). Finally fit a ¼in. I/D O-ring to the groove in the oil hole plug (item 12) and screw the plug into the sump cover.

Base assembly

Using Loctite, attach the two stop pins (item 21) to the reverse bush (item 19) and fit the steam connector (item 26) into the base. Again use compressed air to clean out any excess Loctite in the passage ways.

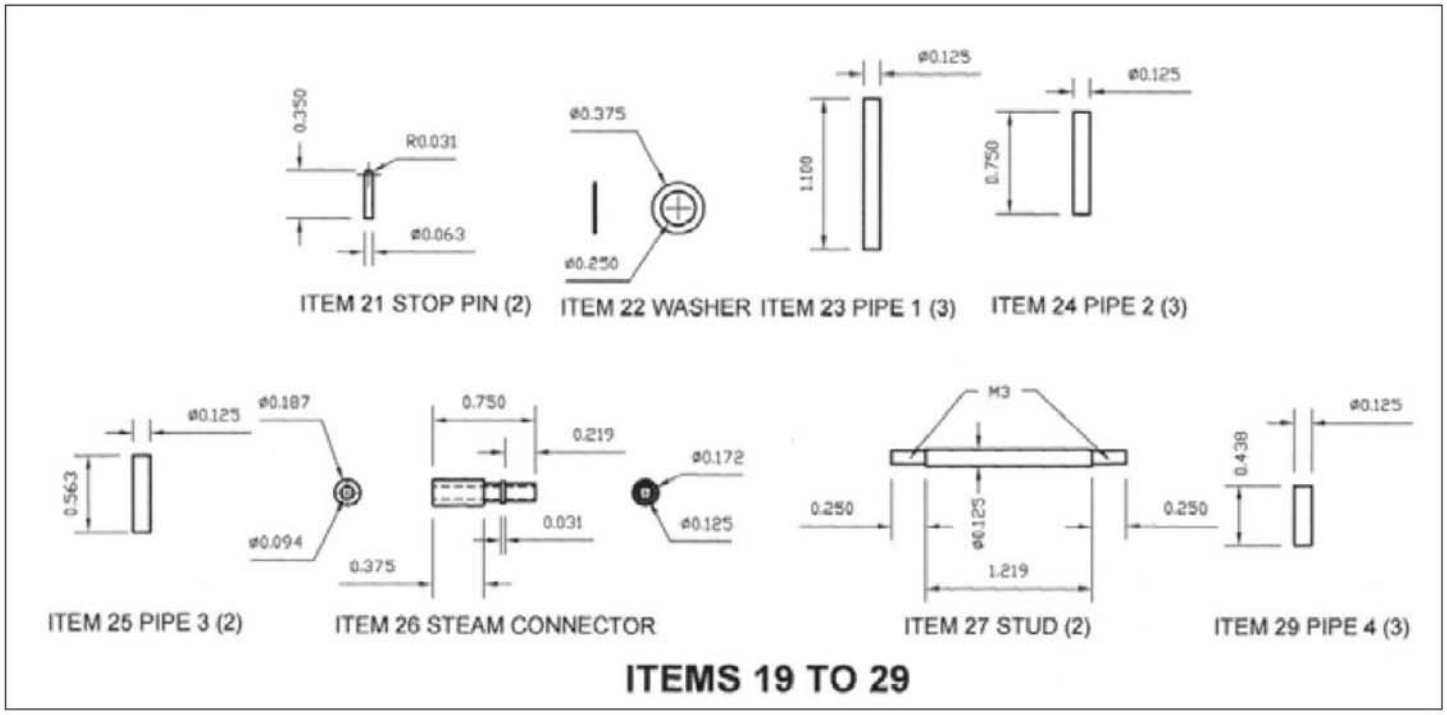
Lightly oil the reverse shaft (item 17) and slide it into the base (item 20) as shown in the assembly drawing. Fit the crinkle washer (item 22) and the reverse lever (item 18). The position of the reverse shaft can be observed by looking down the exhaust port on the end of the base. It is in the correct position when it is open at both ends of the reverse lever travel and blocked off when the lever is in the middle. Tighten the M3 grub screw in the reverse lever.

Attaching the base to the engine

To make an airtight seal between the base and the engine two ⅛in. I/D O-rings are used. Fit one on to each pipe (item 25). Screw the two studs (item 27) into the engine hosing. Slide the studs into the base until the O-rings make contact with its top. Fit two M3 nuts and tighten.

Running

Set the reverse lever against one of the stops. Apply 30psi of air pressure to the steam connector and the engine should start rotating, mine ran at 1,200rpm. Move the reverse lever to the other stop and the rotation direction should reverse. **M.E.**



ITEMS 19 TO 29

BRAY'S BENCH

RACHEL
A wall steam engine

PART 5

Continued from page 459 (M.E. 4310, 12 Oct. 2007)

Stan Bray completes the steam chest cover before moving on to other parts in the cylinder assembly of this unusual engine.

A raised portion on the top of the steam chest cover will require some attention and, not surprisingly, the edges especially were rather rough. The method used to machine this edge was to grind an old, broken slot drill to the required angle. The cutter looks rather Heath Robinson but it did the job quite nicely.

The alternative would be to clean the edges with a file.

Bolt down holes

Readers will have noticed that so far no mention has been made of the holes required for bolting down when dealing with the steam chest or the cover. This is because the method adopted was to drill through the cover into the chest and then into the block.

Therefore, a start was made by marking out and drilling the necessary holes in the cover and removing all the burrs. The cylinder block, steam chest and cover, were then all held together with double-sided adhesive tape and the drill passed through the chest and into the block to the required depth, the stop on the drilling machine having been adjusted prior to the operation. A quick sideways tap with a soft mallet separated the pieces and once again all burrs were then removed. Readers not wishing to use the tape will find that it is quite possible to hold the parts together with a large toolmakers' clamp, although this will prevent some of the holes being passed through. However, it will be quite practical to bolt the parts together and do these at a later stage. If a toolmakers' clamp is being used, some form of protection, such as a piece of card should be used to protect the bore of the cylinder.

The reason people do not like the use of tape appears to be a lack of confidence in its ability to hold pieces securely. In fact as long as the surfaces are cleaned and freedom from grease is assured the method is perfectly safe and it is used for machining quite heavy work, literally stuck to the lathe faceplate with it.

Tapping the block

The correct way to assemble the block chest and cover is with studding, but no doubt some readers will prefer to use bolts. In the latter case the holes must be deep enough to allow the bolt to go in far enough to do their job. In the case of studding it will mean cutting all the studding to length and tapping all the holes to the same depth, the easiest way being to count the number of complete turns made by the tap. A minimum of six complete turns and if possible eight or ten should be made in order to ensure that there is no danger of the threads being literally pulled out when the nuts are tightened.

When we come to final assembly it will of course be necessary to put gaskets between the three parts and allowance must be made for the thickness of the material used to make the gaskets.

Cylinder end covers

Unlike many models the end covers of the engine are made from stock material rather than castings and many constructors may find this more convenient. It is frequently difficult to chuck a casting to run accurately and far easier to use a piece of round bar.

In addition small castings are frequently difficult to machine to shape while, at the same time, removing the >>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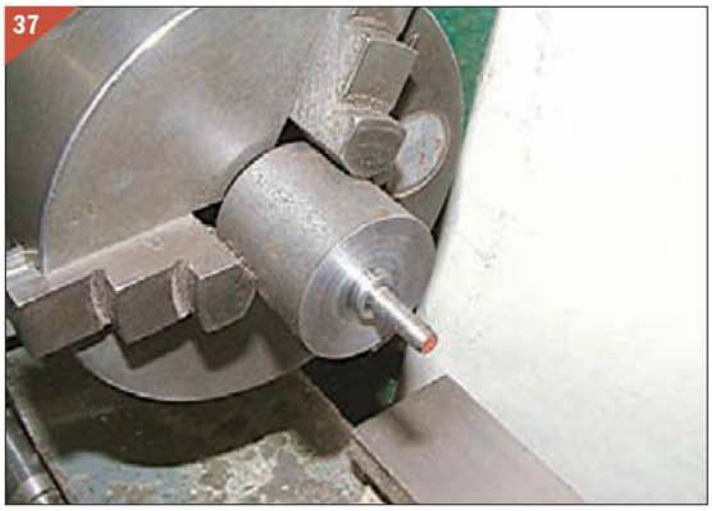
35. The raised section of the cover was machined using a slot drill ground the required angle.

36. Drilling the bolt holes through the steam chest cover, the steam chest and into the cylinder.



roughness associated with the surface and again this does not apply with stock material. The lower end cover of the cylinder is quite straightforward to make, following what can only be described as normal methods.

Lower cover (item 10)

The first operation was to machine the lip that recesses into the cylinder bore and, at the same setting, drill and tap the hole for the drain cock. At the same time make the small counter bore shown on the drawings. It is now necessary to turn the piece round and machine the shape of the front and positioning this accurately in the chuck is the difficult part. If a set of soft jaws happens to be available, the problem is solved as all one has to do is to machine the required recess in them and the cover will remain securely held while the rest of the machining takes place.

Past experience shows that soft jaws are rather rare animals in the amateur's workshop and the answer will have to be a mandrel. In order to offer as much support as possible this should be made from as large a diameter bar as possible and a lip should be machined to fit exactly, in both diameter and thickness, to the recess in the back of the cover. A thread to match that in the cover should be long enough to protrude through and accept a nut to lock the cover in position.

Providing the piece used to make the mandrel is of sufficient diameter, say 25mm or 1 inch. The cover will have sufficient support for the machining operations to be carried out and there should be no chattering or vibration.

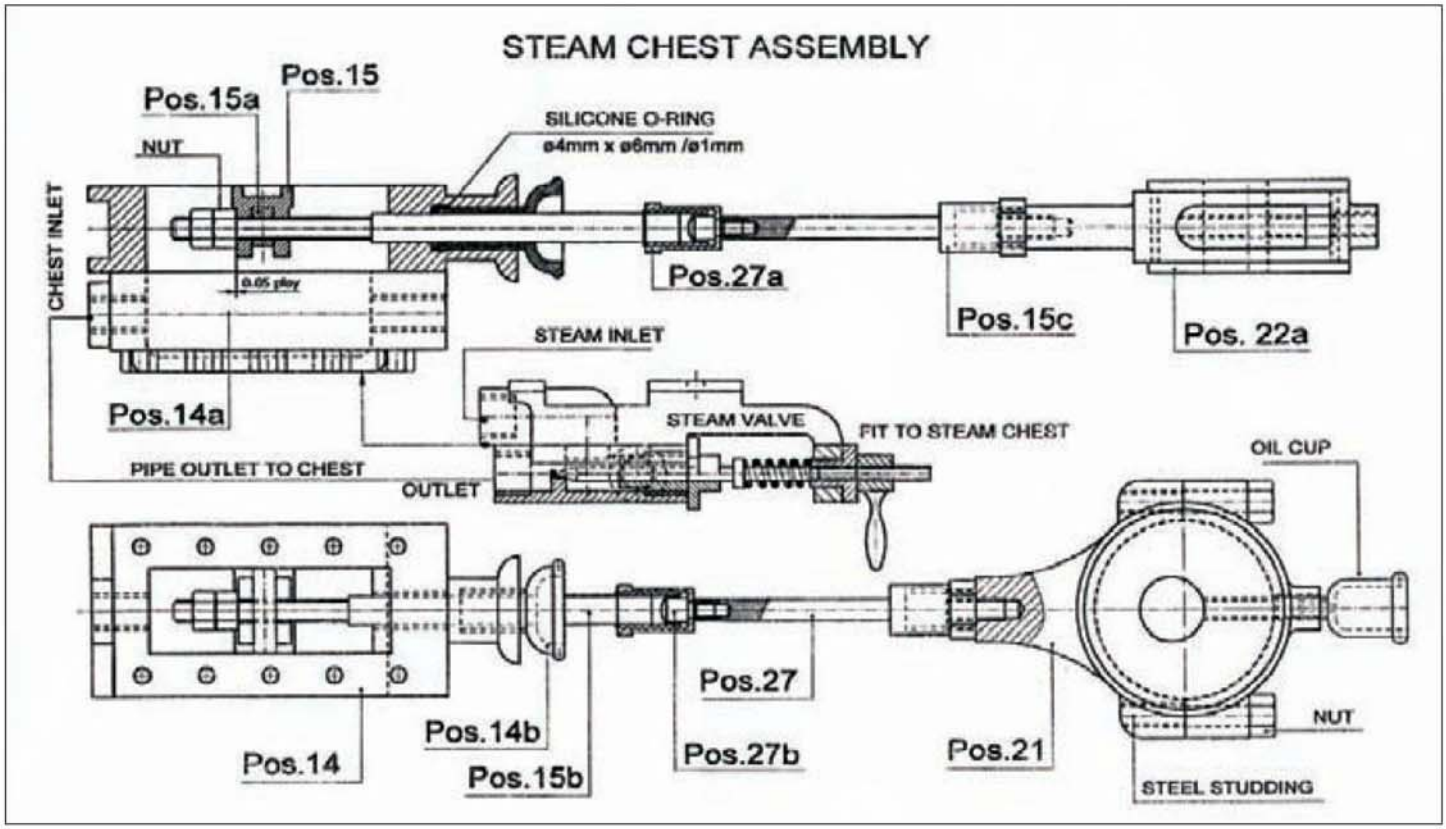
It is rather irksome to machine a large diameter piece of metal to such a small size, simply to make a mandrel that will only be used once. An alternative is to use a smaller diameter bar and support the work at the back.

To do this requires three spacers set against the face of the chuck and also in contact with the work. The spacers can consist of a series of washers, that can be held together and also held to the chuck with cyanoacrylic adhesive. When operations have been completed a smart tap with a soft headed hammer will remove them from the chuck and the application of a little heat will ensure the washers come apart to be used again for another purpose.

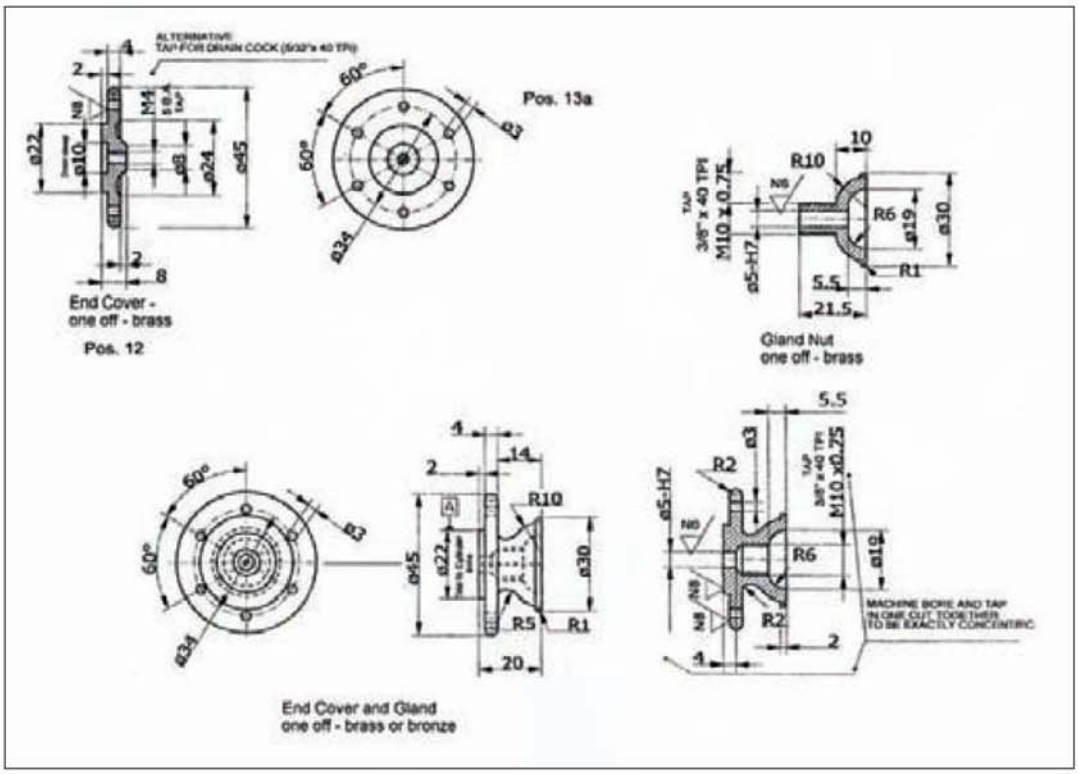
There is another difficulty when making a mandrel for end covers of a cylinder and that is the protrusion on the cover that fits in the bore and while, in very many cases, the protrusion may be of sufficient diameter to offer the required support, in this instance it is not so. The problem was solved by making a thick washer from the bar used to make the cover and slipping it in place before finally bolting the cover to the mandrel for machining.

Top cover (item 11)

The top cover is quite unique in its design and is completely different from the usual cylinder end cover. It is of course still designed to accept the piston rod and has a gland to prevent steam leakage. The main difference is in the shape, which is something like an upturned bell, one assumes that this shape is designed to prevent leakage of oil and condensation on the floor, any waste substance becoming trapped in it and no doubt swabbed out later. The shape can be clearly seen in the



drawings and while it is not difficult to make, the shape is repeated in the gland cover, it was therefore decided that the best idea would be to make a form tool that would ensure both are identical. In addition there is a similar shape to be made for the valve gland and for the pump and the radius in each case is different. Three form tools were, therefore, required and as this was going to involve hardening and tempering, it was decided that all three might as well be made at the same time.



Making the form tools

The material used was ½in. square gauge plate cut to lengths of about three inches, the actual size and length used will depend almost entirely on the lathe on which the tools are to be used. In my case it was a Myford ML7. The steel was first set at an angle in the milling vice so that the top rake could be machined, the operation was then repeated for the front rake.

The appropriate size of end mill was run into the steel to form the radius and that was all there was to it apart from hardening and tempering. At least it was where the two smaller radii were concerned, but when it came to the tool for the cylinder cover this called for a 20mm dia. cutter that was not only not available but would have been far too large for the machine to handle. That radius therefore had to be filed by hand and in order to ensure that it was correct a piece of 20mm dia. mild steel rod was used as a gauge. It is not a difficult job and only takes a few minutes to complete. It definitely takes less time than would be required to try and machine the radius.

Machining the cover

Having machined a length of brass to the correct overall diameter, the protrusion for the location in the bore was made and then at the same setting the hole for the piston rod was also made. This allowed the casting to be turned round in the chuck for machining the outside shape, however the lip alone does not offer sufficient support to push in the form tool as these tools put a greater pressure on the work.

It is, therefore, essential to support the cover from the tailstock during subsequent machining operations. It is almost inevitable that no matter how careful one is, some machining marks will be left and these are best cleaned off with Scotchbrite.

The internal shaping as well as drilling and tapping for the gland can be done from the tailstock, but again it is necessary to be extra careful because of the limited grip supplied by holding the component with the lip.

Alternative method

There is an alternative way to make this cover that some readers may find easier and that is to make it in two parts. To do this the part to be bolted to the cylinder block is machined to fit a small lip machined on the bell shaped section and both pieces are silver-soldered together. The hole for the piston rod should be made under size and a reamer passed through both parts after they are joined to ensure the bore is smooth and accurate.

To be continued.

37. The mandrel used to machine the cylinder covers. It should be left in the chuck until all the machining operations have been completed.

38. When the front cover is finished on the mandrel it is very close to the chuck jaws and there is insufficient room for the outer edge to be radiused. A washer was made to fit between the jaws and the cover to give additional support.

39. This is the top cylinder cover. The shape is unusual but can be readily turned with a form tool.

Pultra lathes

MACHINE TOOLS

Tony Griffiths reviews the highly sought-after, and innovative British precision mini lathe.

Pultra lathes are among the most popular of small precision lathes that have found new lives in model engineers' workshops after their days of use in industry have come to an end. They are popular among those wanting precision machining of small parts.

The Pultra Company, P.T.A., was established just before the Second World War in Manchester, and was acquired in post-war years by machine-tool manufactures Smart & Brown, themselves already part of a bigger group, Gas Purification & Chemical. Pultra initially made both conventional Geneva and WW watchmakers' lathes but in these early days, its most popular model by far was the latter, the robust little Model P. Although established principals of quality engineering were adhered to, the design did not copy that of any other maker.

When the Model P was introduced in the early 1940s, it was described in the company's sales literature as a "Micro Machine." It was an urgently required model for war work. Many thousands were produced.

The company's aim was to manufacture a small but strong lathe capable of the finest accuracy in instrument repair work - and yet one capable of also being run as a production machine non-stop on both day and night shifts. To this end it could be fitted with a variety of accessories including the usual 6-station, self-indexing bed-mounted capstan unit, bar-feed assemblies and lever and screw-feed cut-off slides.

Pultra, like Schaublin of Switzerland, claimed that the beds, headstocks, compound slide rests and tailstocks were all freely interchangeable and, therefore, a factory equipped with several Pultra lathes could easily arrange the best combination of features and accessories for a particular manufacturing job.

Of 50mm centre height the Model P was available in two bed lengths - the short PB1 and the longer 'twin-support' PB2. Two headstocks were offered. The 8mm collet PH2 and the 10mm collet PH4 both able to take either draw-in or quick-action, lever-operated collet closers.

Headstocks were fitted with split bronze bearings were designed for continuous running at 10,000rpm. The bearings had plain bores with a taper on the outside by which means a precise adjustment of the clearance could be made. A ball race was provided to take end thrust. The bearings were intended to run 'warm' at all speeds with the makers suggesting that, if a machine was to be used continuously at high or low speeds, it would be worth adjusting the bearing clearance to suit. When the bearings were well used it was possible to dismantle them and remove a laminated shim (0.003in.).

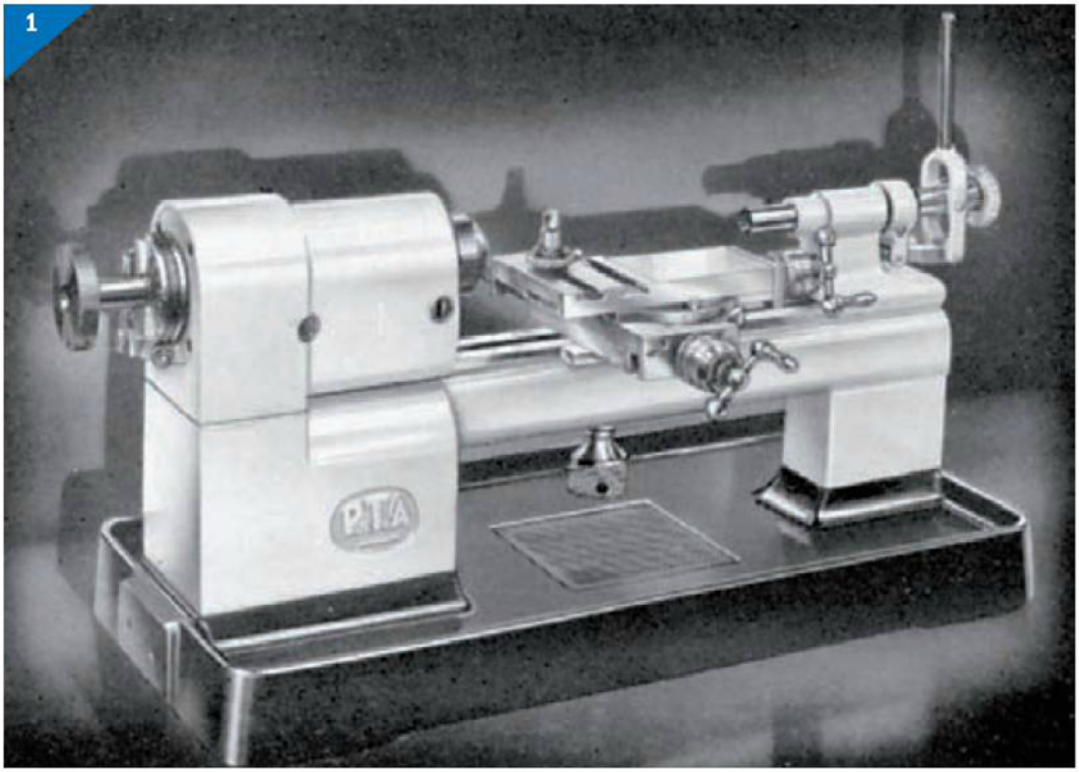
Normally nine speeds were provided spanning approximately 236 to 5,970rpm. A 2-stage countershaft was also offered that gave an 18-speed drive from 236 to 10,600rpm. Various arrangements of well-engineered rear and overhead drive countershafts were offered.

The tailstock was normally supplied with a simple 'push-action' barrel but a lever-operated device was an option and a screw-feed barrel was eventually offered as well.

Later machines

Developed as the 1590, 1750 and 1770 (the 50, 70 and 90 referring to the centre height in millimetres), these versions were to be the final development of the lathe and production continued, albeit in very small numbers, into the 21st century. The post-war models had clean, modern lines with a very high quality paint finish and an enclosed headstock pulley with the drive able to be taken downwards or rearwards to choice.

First lathe of the new series was the 90mm (3.5in.) centre height Series 15.



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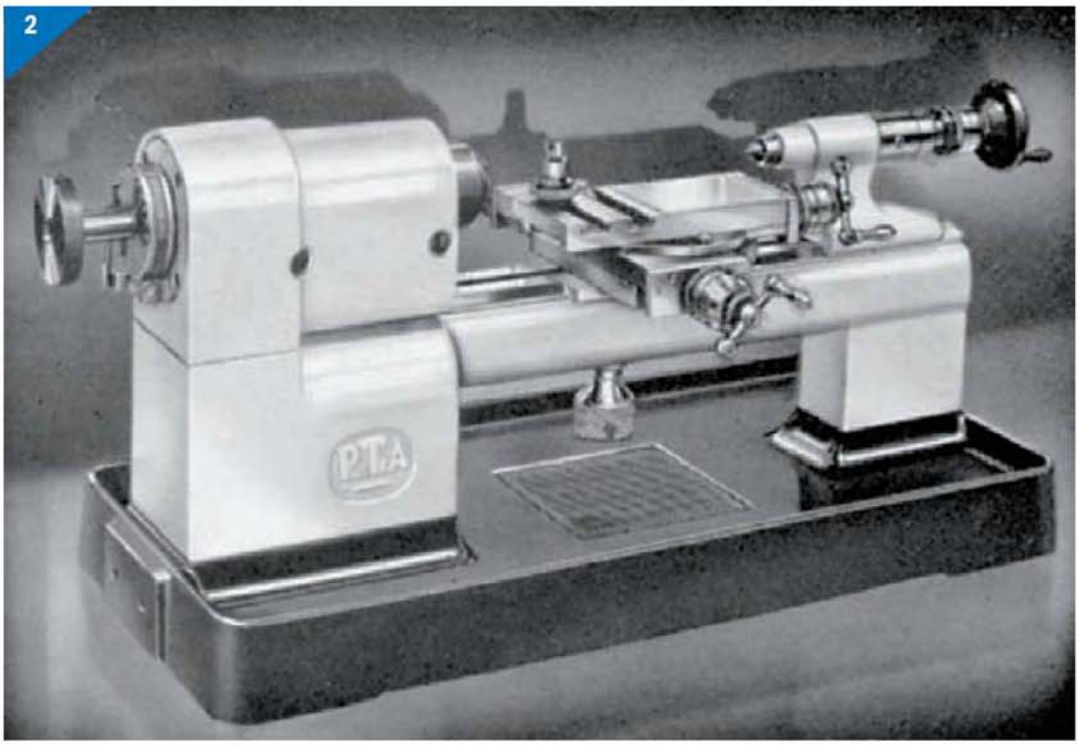
1. General purpose lathes 1750L and 1770L.
2. General purpose lathes 1750M and 1770M.
3. Production lathes 1750P and 1770P.



This was a very much larger and heavier lathe than other Pultras and, although styled along much the same lines, was constructed from entirely different components. The 20mm bore headstock spindle accepted collets with a Pultra reference of CJ.1 (20mm shank, maximum through-bore of 14mm) while the grinding and milling attachments took the Type CE.1 collet with an 8mm shank (maximum through-bore of 4.7mm).

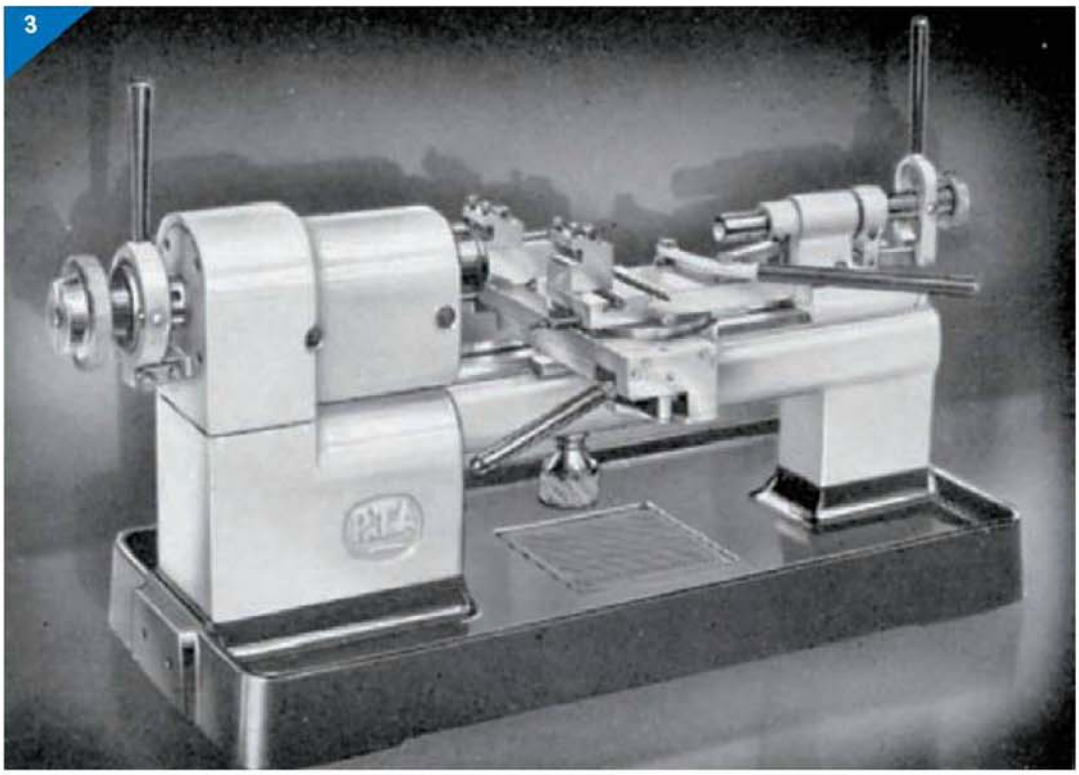
Three different headstocks were available, all based on a common unit but categorised as Standard (H.191D), Special Toolroom with 'Locking Attachment' (H.191.A) and Production (H.204D) with, naturally enough, a lever-operated collet closer fitted as standard. Because the single drive pulley was overhung on the left-hand end of the spindle (though covered with a neat guard that made the headstock look bigger than it actually was) the belt could be changed on all versions without having to disturb the setting of the super-precision, plain headstock bearings. Driven from the recommended 3-phase, 1,425rpm, 0.9hp motor with a 3-step pulley on its shaft (and via either rear or stand-contained countershafts) the 9 spindle speeds were: 135, 208, 350, 410, 633, 1068, 1258, 1936 and 3,265rpm.

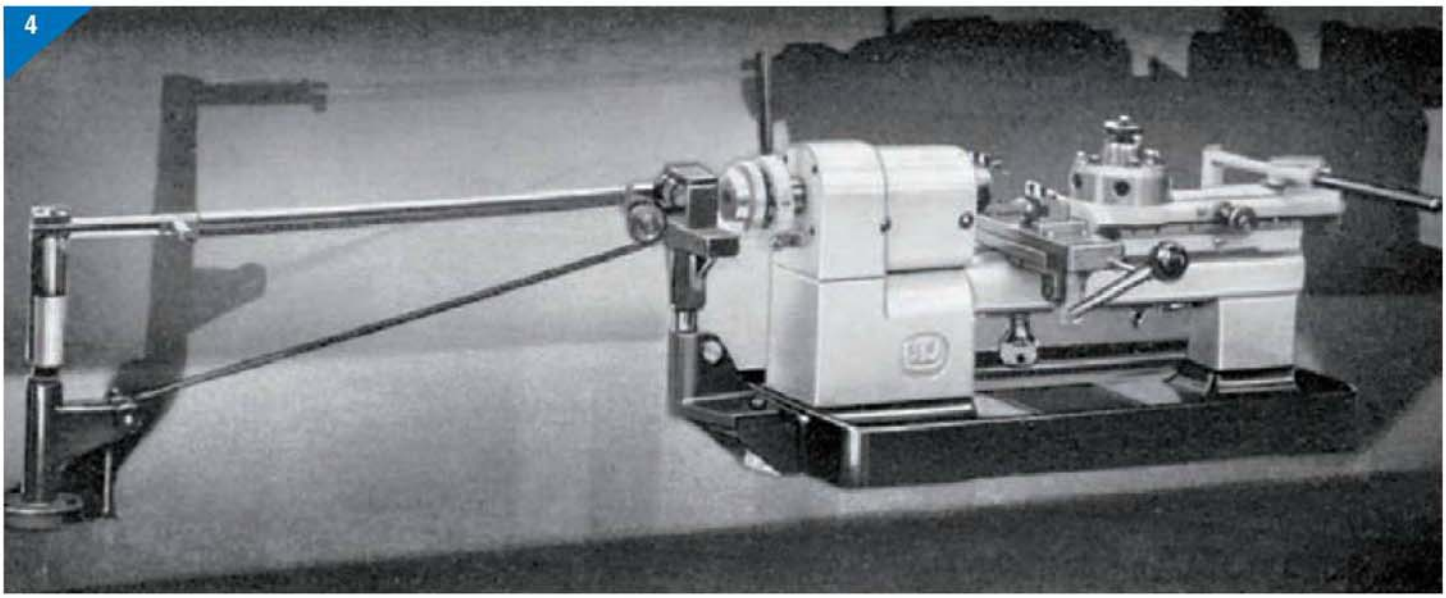
Although the 1750 and 1770 models had headstock spindles that accepted only collets, or accessories carried on collets, the 1590 could mount chucks and faceplates using a fixing with captive screwed ring behind the spindle-nose flange that resembled a miniature version of the American L Series long-taper key fitting employed on industrial-size lathes.

The cross slide had a travel of 4in. (100mm) and the top slide 3in. (75mm) - both considerably more than the 1.875in. (48mm) and 1.75in. (45mm) of the 17/50 and 1770 models. The bed was 33.8in. (860mm) long and the length of its shears 31in. (790mm); it could accommodate 15in. between centres (7in. or 178mm for the 1750 and 1770). On its optional (but essential) cast-iron base plate the total length was 35.75 inches.

The 0.8125in. (30.2mm) diameter tailstock spindle was fitted with a No. 2 Morse taper centre and had a travel of 2.25in.; both screw and lever-feed versions were available with the latter having the same CJ.1 collet fitting as the headstock. A micrometer-graduated collar was fitted to the spindle handwheel, marked in divisions of 0.02 millimetres.

Like the Series 15, the pair of Series 17 lathes had a very stiff, box-section headstock with the drive pulley over-hung on the left-hand end of the spindle -again cleverly disguised by the comprehensive guarding. Besides being available for bench mounting, with a conventional countershaft, they were often fitted to an underdrive cabinet stand - the Mardrive. This very heavy unit was, in reality, a beautifully made industrial sewing-machine cabinet suitably modified by its Stockport (Cheshire) makers for lathe use. It held a multi-speed countershaft unit (part A.890a) neatly inside its left-hand compartment with a foot pedal, ≫





4. Capstan lathes, models 1750R and 1770R, shown with bar feed.

positioned between the stand pedestals, to operate a motor-mounted combined clutch and brake unit.

Although this choice of stand might seem strange, it was actually a very sensible choice for, if you have ever examined industrial sewing equipment, you will be aware that, due to the daily hammering it suffers at the hands of piece-work operators, everything has to be every bit as well made as the finest precision machine tools.

Identical, in all but centre height and the depth of their toolposts, the 1750 and 1770 both used 10mm collets in the headstock spindle - a $^{7}/_{8}$in. diameter 26tpi thread on the spindle end being for the use of a protective sleeve when the job included cutting close to a collet face or to mount a closer for large disc chucks.

Four types of headstock were available for the 1550 and 1750: Standard Duty and Heavy Duty. Both were set to run at an average speed of 3,000rpm with a maximum of 6,500rpm (large bore limited to 5,100rpm) and a High Speed version that could reach 12,000rpm. Although, in reality, all models could be provided with any type of headstock, the 50mm lathes were advertised with a choice of Standard or Heavy Duty types while the 70mm version was fitted as standard with just the High Speed unit.

Two bed lengths were produced: a rare 14in. that stood on a single headstock-end foot and a more common double-foot 18in. that gave, respectively, 3 and 7in. between centres. When mounted on the common-to-both models cast-iron chip tray base unit the overall length was 18.75in. and the weight between 50 and 64lbs (22 to 29kg).

Three varieties of tailstock were produced for all models: each used an identical standard body and could be fitted with either a manually positioned, screw or lever-feed spindle. The two screw and 'push-feed' models had either a CF.1 collet fitting or a No. 0 Morse taper and the lever-feed version just the collet-holding nose. The screw-feed spindle carried a micrometer dial and, because the various components were precisely made, it was possible to buy all three fittings and use them interchangeably on a single casting.

As with most precision lathes the Pultra could be fitted with a useful range of expensive accessories to enable almost any precision machining process to be carried out. These included high-speed grinding and milling spindles to use in both the toolpost and on a vertical slide; a headstock-mounted dividing attachment; tilting and fixed handrests with wide and narrow T-rests; a miniature saw table; 4-way, single and rear toolposts, a filing rest, adjustable roller rest and raising blocks for the headstock, tailstock and toolpost and fixed and travelling steadies.

Alone among the models, the 1590 could be equipped with a screwcutting drive to the top slide. This was a particularly well-engineered system and gave a wide range of pitches and feeds. Compound slide rests, almost unchanged from the first examples could be fitted with any combination of lever and (ultra-fine) screw feed to either the top or cross-slide.

At the height of production a vast range of standard, disc, bell and nose-recessed collets and the usual miniature fittings - die heads, box and knee tool holders, drill and tap holders, etc. were all catalogued. Today the accessories are highly sought-after, especially the collets, milling slides and boring and grinding heads - while even the previously neglected production items will find a home in the workshop of a Pultra collector.

Rarities

Pultra watchmakers' lathes are rare: there were two types: a Geneva-pattern machine made to hold either 8mm or 10mm collets and sold as the P.T.A. 8 and P.T.A. 10 (or sometimes as the Series 8 and Series 10) and a lighter WW style 8mm machine that may have been the company's first production model - but of which technical details are not known. All examples found of each type have been arranged to accept 8mm collets.

Unfortunately, the only Model 10 that the author has come across in recent years was something of a disappointment; upon retrieving the pristine maker's box from the back of a junk cupboard, and beholding the array of perfectly preserved and complete accessories, he enquired where the lathe itself might be. The brother of the deceased owner, obviously not versed in the matter of quality machine tools, replied casually, "Oh, that b***** little thing. Chucked it into the dustbin. Far too b****** small to turn anything, that little **** was." Upon which comment the writer was, for once, lost for words.

Besides lathes, Pultra also made several small grinding machines (in production quantities, though today they are very rare) and advertised the fact that they were able to produce special-purpose, miniature machine tools as one-off orders. The grinders included a cylindrical model, the 1970, that was made in three versions with 10mm and 20mm bores, live and dead workheads and the 18C5, a radius-grinding machine with a hydraulically-operated wheelhead.

For more information visit **www.lathes.co.uk** **ME**

3F to 3F
An ambitious conversion

PART 11

Continued from page 456 (M.E. 4310, 12 October 2007)

Geoff Dowden completes the build of this delightful locomotive.

The grate was simple enough, just a section of stainless steel 5in. g pattern and sized to an easy fit inside the foundation ring. However, as a portion of the lower edge of the 3F firebox slopes downwards from back to front, a straight and level portion of grate would not be satisfactory. Fortunately for me, a fellow club member had the appropriate heavy-duty equipment to heat the thing up at a point approximately three quarters of the way along its length so that the grate could be persuaded to adopt a shape more favourable to the opening into which it had to fit.

The ashpan was quite a different animal and required the obligatory cardboard cut out to be trialled first. Not an easy matter. With the boiler in the frames everything had to be done from underneath and with the locomotive on the bench I found the task to be virtually impossible.

I eventually resolved the problem by utilising the Black & Decker Workmate, which, with the top opened up to a little less than 'gauge', the necessary area under the locomotive at least became accessible. However, how much better it would have been if a purpose built locomotive stand that enables the locomotive to be held securely upside down had been available.

Trial and error then provided the required dimensions, shown as **fig 34**, the final example indicating the pattern which would clear the frame stretcher and rear axle and easily drop out between the frames on withdrawal of the dumping pin for fire cleaning purposes.

After I had cut out the necessary shape from 18g mild steel sheet, the ashpan became three dimensional when it was introduced to the metal folder of a club colleague who then graciously applied the *coup de gras* by way of a few tack welds to keep things where they should be.

I wonder if I could ever learn the basics of simple welding? I have only tried it once and quite simply, could not get used to looking at things in the dark through the visor!

To anyone who has been following these notes it will perhaps have become patently obvious that I am neither a locomotive engineer nor a design specialist and in this respect I feel that I am unqualified to offer proposals for the 3F's draughting arrangements.

However, I am well aware that a number of 5in. gauge ashpan designs by notable contributors in connection with a particular locomotive, have appeared in these columns from time to time, where an opening flap is shown in the front or rear of the ashpan, or indeed, on occasions, a combination of both.

Ultimately, I chose not to provide a flap at the front as I considered there already to be more than enough to control and contend with in the locomotive's cab. Also, I did not think that a flap at the rear to be a good idea either due to the close proximity of the rear axle hornblocks and the possibility of the latter been showered in ash from an opening flap. Notwithstanding that, having been recommended to do so, I will probably fit an inverted U-shaped cover that drops over the axle between the horn blocks.

Instead, having taken advice on the matter, a row of five $^{7}/_{16}$in. dia. holes was drilled in both the front and rear plates and then on both sides of the ashpan, a further row of four $^{5}/_{8}$in. dia. holes, parallel to the top edge, with a couple of $^{1}/_{2}$in. holes below and to the rear were provided as shown in **fig 34.** When the time comes, I hope that the holes will allow sufficient air flow to ensure satisfactory steaming performance but I have no doubt that more experienced builders/designers will improvise appropriately and in the event that my proposals prove to be nothing short of a disaster, I am sure that in due course, I will receive all the >>

information that I require to put things right!

With the ashpan now capable of being held in place, the position of the dumping pin was spotted through the holes in the frames and drilled out 5/16in. to enable a length of mild steel bar, previously drilled out 1/4in., to be silver soldered in position. The final task was to fix the two 1/4in. diameter grate supports, their positions being determined by the grate crossbars to which the eight lengths of firebar are attached.

The opportunity was also taken to mill a rebate into the top of the grate supports to provide a location for the grate and in an effort to counteract unwanted movement and the force of gravity during attachment of the ashpan, a process where digital dexterity is almost a mandatory requirement and I imagine to be nigh impossible on a ground level track. I can foresee some very unprotypical and upward manoeuvring of the locomotive's rear end when this occasion demands!

Handrails and dummy ejector assembly

The 1/8in. dia. handrail on the left-hand side of the locomotive follows conventional practice being secured by the usual stanchions, inserted into holes 5deg. above the horizontal. Two are provided to the side of the smokebox, two to the boiler cladding, one to the firebox wrapper, and at its rear end, a short length of 5BA thread for screwing into and through a turned fitting. The free rear end is then inserted through a hole in the spectacle plate and secured with washer and 5BA brass nut in the cab. The smokebox end of the handrail is drilled and tapped 10BA to receive an 1 1/64in. dia. turned knob, the front edge of which is given a small rounding off.

The right-hand side is much more complicated, as just to the rear of the smokebox there is the ejector apparatus to contend with, the details of a similar arrangement being shown in the F. J. Roche Drawing No. DET/L1. A drawing also appears in *Midland Engines Volume 2* that shows the ejector exhaust pipe entering the smokebox to make a connection with the top of the blast pipe. Obviously I was not concerned with the latter function as the ejector assembly will only be a cosmetic feature on my 3F, but as the equipment is very prominent on this class of Midland Railway locomotives I decided that I ought to give some thought as to how the ejector assembly could best be portrayed.

As the Roche drawing was illustrated for left-hand drive engines, I first of all produced its mirror image, suitably amended to suit the class 3 arrangement as seen on numerous locomotive photographs. My effort in producing a general arrangement drawing is therefore shown as **fig 35**, probably not technically perfect, but I thought that if I could produce a version that looked reasonably similar on the locomotive the ultimate effect would be acceptable.

The construction process I adopted for this last item of the locomotive to be manufactured resulted in a 5in. gauge version with which I was quite pleased and perhaps somewhat remarkably, was produced without any undue strain or stress. If any modeller needs to provide this equipment, or a very similar arrangement, which incidentally is present on numerous other classes of locomotive, and perhaps may wish to learn more about my methods of replicating this feature, the full story of my experience was outlined in *M.E.*

Fig 34

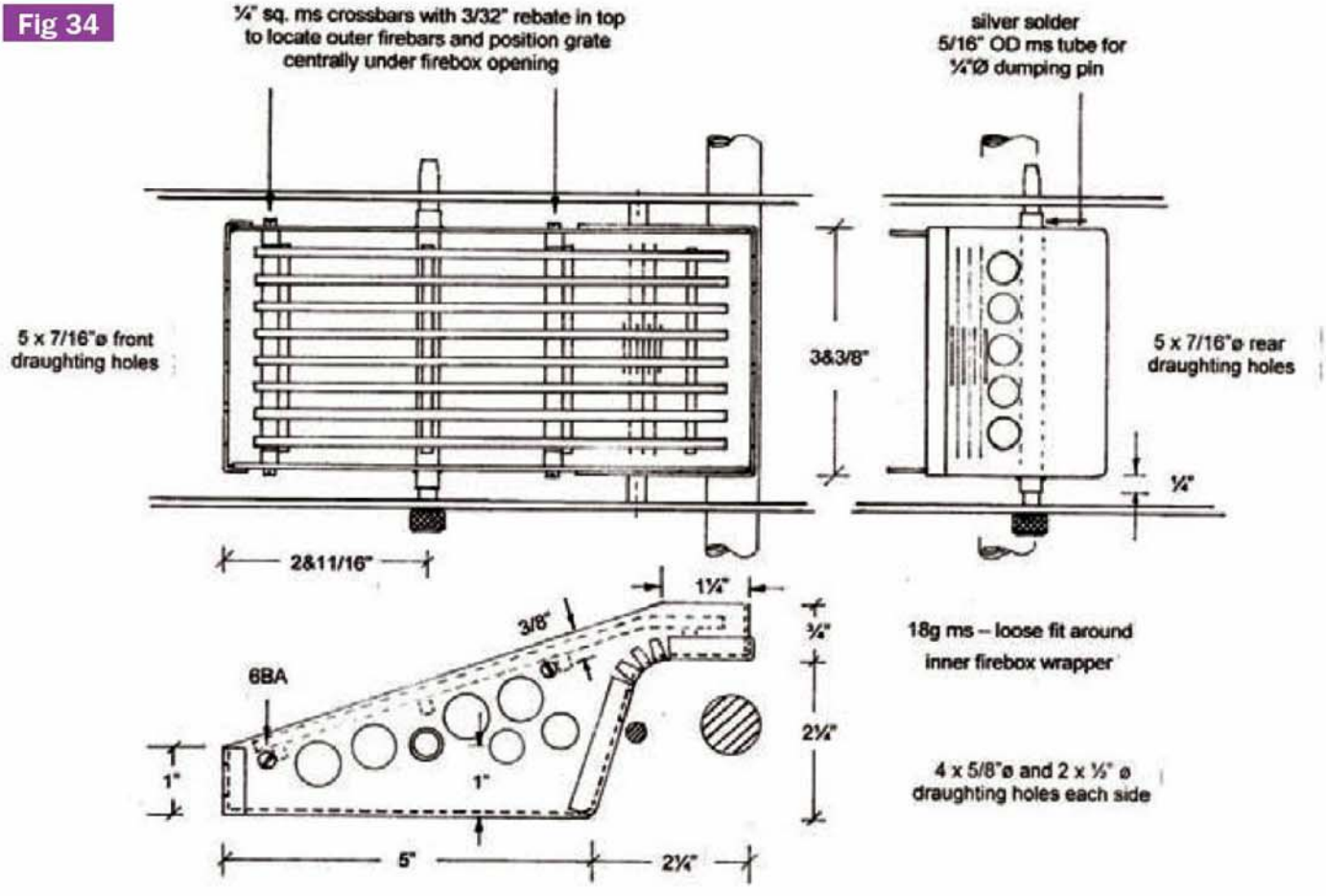
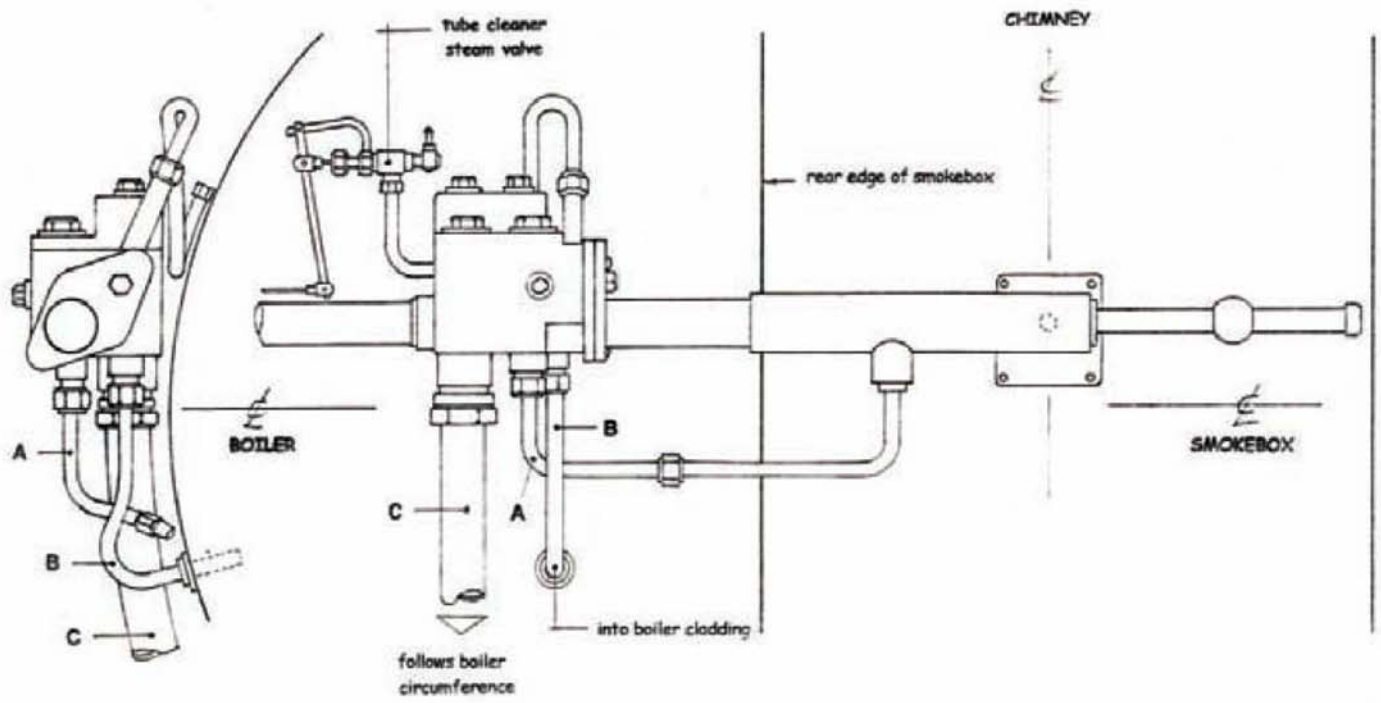


Figure 34 – Ashpan and Grate

Fig 35



Volume 193, nos. 4227/29.

Painting and livery

Towards the end of the construction period of my locomotive, I knew that one or two important decisions still had to be made, namely what was to be the livery style, and in order to place an order for works plates, smokebox number plate, tender water capacity etc., what locomotive number should I choose?

During the preceding decade I learned a great deal about the 3Fs, never more so than the last 18 months. In retrospect, with the benefit of hindsight, I would probably have done several things differently, but that is 'water under the bridge' and I had to think positively.

I had learned that following the final rebuilding of these locomotives, there were nine different classes of engines within which either some, or all, received the G7 boiler. Other noticeable differences included cab and buffer beam detail and style of tender. It was necessary, therefore, for me to either identify one particular engine; adopt a compromise or ignore all the facts, technical data etc. and do just as I wished – rather like the owner of a preserved prototype example who, for whatever reason, chooses to ignore historical fact and paint his pride and joy a different colour to its original company livery.

So, among all the relevant information where did my locomotive fit in? To begin with, having straight brake hangers, and to be technically correct, it should be in the 3815 class and numbered between 3815 and 3834, the last group to be built in 1908 and outshopped with straight hangers. However, these locomotives were also equipped with an additional set of footsteps and grab handle midway along the running plate and were coupled to 3500 gallon tenders with modified coal plate and front shortened coal rails.

My locomotive has no additional steps and for the reasons outlined earlier, my version of the tender is modelled on the original Midland style. Ironically, a few years ago my locomotive did sport this extra pair of footsteps as I had seen a photograph of no. 3817 which was so adorned, but I subsequently removed them erroneously thinking that they were an LMS addition and out of character for my engine which was going to be outshopped as a Midland Railway stalwart. Short of refitting a set of steps and altering all the coal plate dimensions, or accepting that the locomotive had been paired to an alien tender, I could not therefore select any number between 3815 and 3834.

I also discovered that there was a group of 50 engines, the 2736 class, which appeared to fit all the criteria, except the brake hanger issue, and were outshopped between 1903 and 1907 with 3500 gallon tenders and in the 1907 renumbering scheme received numbers 3765 to 3814, all ultimately being rebuilt with the G7 boiler. So far, so good, but even so it became obvious that some compromise would have to be made and the matter was finally settled in August 2002 when I was fortunate enough through a friend of a friend, to have the loan of a copy of the Wild Swan/National Railway Museum publication by Messrs. Hunt, Essery and Jones entitled *Midland Engines No. 2 – The Class 3 Goods Engines*, a veritable treasure chest of detailed information with several copies of original works drawings and many excellent photographs. If only I had known about this work of reference years earlier, but there was some degree of consolation when I noted the publication date of 2000 on the inside cover. Still, better late than never!

On page 19 there is a photograph of No. 3809 which my locomotive mirrors almost perfectly. Beaded splashers and cab sidesheets, fluted coupling rods, the later type of circular cover to the safety valve base and coupled to an early style of tender. I concluded that this would be the one and I could live with the visible differences. 3809 had been fitted with screw couplings but still retained its Salter safety valves and Furness lubricators to the bottom of the smokebox whereas my example has 3 link couplings, Ross pop valves and is devoid of the Furness lubricators. However, I am quite comfortable with these minor >>

discrepancies as if I choose to do so I can change the couplings, the reference book also informing me that:

(a) The LMSR fitted Ross pop valves in the mid 1930s and

(b) A copy of the Midland Railway smokebox drawing updated and annotated by the LMSR in 1928 indicates that "the Furness lubricators were no longer required."

Brilliant, 3809 it had to be! The downside to this decision unfortunately meant that the presence of the Ross pop valves dated my locomotive to the 1930s era and definitely well into LMSR ownership when I had always envisaged my example to be finished in Midland red livery with the large 18in. high numerals on the tender. Yet another anomaly to be resolved and to add insult to injury, the chapter on the livery details of the class 3s categorically states that "none of the class 3 Belpaire engines were ever painted in anything other than black."

Tragedy. Very disappointed I realised that to be historically and technically correct, even in Midland livery, my locomotive would have had to be black. However, as mentioned earlier and in the spirit of "he who pays the piper calls the tune", should I ignore the facts and paint it red to satisfy my long cherished dream and " to heck with the know-alls who will delight in telling me that I have got it all wrong"? In the end, I decided to elect for the former option with LMS gold shaded red serif style letters and numerals concluding that this decision was probably the best compromise.

But – who knows? Sometime in the future I might just develop an uncontrollable desire to repaint it Midland Red and if anyone should comment on it being the 'wrong' colour for a 3F, which I feel would undoubtedly be the case, my story is ready for the potential challenge. This engine is the 'one that got away' and as one of the last 5ft 3in. wheeled engines to be out-shopped from Derby works after rebuilding in 1922, (a historical fact), the long serving paint shop foreman felt an overwhelming resurgence of loyalty to the glory days of his former company and in an undying tribute, he turned out 3809 in Midland Red. Well it's just a thought and everyone should be allowed a little license once in a lifetime!

Footnote

With the fitting of the outstanding plumbing and piping requirements, construction of the locomotive was virtually completed and it was time to carry out the dismantling process in order to start the painting procedure, at the same time being ever mindful of the need to do 'a proper job' and give full justice to an inanimate object upon which I had invested such a large proportion of my lifetime.

To this end therefore, off came the cab assembly; firebox wrapper unit; boiler/smokebox; both running plates complete with footsteps, splashers and sandboxes and finally the front, central infill section between the frames that houses the dummy front end covers for the non-existent valve rods. The tender water tank; coalplate with lockers and toolboxes; footplate extension assembly and the complete brake running gear were also removed from the chassis for painting as individual items.

Having previously painted the tender frames, dummy springs and yokes at the outset, the wheel sets will also be removed to allow the matching final spray painting of satin black to be carried out on the footsteps, hornplates, spring support yokes and axle box cover plates.

Hopefully, when painting is completed and LMS ownership, number transfers and works plates have been attached, all will go back together without too much difficulty (*Ed: it did! See photo of the painted locomotive*). The boiler has previously had its successful second hydraulic test out of the frames, so following the mandatory steam test, where I anticipate attention will be required to correct the almost obligatory steam and water leaks. I am looking forward to many pleasurable hours of hauling my freight stock around our home circuit and other club tracks up and down the north west region.

At this point my intention is to take a few more photographs of the locomotive. in freight train service, when with your editor's approval, I could submit an update on the final chapter of my almost 20-year undertaking.

In the meantime, I see the void created by the locomotive's completion now being filled with my ambition to construct two further 5in. gauge wagons, namely a six-wheel milk tank that could also serve as an extra water tank and a 'conflat' wagon that could be used to sport a variety of different loads. However, firstly there is the small matter of completing a 3½in. gauge LNWR 2-4-0 Jumbo (LBSC's *Mabel*) that was given to me a good number of years ago as an almost rolling chassis, with a request by its builder that I finish the job! I assured him that I would, once the 3F was built, but I have to admit that between 3F tasks over the years, I have already almost completed the tender and brought the chassis to boiler building stage, during which time unfortunately, I have had to manufacture a new crank axle for the engine as the original, to put it mildly, had something of a wobble due to fractures of the right hand webs in the crank pin area!

During the course of the last 19 years of bringing 3809 to life, it would be fair to say that I have experienced the full spectrum of emotions. There were periods of anger and frustration when I almost wallowed in the depths of despair but equally, these occasions were probably balanced with feelings of sheer exhilaration when things went well or sometimes better than imagined.

I have certainly learned a great deal and can now speak a little more authoritatively on certain matters, the whole exercise clearly demonstrating the age-old saying that "an ounce of practice is worth more that a ton of theory anytime."

To the readers who may have followed the saga through these pages, I hope that I have managed to convey some of the heart felt images and recollections that have given me a great deal of pleasure, and ultimately, a tremendous sense of achievement during the intervening period of almost two decades. Also, if by chance my experience should encourage anyone to attempt the same or similar objective, they will be aware of some of the pitfalls and perhaps at least, have a little more to go on than I did! **ME**

The completed 3F draws admiring looks from the judges at the Model Engineer Exhibition, 2007.

NEWS

Malcolm Stride
reports

UK Club News

Barry Harrison of the **National 2½" Gauge Association** reports that he has tested the new 2½in. gauge track at **Warrington DMES** and did three laps of the 1,710ft. track with his Crab 2-6-0 locomotive. The Rugby Rally in June was enjoyed by those attending; in particular Robin West (**photo 1**) seems to be enjoying the second outing with his *Fayette*.

Progress at the track site of **Ascot Locomotive Society** continues (with a slight interruption for the Model Engineer Exhibition) with the viewing area levelled, and the three island platforms, entry path and walkway around the turntable in the terminus area concreted. Two 8ft. gates have been erected and also the base for the rebuilding of the signal box has been laid.

The annual contest for pop-pop boats and rubber-powered locomotives was held on 4 July at **Bradford MES** and was attended by nine locomotives and three pop-pop boats. In the locomotive competition, Graham Done retained his title for the longest distance travelled with a distance of 600 feet. Russell Coppin achieved fastest time over 30 metres, covering the distance in 6.9 seconds. Russell almost completed a full 440ft. circuit before derailing at speed. Daniel Hobson retained the Piot Trophy for the fastest time (24 seconds) in the boat competition.

The club outing at **Brighton & Hove SMLE** combined trips by rail and water. The first part of the trip was to the Sittingbourne & Kemsley Light Railway for a trip to Kemsley Down. The return journey incorporated a "run past" for the photographers present. A further trip on the coach took the group round Canterbury for a trip on the paddle steamer *Monarch* which is moored on the Great Stour river at Grove Ferry. The final part of the day was to a privately owned ground 5 and 7¼in. gauge garden railway.

Fylde SME is celebrating the acquisition of a new club locomotive to replace the two Class 08 shunters that were stolen some time ago. The new locomotive is a Class 20 from Don Jeavons and was running for the first time on 12 August.

The **Leighton Buzzard Narrow Gauge Railway** held an Indian weekend in May which was blessed with suitable 'monsoon' type weather. In spite of this the railway was turned into a "little corner of India" and there were four locomotives present which had worked in India. These were Darjeeling Railway No. 19, Baldwin No. 778, No. 740 and *Rishra*. Further information on the railway can be obtained from www.buzzrail.co.uk or T. 01525 373888.

The newsletter of the **Malden DSME** carries a report that "the Alps have been scaled at last". This refers to the first public running train to go over the bridge on the ground level track. Mike O'Brien reports that "apart from a standing start at Hampton Court Junction and wet rails, no real problems were encountered". The route will now be used on all track days. The refurbished kitchen has received a "silver" award from the local authority in a recent inspection.

I have received a very nice newsletter from a society new to me (and this column I think). The society in question is **Mold MES** which is based at the Welsh College of Horticulture, Northop, Flintshire. Further details can be obtained from the website at www.moldmes.com or Secretary Pete Ball (T. 01352 750492). The society offers facilities for 3½ and 5in. gauge locomotives on a raised 1,700ft. track in Celyn Wood and has a current membership of around 70. The track features a full set of line side buildings and a long curved viaduct. There are also facilities for smaller gauges (32mm gauge). Public running takes place on Sundays from 1am until 4pm and work parties on Wednesdays. I am sure readers will look forward to hearing more from this society and I welcome the society to our exclusive (very) group of correspondents.

The lease for the Goodwin Park site of **Plymouth Miniature Steam** has been renewed with no significant alterations although with a rent rise of 25%, but this is fixed for a number of years. One of the conditions imposed when the society "moved in" was that trees had to be planted. Now, several years later, control of the undergrowth has become a major maintenance task. Dave Everett reports on a visit to the Anson Engine Museum (www.enginemuseum.org T. 01625-874426) on the outskirts of Poynton in Cheshire. Dave recommends a visit for those interested in the history of internal combustion engines.

The club running session on 12 August at **St. Albans**

1. Robin West obviously enjoyed driving his Fayette at the National 2½" Gauge Association Rugby rally.

DMES turned into something of a GWR pannier tank festival with no less than three of the locomotives present being pannier tanks.

The workshop at **Taunton Model Engineers** has gained an Atlas lathe, courtesy of Alan Miller. The result is that the second Tuesday of each month has now been designated as a workshop evening where less experienced members can learn some model engineering skills. Works completed on the track site include a piped water supply to the station area and a large water tank by the foot crossing. The point lever has been installed on site and some trains have now used the north loop to extend their trip on the line. The decision has been made to construct a club locomotive and an electric-powered Class 35 Hymec design has been chosen. Construction is under way with some parts already almost complete.

There was some apprehension before the open day at **Wigan DMES**, not due to worry that no one would turn up, but in case everybody turned up. The reason was that the overflow car park area had become very soft due to the wet weather. On the day, half the car park had to be taped off but the 84 cars that arrived were parked on firm ground with only a short walk to the track. There were 26 visiting locomotives on the day with only one non-runner. The weather relented and remained sunny for the day, resulting in a very successful event.

I recently visited the Kew Museum Steam Extravaganza and came across an unusual engine (**photo 2**) which was on loan to the museum from **Harrow & Wembley SME**. The model is a fine stationary engine (circa 1870) and is thought to be either an apprentice piece or a company demonstration model. The engine features Proel valve gear (**photo 3**) indicating that the engine was of German origin. After some attention to the glands, the engine was soon ticking over on the museum steam supply and generated a lot of attention from the visitors.

The fine vintage model stationary engine at Kew Steam Extravaganza

The Proel valve gear on the stationary engine.

World Club News

New Zealand

Hutt Valley MES reports that the 4 August meeting involved some breath testing of members. This was entirely voluntary and was part of the presentation by Ross Gainsford on breath testing equipment. This does not mean that random testing will be carried out on rostered locomotive drivers.

Members of **Maidstone MES** are hoping that the opening of a new 'megastore' opposite the entrance to the park site will boost takings on running days.

Trade News

Myford Series 7 Manual – Ian Bradley

The latest re-issue of Ian Bradley's classic guide to using Myford's 7 series metalworking lathes in the home workshop is now available.

First published in 1973, the author subsequently revised the work to include the ML7, Super 7 and ML7-R lathes, so that the contents of the book are as valuable to readers who have the later types of lathe as well as those who possess the earlier machines.

Topics covered include

· Installation · Lathe tools · Sharpening · Mounting work in the lathe · General turning, drilling and boring in the lathe · Milling in the lathe · Gear cutting in the lathe · Taper work · Repetition work · Maintenance · Additional fitments and operations · A two-tool back tool post · Design changes · Formulae for gearing · Tables for threads · Lubrication ·

The book was first published in 1973 by MAP (Model & Allied Publications), revised by Argus Books in 1982 and republished by Nexus Special Interests in 1997.

Myford Series 7 Manual by Ian Bradley, (ISBN 978 085242 775 0) is a paperback, 210 x 148 mm; 232 pages with black and white photographs. It is priced at £7.95 and can be obtained from Special Interest Model Books; Sales Office, Stanley House, 3 Fleets Lane, Poole, Dorset, BH15 3AJ United Kingdom, T: 01202 649930.

Humour Time

The following was from Sutton MEC:

A story broadcast on the Wake up to Wogan show, Radio 2

Late on a dark autumn evening, whilst travelling home on board a train comprising of the old slam door railway carriages, a well dressed city gent, probably on his way home after a sumptuous business lunch, was quietly dozing in a corner seat after reading the *Financial Times*.

For some unknown reason the train drew to a halt with a jolt between stations, at which point the gent woke with a snort, rose from his seat, quickly gathered up his briefcase and umbrella, checked his bowler, and opened the nearest door, promptly strode out into the blackness of the night.

There was a sickly thud and a scrunching sound as he made the rather unwelcome acquaintance of the ballast and an over friendly sleeper, and in the true fashion of seasoned commuters, nobody was willing to make the first move in the offer of assistance.

A rather scuffed briefcase, dented bowler hat and still neatly furled umbrella were unceremoniously dumped on the floor inside of the carriage door, followed by a rather dishevelled pin-stripe clad city gent.

Having clambered back on board, he shut the door and muttered to no one in particular, "that was silly of me wasn't it", proceeded to brush himself down and strode across the carriage, he then opened the opposite door and repeated the foregoing procedure in the same dignified manner!

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.

Gilbert Bennett	*National 2½" Gauge Association*
John Clarke	*Northampton SME*
Roy Taylor	*Taunton Model Engineers*
Bill Smith	*Malden DSME*

NOVEMBER

9 **Colchester SMEE.** *Chris Hurricks: Scotland & West Steam.* Contact K. Wraight: 01255 434091.

10 **Glasgow & S.W. Rly Ass'n.** *Ian Quinn: Northwards by Sea.* Contact Bruce Steven: 0141 810 3871.

10/11 **Hutt Valley MES.** *Tauranga Open Weekend.* Contact Gavin McCabe: 567 4487.

10 **SM&EE.** *Training Seminar.* Contact Maurice Fagg: 020 8669 1480.

11 **Bedford MES.** *The great autumn put away.* Contact Ted Jolliffe: 01234 327791.

11 **Bradford MES.** *Ron Rose: Carriage Clocks.* Contact John Mills: 01943 467844.

11 **High Wycombe MEC.** *Roger Radshaw: Nuclear Submarines.* Contact Eric Stevens: 01494 438761.

11 **Leighton Buzzard NG Rly.** *Armistice Day.* Enquiries: 01525 373888.

11 **Sutton MEC.** *Track Day & Bonfire Night Barbecue.* Contact Bob Wood: 020 8641 6258.

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

12 **Bedford MES.** *Our winter plans on site and track.* Contact Ted Jolliffe: 01234 327791.

12 **Melton Mowbray DMES.** *Work in Progress.* Contact Phil Tansley: 0116 2673646.

12 **Saffron Walden DSME.** *Club Night.* Contact Jack Setterfield: 01843 596822.

13 **Manx Steam & MEC.** *Meeting.* Contact Richard Rake: 01624 671258.

14 **Chingford DMEC.** *Trade Visit – Phoenix Locomotives.* Contact Ron Manning: 020 8360 6144.

14 **Hull DSME.** *Auction.* Contact Tony Finn: 01482 898434.

14 **Norwich DSME.** *Andrew Ward: Considerations of CNC Machine Tools.* Contact Shirley Berry: 01379 740578.

14 **St. Albans DMES.** *EGM & Members' Evening.* Contact Roy Verden: 01923 220590.

15 **Cardiff MES.** *Cyril Chandler: Cyril's Film Night.* Contact Don Norman: 01656 784530.

15 **Frimley & Ascot LC.** *AGM.* Contact Bob Dowman: 01252 835042.

15 **Isle of Wight MES.** *AGM.* Contact Malcolm Hollyman: 01983 564568.

15 **Sutton MEC.** *Chat Night.* Contact Bob Wood: 020 8641 6258.

16 **Brighton & Hove SMLE.** *Mike Hudson: Allied Military Steam Locos of WW2.* Contact Mick Funnell: 01323 892042.

16 **Canvey R&MEC.** *Meeting.* Contact Brian Baker: 01702 512752.

16 **Rochdale SMEE.** *Bits & Pieces.* Contact Bob Denyer: 0161 959 1818.

16 **Romford MEC.** *Photo Talk.* Contact Colin Hunt: 01708 709302.

17 **Canvey R&MEC.** *Members' Only Running Day.* Contact Brian Baker: 01702 512752.

17 **Dublin SMEE Ltd.** *Meeting.* Contact Colm de Brun: (01) 868 2549.

17/18 **Kempton Steam Museum.** *Steaming Weekend.* Information: 01932 765328.

17 **SM&EE.** *Rummage Sale.* Contact Maurice Fagg: 020 8669 1480.

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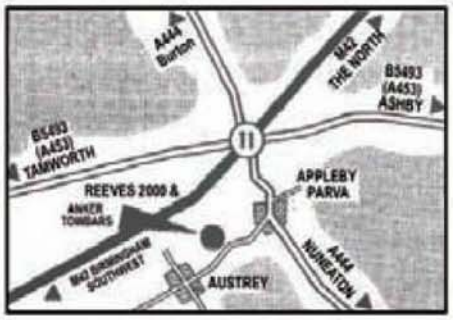

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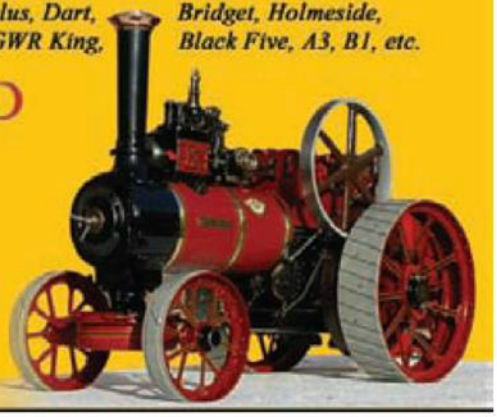

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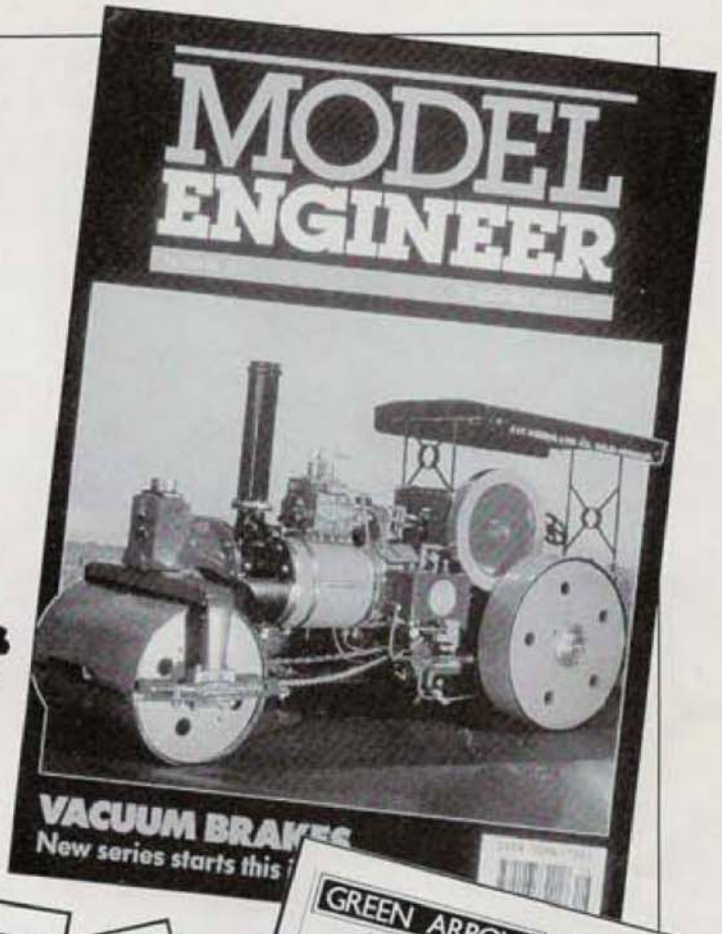

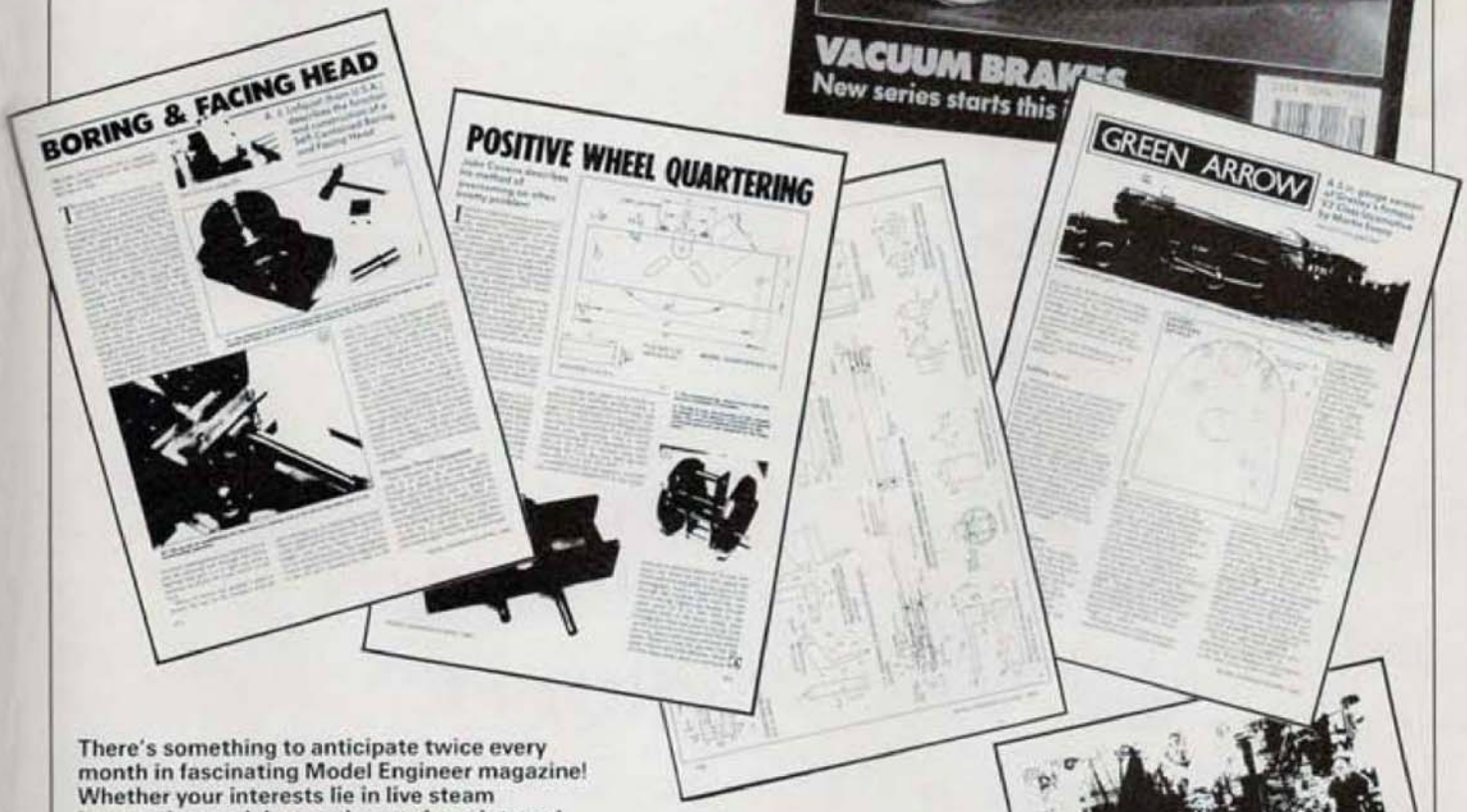

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