

MODEL ENGINEER

Vol. 196 No. 4264

6 - 19 January 2006

NEW YEAR
:
NEW MODELS
:
NEW NEVILLE
EVANS
LOCOMOTIVE
BEGINS IN THIS
ISSUE

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Modeller
of the Year



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STEAM
TRACTOR**
Unique
vehicle
described

**NEW
SERIES**

**MAKING THE SR SCHOOLS
CLASS LOCOMOTIVE**

Part one: Introduction and general arrangement drawing

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winner of the Joe Martin Foundation,
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award. As can be seen from the cover,
winner David Kucer of Montreal, Canada
specializes in model guns. A report
appears in Smoke Rings in this issue on
page 13. Mr Kucer is the tenth winner of
this award and will receive a gold
medallion, award plaque and US\$1,000 at
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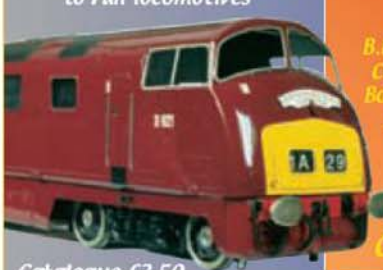
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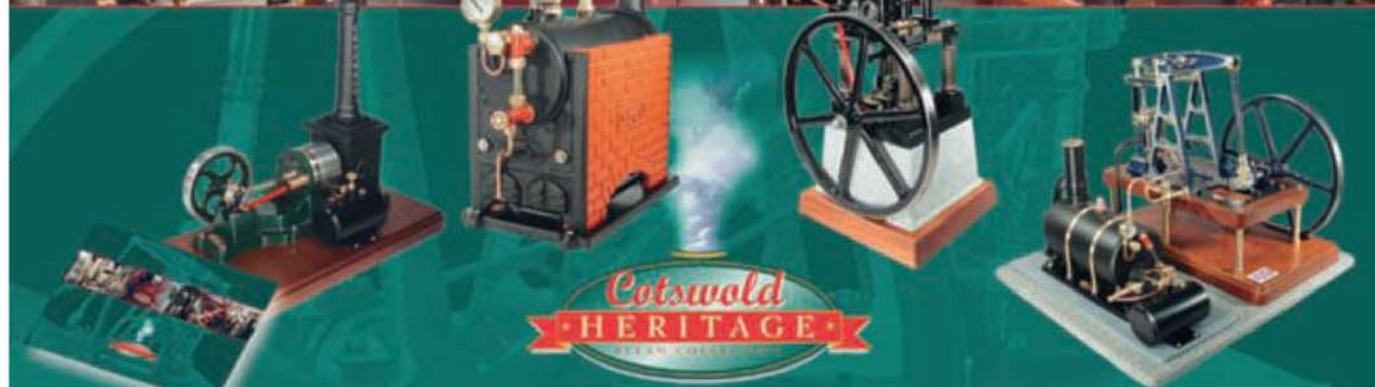
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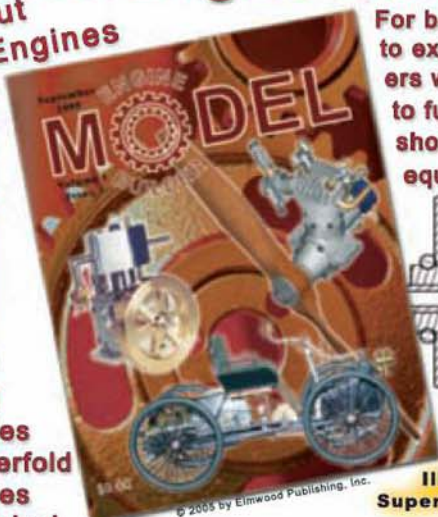
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Model Steam Locomotives

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Henry Greenly's *The Model Locomotive* was published in 1904 and formed the basis of the first edition of this book, published in 1922. Five further revised editions appeared over the years before the outbreak of World War II, a seventh edition appeared in 1951, and the eighth edition, reprinted here, appeared in 1954. The last two editions were revised and updated by Greenly's son-in-law Ernest A. Steel, with considerable input from Greenly's daughter

Elenora, but remain very much the work of Henry Greenly. Perhaps because of the amount of work he undertook for Messrs. Basset-Lowke, Greenly's experience of designing and building model locomotives covered all gauges from Gauge 1 to 15" gauge, and the major changes between editions of this book chart the gradual increase in gauge of the models being built by model engineers, with 5" and 7 1/4" gauge practice becoming more and more prominent. However the smaller and larger gauges are also well covered, and this range of gauges is unique to this title. Greenly was a professional engineer with very wide ranging experience, and this is reflected in the pages of this book; 16 chapters of direct writing and instruction, all very fully illustrated with drawings, tables and photographs - many of the latter illustrating models built by some of the twentieth century's finest builders.

Any book which has effectively remained in print over some fifty years has to have been of the very highest quality, and a century after the first version of it appeared, *Model Steam Locomotives* remains one of the very best books written on building model and miniature steam locomotives, and one which will prove an invaluable reference for locomotive builders in the 21st century. 322 pages and paperback.



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In this best selling book, New Zealander Ted Warbrooke describes how to build a unique form of Stirling Engine which does not have a displacer. The theoretical possibility of such an engine has been long considered, but as far as we are aware, Ted's is the first design that actually works. Because the only moving parts are the piston, crankshaft, crank and flywheel this is a very simple engine to build, and an ideal project for the beginner. Equally it will have considerable appeal to Stirling Engine enthusiasts as the possibilities for experimentation with this design are considerable. This book contains full drawings for this engine, plus hints and tips on building it, assembly photos etc. *Stirling 1* requires no castings, and can largely be made from bits in the scrap box. Simple but accurate turning, some hand work and some soldering are all that is required to build this fascinating engine. High quality 32 page A4 paperback.



Clockmaking for the Model Engineer

• Thorne • £ 13.95

Written to help the established model engineer who would like to build a first clock, this book does just that extremely well. There are no instructions on how to get the best from your lathe, how to set up work on the milling machine, or similar sorts of advice. It is assumed that you know these things already, and that you are experienced in the use of hand tools. Perhaps you have thought you would like to make a clock (a future family heirloom), and

wish to know what specialist techniques and tooling are required. This book takes you through the construction of a typical clock, describing, as they arise, those techniques of the clockmaker that differ from, or are seldom used, in model engineering. Specialist tools and their uses are also described, as the need for them arises during clock construction. Virtually all of these tools can be made by the clockmaker; clockmakers have always been toolmakers as well. Finally, drawings are provided for one simple, and unusual, clock which is ideal as a first clock making project, but which still requires you to make all the pieces likely to be found in many more complex timepieces. Within the pages of this book, well known horologist Colin Thorne has provided the model engineer with an ideal introduction to the fascinating world of clock making. Here is comprehensive information, put over in a relaxed and readable way, with lots of 'wrinkles' which will be useful to all model engineers, whether or not they go on to build their own horological masterpiece. Any model engineer considering making his first clock should have this book on his bookshelf. 88 A4 format pages. 58 drawings in text plus complete set of 9 drawings for the *Benjamin Franklin Clock* and 11 B & W photos. Softcover.

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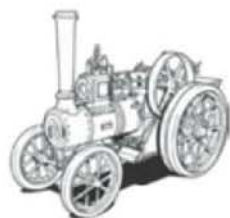
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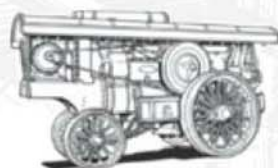


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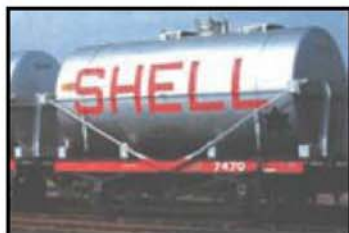
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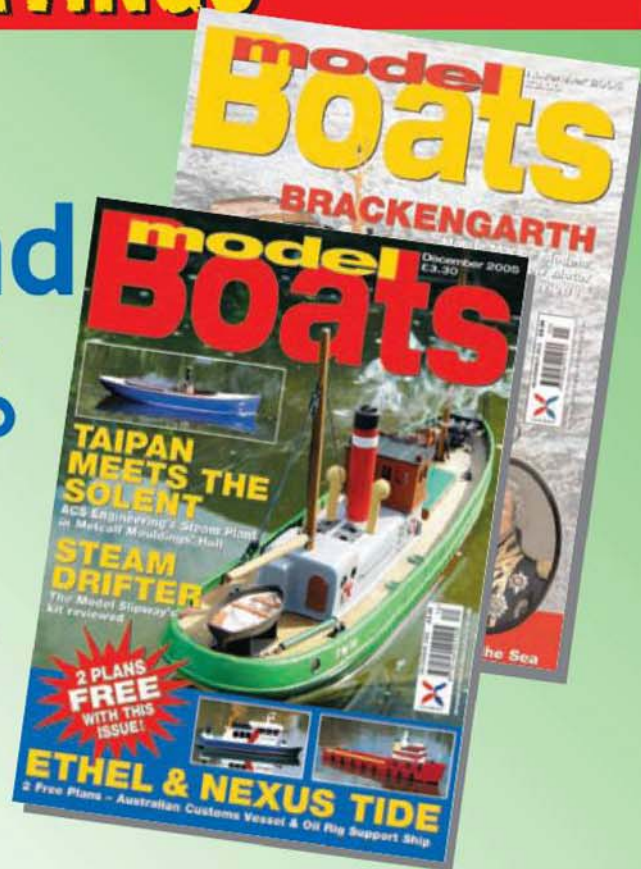
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SMOKE RINGS

With the Editors



David Kucer's model Thompson machine gun

Top gun

David Kucer of Montreal, Canada has been selected as the winner of the Joe Martin Foundation award for Outstanding Metalworking Craftsman, 2006. He will receive an award plaque, a gold award medallion and a cheque for \$1000.00 from the Foundation.

The award will officially be presented at the North American Model Engineering Society Exposition in Toledo, Ohio on April 24, 2006. Mr Kucer will attend the show and display some of his work.

Mr. Kucer was apprenticed in his father's workshop in Poland before the family emigrated to Canada in 1930. As a boy, David had seen two miniature pistols at a show in New York. He says: "The disease struck me."

Using equipment in his father's shop he built his first, somewhat crude, miniature gun. After serving as an armaments artificer in the Canadian army during the Second World War, he decided to make a miniature of his Colt .45 service automatic. He collected or made the proper tools for the job and began the learning experience of making miniature guns. Along the way he also studied painting, drawing, sculpture and Japanese netsuke carving, at which he has become quite accomplished.

Over the years, however, it has been his miniature firearms that have brought David's work to the attention of collectors worldwide, where his pieces are highly sought after. The level of craftsmanship of his work is ranked with the world's best in this area.

Joe Martin is a lifelong modeller, toolmaker and the president of a company that manufactures miniature machine tools. The Joe Martin Foundation was established to reward craftsmanship.

The purpose of the award is to bring attention to those who have attained a level of craftsmanship that is recognised by all who see it to be 'head and shoulders above' similar work in a particular area. By recognising the

achievements of these individuals, it aims to "bring attention to the hobby of miniature machining and encourage a new generation of people to learn and enjoy the skills of working with machine tools and making things of precision and beauty."

Grandson gremlins

Adrian writes to tell us that there is an error in the No 81 letter to him. The final equation should read:

$$g + (p + q) = (L_1 + L_4)/2 = (L_3 + L_2)/2$$

And that the distance between C and C1 presumably meant the average of $L_1 + L_4$, or of $L_3 + L_2$.

Changes

In case you missed it in the last issue, please note that the office phone numbers have changed. Please see page 3 for our new numbers.

You will also find there our correct postal address. Any other address can take an age to get here, if it ever does.

Driving ambitions

Bournemouth and District SME has discovered that it is possible to have a day's driving experience on the delightful Seaton Tramway. It can cater for a group of six people to have a full day with a tram and driver/instructor. Each person can have one and a third end-to-end journeys at the controls.

The day includes a mid-day meal, morning tea or coffee, and a cream tea in the afternoon. A tour of the workshop is included.

Seaton Tramway operates narrow gauge heritage trams between Seaton, Colyford and Colyton in East Devon's glorious Axe Valley, travelling alongside the River Axe estuary through two nature reserves and giving an unrivalled view of the abundant wading bird life. The coastal resort of Seaton is now a gateway town to the Jurassic Coast, a UNESCO World Heritage Site, while the historic town of Colyton was described as "Devon's most rebellious town" for its part in the Monmouth Rebellion of 1685.

Seaton Tramway has always been famous for its open top trams, but also has three enclosed single-deck saloons — a tram for all seasons!

See www.tram.co.uk for details of the Seaton tramway.

The Bournemouth Society is also reviving its Funlec this year, with a different format with the aim being "to have some fun." Competition for the Funlec Cup will take the form of a shunting competition using an electric locomotive.

Teams comprise a driver and a shunter/guard, and a large entry is expected.

CHUCK, the MUDDLE ENGINEER

by B. TERRY ASPIN



POST BAG

I/C engines without worry

SIRS, - M.E. 4257, 30 September 2005 just to hand and I note the letter from Mr. Alex du Pre. For a long time I too did not dare and then something happened (no, I don't know either) and I sent off for Mr. Chenery's drawings of his 15cc V-twin as a first attempt. Yup, cocky git and no one was more surprised than me when it ran.

So, I wouldn't be over worried about materials- no lead con- rods mind! There were four alloy castings supplied (and very nice too) otherwise it was Dural bar for the cylinder jackets (off-cuts) cast iron stick for the liners (College Engineering Supplies) odd bits of mild steel for the crankshaft, some little bits of silver steel for the valves (left as supplied), some gash piano wire for the springs. In other words it was mostly made of specially selected junk. The contact breaker is a commercial item, the smallest I could find. The distributor likewise is an off-cut of Perspex and Tufnol.

Lubrication is by crankcase vacuum, it works. Air cooled, the prop takes care of that. Surface finishes of bores etc., get it as good as you can, it'll bed in. You can leave all that honing and lapping etc. to when you get round to thinking about winning medals.

Camshafts, yup-there'll be no medals for me - I made them all the same in one piece by filing using a roller filing rest, drilled through and reamed (yes, yes, I know) and then parted off and Loctited the lot to the camshaft. I can't now remember how I set them up but it was a ridiculously simple process using a try square and the cross slide.

I think you get the drift, I too started by thinking of all the obstacles, surprising how they disappear when you forget about medals.

I'd got the lot finished when the real problem that had been in the back of my head from the beginning finally needed to be addressed; spark plugs. Well, I did my usual reading and nothing seemed right. Then by chance I met a chap I took to be Dave Bramwell (if you get a chance, take a look at his stuff.) Anyway, we fell to talking, initially about motorcycles, and he suggested using ceramic fuse bodies for the plug insulators. 20mm fuse bodies is what I used and they work well.

Bar frames

SIRS, - Peter Rich in his article *GWR Locomotive Bar Frame Extensions and Cylinder Arrangements* M.E. 4258 14 October 2005, writes:- "I point out that the bar frame was an idea imported from America by Churchward". From *The British Steam Locomotive 1825 - 1925* by E. L. Ahrons, "the locomotive America

built by Messrs Stephenson in 1828 for the Delaware and Hudson Canal Company was in many respects similar to the Lancashire Witch and had a primitive single bar frame".

The firm of Bury, Curtis & Kennedy, Clarence Foundry, Liverpool, originally designed and used bar frames on their locomotives with Edward Bury the inventor. From *The Engineer* of 1923:- "Between 1831 and 1837 the firm sent about 20 locomotives to America that had inside bar frames. The day of the bar framed engine was practically over in 1848. Bury's firm had had an almost entire monopoly of this design, of which it had built more than 350 engines".

The photograph of the blue plaque at right was taken recently. It is fastened to the wall of Hillsborough Hall, Sheffield now a local library, and is within half a mile of



Sheffield United football ground.
P. J. M. Southworth, Chesterfield.

Right, enough ranting, the main thing I found was that the problems were mostly inside my head and not with the job. No I didn't make another engine, I made a couple of clocks. Variety, etc., etc.

J. Duffus, Edinburgh.

Letters to a Grandson - No. 80

SIRS, - Mr. Paul Abley of Great Ayton, North Yorkshire has drawn my attention to an error in my article *Letters to a Grandson* (M.E. 4257, 30 September 2005).

I said that the astronomical quadrant, for which John Bond was celebrated, was used to measure the "right ascension" of a star. This is incorrect and I should have said "altitude".

The mistake was not caused by carelessness, but by misunderstanding on my part, and I apologise to readers for inadvertently misleading them.
Monty Ellis, Bristol.

A Sealion engine

SIRS, - In M.E. 4252, 22 July 2005 your contributor Neil Read showed a picture of my 4-cylinder OHC petrol engine and wondered what it would be used to power.

My intention was that it would power a shunting engine similar to a BR Class 08, but with a very simple transmission system.

About 30 years ago on a visit to The North York Moors Railway I noticed an old rail trolley half hidden in long grass. There was no bodywork on the trolley so it was easy to see the drive mechanism. The engine was mounted in line with the chassis and the flywheel was perfectly flat except for a small depression in the centre. Immediately behind the flywheel and at right angles to it, was another

wheel mounted on a splined shaft. A chain sprocket was fitted to the end of this shaft, and the drive went from this sprocket to a similar one on the back axle.

When the driven wheel was over the centre depression of the flywheel there was no drive but as it was moved left or right across the face of the flywheel, it turned the rail wheels either forward or reverse. A cone clutch in the model, in the drive sprocket, would have eased starting and provided a means of stopping quickly in case of emergency.

The *Sealion* engine was quite easy to build; the only things which looked likely to cause a problem were the crankshaft and the camshaft. I had previously built a six throw crankshaft and a camshaft for my Sentinel rail car so I thought it would not be too much of a problem. Having made all the big end bearings I started on the centre bearing. Unfortunately this shaft is not as robust as my previous one and just as I was almost at the correct size the tool dug in and the shaft flew across the workshop. I have not yet found a use for a crankshaft which is bent

in the middle at 30 degrees! Fortunately I had enough steel bar left to make another one. The engine as shown is as far as I have progressed to date; the engine was put to one side while I got on with my other job of finishing a pair of L&YR Pugs, but that as they say is another story.

John Pullan, Scunthorpe.

An unknown lathe

SIRS, - I am writing in hope, to ask if you or any of your readers could identify and date this lathe. All parts including change wheels etc. seem to be of Myford origin.

It is mounted on its own cast iron stand and was originally flat belt driven, but I converted it to V-belt drive. Measurements are 3in. centre height, 19in. between centres, with an 8in. swing in gap. No numbers are visible on it and the maker's plate is missing.

The bed was reground about 10 years ago, and it is a beautiful little machine to work with. Trojan and a Stuart No. 5 have both been built using this machine. My grateful thanks to any reader who could help identify this machine.

Mick Johnson, North Yorkshire.



Can any reader identify Mick Johnson's mystery lathe?

Seeking springs

SIRS, - I am delayed in completing a model due to my inability to locate a company prepared to manufacture 20 off small light weight coil springs.

It would prove most helpful if any readers could advise me of suitable companies who will be prepared to undertake this small batch requirement.

Robin Howick, Devon.

Leaflet drop

SIRS, - Can anyone advise? I am the author of a semi-technical booklet and want to promote it by leaflet and by a small five foot balloon with the leaflets inserted inside.

The problem is how I could burst the balloon at altitude using a small harmless device to pop it allowing the leaflets to be cast to the wind. Any ideas?

P. Phipps, Berkshire.

Rockers in the valve gear driveline

SIRS, - The Swindon G/A for the King Class depicts the outside left-hand piston in mid stroke. In this position the inside blade of the rocker is at 90deg. to the frame and inside left-hand valve spindle, and since the inside crank is at 180deg. to that on the outside, it follows that the former is several degrees from reaching mid stroke.

That in turn means that the common conception of the rocker having one straight blade and the other cranked at an angle is in error - clearly both are cranked but to different degrees. Their lengths, too, are different. Peter Rich's elegant drawings do not follow the King arrangement in respect of this setting, though I am sure that this well-respected builder has a reason for not so doing.

The cranking of an arm to ameliorate (but not cure) crank angularity has been used many times, perhaps the most familiar being that of the bell crank in Baker gear. In fact, the Walschaerts expansion link is itself a form of 'cranked rocker', this time to a curve. It needs to be this shape at dead centres to conform to the principle of the radius rod, yet as soon as it tips away from this position it would be helpful if it could assume a larger curved or even straight form! Back-set adjustment may result in an adequate but indefinite solution, often altering the expectation that the eccentric rod's centreline should pass through that of the axle.

There is no reason why this should always obtain, save to preserve the logic of designing

valve gears using first principles and then fine tuning for angularity problems by adjusting appropriate parameters. Any other method invites and prolongs the conjecture that should not arise from a finite mechanism.

Don Ashton, Manchester.

More on Juneero

SIRS, - Following Peter Spenlove-Spenlove's letter (M.E. 4255, 2 September 2005), I append these notes on the subject of the Juneero multi-purpose tool.

I bought one of these delightful tools in about 1937 and have used it on occasions ever since! I can confirm that it bends, cuts and punches holes fairly safely in steel strips $\frac{3}{8}$ in. wide and similar strips of steel $\frac{3}{8}$ in. angle.

I am enclosing a photo showing the tool a bit worse off for wear, as far as the paint is concerned, but the steel used in its construction is still sound, for its age it is pretty good.

I didn't come across any fancy sheets that Peter shows but it was quite a time ago and pocket money was pretty short. The basic tool was very attractive and was itself a good find. I think it was a much reduced bargain at a post Christmas sale in Lewis's, a shop which did not normally sell such goodies, later destroyed by the Luftwaffe.

Joseph Preston, West Sussex.

Scissors valve gear

I read with interest in M.E. 4256, 16 September 2005, the letter by Robert Mills of Birmingham regarding the so-called 'scissors' valve gear. I can recall quite clearly having a discussion about this gear at the Model Engineer Exhibition some 50 years ago when I was helping to run the passenger track.

A friend of another member, just retired as Mechanical Engineer from the East India Railways, had been a GWR apprentice at the time the gear was being fitted to locomotive No. 40. For what it is worth this person recalled that setting the valves was a very troublesome proceeding, for to get the correct valve setting various links and levers had to be dismantled and sent to the blacksmith's shop to be lengthened or shortened, the whole process taking about three weeks! Whether the Midland Railway, had the same problem I do not know, but clearly this form of valve gear did not find favour.

I was rather pleased to see the photo of my Merchant Navy Class locomotive No. 35021 in the report of the Southern Locomotive Rally



Joseph Preston's Juneero looking slightly worse for wear but still functional.

at the Surrey Club's track at Leatherhead. In the competent hands of fellow Sutton Club member Peter Moles it ran smoothly throughout the rather wet day. I fired the full size version when in the Top Link at Nine Elms. I kept all the footplate fittings well polished, it was a treat to come to work and both my driver and I never had any troubles except for losing the top of the oil well on the right side connecting rod big end and suffering a hot big end bush by the time we got to Southampton thus needing a change of engine.

The rather nice Southern multiple unit should have been described as a 3-Sub. After WW2 they became a 4-Sub. having an all steel additional trailer coach inserted in the formation of the set. I often drove them in later years.

R. H. Coffin, Surrey.

A GWR mystery

SIRS, - A colleague of mine recently unearthed a railway sleeper, long buried, on the side of the former single track Great Western Railway line near Alvescot, Oxfordshire. The line closed around 1963. The sleeper retains both chairs, each marked 'GWR' and cast in 1892. Presumably the letters 'SN' denotes that the chair was manufactured in Swindon.

What we would like to know is where the other chair, marked 'PNB' was cast? Is there a list of the GWR foundries which produced such items over the years?

R. A. Chambers, Oxfordshire.

Savage's Universal Carrier boilers

SIRS, - Re the Savage's Universal Carrier boiler (M.E. 4260, 11 November 2005).

I am pleased to note the advanced (i.e. water tubed) boiler design for this project and would like to offer some comments.

I observe that the boiler is well constructed and tested to 400psi for a working pressure of 125psi.

There are a couple of problems that should be drawn to your attention.

Copper at 125psi steam temperature has 0.8 times its strength at 100psi. Adding thickness does not work as the copper has already failed by partial plastic flow within the thickness of the material (from the pressure side).

Thus the material is being used outside the normal operating stress level. (This is HND stress theory, which is way outside the scope of M.E.).

Whilst the HSE guidance notes (Pressure Systems Safety Regulations 2000) give no upper limit (other than 32 bar), regulation 4.2 requires the system to be properly designed so as to prevent danger.

I have a copy of the Australian Miniature Boiler Safety Committee Code (1984) which states:

"1.1.5 Maximum design pressure 700kPa (101psi equivalent).

1.1.6 Boilers of higher pressure to be submitted to the statutory authorities for design approval."

I believe that a similar situation exists for insurance cover under the Southern Federation codes.

I believe that the copper boiler could be operated at 100psi maximum to give safe and durable service life but higher pressures would require a change of materials to ferrous based.

P. W. Collyer, Kent.

The Duplex company

SIRS, - Do any of our readers know if the 'Duplex Company' is still in operation? I have tried to contact them, but to no avail. Perhaps someone out there knows of a source of supply of drive belts for the Duplex tool post grinder (MYS 7 Myford Super 7B).

I have tried making my own but they do not last very long. Any information would be most welcome.

N. Dakers.

Another rocking engine

SIRS, - Further to my letter of April this year, part of which you published (*M.E.* 4252, 22 July 2005, I thought I would have a go at my own version of the 'rocking engine'.

It is made mostly from oddments which have accumulated in the workshop. The contact blades came from an old Post Office relay. The only parts purchased were the battery holder, the switch and a capacitor for spark suppression. It runs well from four AA size cells in the hollowed out base.

I have now made a start on another one that will use a magnetic core reciprocating in a solenoid. It makes a change from our more usual, serious subjects. Where there is no actual prototype, one can use a bit more imagination!

Derek Winks, London.

Chinese lathes

SIRS, - I was interested to see the recent letters from Messer's Thompson, White, Walker and Dodd (*M.E.* issues 4251 and 4259) on choosing a lathe and the references to my article on the Warco BH600 lathe.

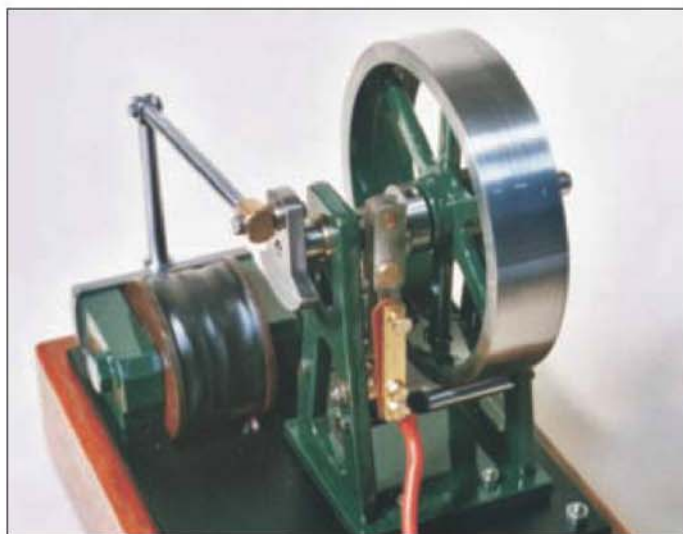
There can be no complete answer on how to choose a lathe as we all work under different circumstances and criteria and view things from different perspectives. However, I can give a few pointers on how I see things.

The major decision to make first of all is what sort of model you want to build. Will it be large or small, will one want to ring the changes through the different disciplines, or stick to one segment of the hobby. Once that decision is made sourcing the equipment can begin.

Unless you are doing only tiny things whatever you choose will ultimately prove too small, so get the biggest you can house.

The choice between second-hand and new is difficult, and from the correspondence seems to have evolved that the second-hand is British built and the new is Far Eastern in origin. It would be very nice to always buy new British machines but the prices are beyond the reach of many at least where a hobby is concerned.

The problem with second-hand is that you usually do not know the history of the machine. Why has it been sold? Is it worn out, damaged, or surplus to requirements. We have all abused our own equipment at some time whether by chance or intent and the model engineer is much more careful than industry.



Derek Winks' version of the 'rocking engine' made mostly from oddments.

So that should be born in mind, carefully check out the second hand lathe and if possible take along a friend who knows the ins and outs of these machines. Also spares for the British machine can be very expensive.

When comparing the overall size or footprint of the BH600 it is somewhat smaller than the equivalent British machine of the same capacity.

The cost of home grown equipment even when second-hand can be two or three times the cost of a new Far Eastern machine. Even when you have your lathe installed it is not much use without a range of accessories and tooling. Some of the accessories come as standard with the Far Eastern machine, and the rest of the money saved can be used to buy the tooling.

Relatively speaking tooling has never been cheaper and the quality can be very good indeed. As in all things you get what you pay for. Take for example the digital calliper. The 150mm variety can be bought from £7.50 to £50, and at first glance they all look the same. They may even have come from the same factory, but you can have them made to any quality standard you want. The case is the same for

lathes, mills, etc., so look carefully at the same machine from different suppliers. However, the cost of high quality Far Eastern tooling is often very much cheaper than the European or American equivalent.

The situation in China has similarities to the start of the industrial revolution in Britain. Large numbers of agricultural workers are leaving the land (100 million in 20 years for China) and taking jobs in manufacturing industry. Their economy is growing at 10% a year, ours is about 1 1/2% a year. Manufacturing creates wealth, service industries do not. The Chinese are an educated people; they have had 4,000 years of continuous civilisation. They were able to cast iron a 1,000 years before we could. In the 18th century they had the largest economy in the world, just think of the exports of porcelain. They want to regain that position.

The quality of some of the early far eastern machines did leave something to be desired. The quality from some factories is now very good. Interestingly I believe about 75% of the new factory start ups are funded by foreign companies. The very latest technology is used coupled to much

cheaper labour than available in the developed world. However, the pay for a Chinese factory worker is much better than that of an agricultural worker. It all has to be viewed relatively.

There were some comments on the modifications I made to my lathe. I have never been satisfied with any lathe I have had whether British or Foreign they all needed modification of some sort. With regard to the addition of oil grooves I did that to the Myford as well, as that did not have them either.

As was mentioned in a couple of letters real advances are being made with electrical equipment and the costs are dropping fast, I see the way forward as having a three-phase motor running from a single-phase supply through an inverter giving infinitely variable speed at the turn of a button and the advantage of a soft start, beneficial to both motor wear and running costs. Some Far Eastern lathes are now being built with this as standard, (it is not the case with British machines but there is a German machine), and they even have digital speed readout. Also give serious consideration to a two axis DRO for the lathe, three axis for the mill if you are going to do a lot of work.

As fascinating and interesting as model engineering is, it is for most practitioners a hobby not an essential of life. A Far Eastern lathe is for many the cheapest and only option to gain entry. I found my BH600 an accurate lathe ideal for the type of model engineering I do. I suppose I spent about 40 hours, a weeks work 'fine tuning my lathe' the major parts clutch and tailstock capstan feed are not fitted to Colchester type lathes either, the time taken was infinitesimal compared to the life of the machine. But I still dream of the ideal model engineer's lathe, but it has not yet been built.

Anthony Mount, Devon.

Woods metal

SIRS, - I was reading the article on boiler construction in *M.E.* 4258, 14 October 2005 for the Savage's *Universal Carrier* and noticed the mention of Woods Metal.

I have been searching for this material for many years and had virtually given up as all enquiries to the usual suppliers met with a negative response.

Can any of our readers please let me know where I can get a supply of Woods Metal?

M. J. Atkinson, Cornwall.

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Responses to published letters are forwarded as appropriate.

EDWARDIAN ELEGANCE

Ron Isted

continues the fascinating story of the Smith Atlantics.

● *No. XIII Part II.*

Having put on record the performance data achieved by No.730 last time, 72mph would appear to be the highest speed ever recorded by either of the two North Eastern Railway Smith Atlantics, in spite of their big wheels, although admittedly records of their performance are relatively few. As mentioned earlier, the same railway's 2-cylinder compound 4-2-2s had achieved 86mph back in the 1880s and I cannot help wondering whether, magnificent engines that they were in many ways, Nos.730 and 731 suffered, like the Deeley/Fowler LMS compounds, from excessive throttling of the exhaust as speed increased. This rather thorny subject was discussed in part IX of this series on the Midland Compounds, so I will not repeat it here.

Digressing slightly, the tests on No.730 in 1906 were carried out with the same dynamometer car that was to achieve fame over 30 years later when it recorded Gresley's A4 Mallard capturing the world record speed for steam traction of 126mph, and both the car and that immortal locomotive are now re-united in the National Railway Museum at York. Reverting to the 1906 trials, it is a great pity that no tests appear to have been made with the Walschaerts engine, No.731, as the footplate grapevine suggests that she was superior to her Stephenson equipped sister and might have made Walter Smith's triumph greater still. Even so, his original acidic comments were more than justified by the calculation of the relative capacity of NER front line express engines, based on the results of the 1906 tests. Taking the very successful R class 4-4-0s as 100, the much larger S1 4-6-0s came out at a paltry 105, Worsdell's V class Atlantics, the target for Walter's original criticism, at 128, while the 4CC Atlantics were well and truly top of the class at 145.

Ten more 4CCs were immediately authorised, which says a lot for the character of Wilson Worsdell, but, tragically, this was not to be. Walter Smith had been taken ill again shortly after the two original locomotives emerged from Gateshead works, and this time he did not return. He died on 25 October 1906 at the age of 63 and how much he actually knew of the brilliant debut of his two masterpieces is uncertain. A second tragedy of a different kind occurred when his executors demanded exorbitant royalty fees for the use of his patents. As a direct result, not only were the ten North Eastern engines cancelled, but no more of the highly successful 3-cylinder compound Great Central Atlantics were built, even though J. G. Robinson had previously expressed his intention of doing so. On the Midland Railway, as recounted in Part IX of this series, R. M. Deeley had made so many alterations to the original compounds that they could no longer be referred to as 'Smith system' engines. Whether he did this to avoid problems with the executors, or purely to simplify (some might say mutilate) what was admittedly a very complex machine, we shall probably never know.

The subsequent career of the North Eastern's two 4CCs was something of an anti-climax. They were superheated in 1915, but the advantages were rather nullified by the simultaneous reduction in boiler pressure from 225 to 200psi, as was the fashion at that time. Both spent almost all their operational lives at Gateshead shed, No.730 tending to work south to York, while her sister favoured more northern latitudes and appeared regularly in Edinburgh. Both remained on top link workings interspersed with regular Royal Train duties, a sure sign of a high reputation, and both had long lives considering that they were completely non-standard. When the North Eastern Railway became part of the LNER in 1923, the two 4CCs were classified CS by their new owners and for the first few years, little changed, apart from the colour scheme and the fitting of a capuchon to the chimney, increasing the overall height by an inch to 13ft. 3 inches. By the early 1930s however, the general slump in traffic combined with the rapidly increasing fleet of Gresley pacifics made the retention of these two completely non-standard express locomotives uneconomic, so that when the boilers wore out, they were sent to the scrapheap. The Walschaerts engine, No.731, went first, in December 1933, with a mileage of 669,328, but her sister lasted just over a year longer, before being withdrawn in January 1935, after having run 752,939 miles in her life of 28½ years.

A working model of one of these elegant locomotives would certainly be a fine memorial to a very gifted engineer, but like most compounds, is probably not a good idea for a first attempt. One major problem that immediately springs to mind is how to accommodate the scale equivalent of two 22in. dia. low pressure cylinders between our thicker than scale frames. The situation is not made any easier by the main frames on the full size locomotive being in two halves, with the front part containing the cylinders spliced inside the rear section, in order to give clearance to the bogie wheels. Cut-outs to clear the wheels, which are in any case larger than average, are not a practical alternative on a model, as the front section of the main frame is already very shallow due to the position of the high pressure steam-chests previously mentioned. I would suggest that the only possible way round this one is to follow the lead of that fine model engineer, C. M. Keiller, and use a very high boiler pressure allied to a fairly substantial reduction in cylinder diameters. As mentioned in part IX of this series dealing with the Midland compounds, Mr. Keiller used 150psi in 2½in. gauge, which allowed him to incorporate well below scale size cylinders in his LMS 4-4-0, thus staying within the correct loading gauge even in this scale.

A miniature four-cylinder Smith compound, however, is much more difficult to squeeze into the width of the British loading gauge than the three-cylinder type. The total diameters of the four cylinders on the full-size NER locomotives add up to 72½in. (14¼ + 14¼ + 22 + 22 in.), to which must be added seven cylinder walls thick enough to take studs for the covers, plus two frame thicknesses. Taking 3½in. gauge as an example, the sum of the cylinder diameters comes to 41⅞in., to which must be added

approximately (7 x ¼in.) for the walls, plus (2 x ⅛in.) for the frames, giving a total of 61⅞in. As the overall width of the full size locomotive is 8ft. 9in., equivalent to 69⅞in., we are left in theory with a surplus ⅛in. In practice the situation is very much worse, because a pair of scale diameter low pressure cylinders (2 x 1⅜in.) would require at least 3¼in. between frames, an impossible figure. Fortunately, a reduction in cylinder diameter would seem to be essential anyway in order to achieve a reasonable tractive effort/adhesion weight ratio when using a high initial pressure and superheat, both of which are desirable with compound expansion.

Digressing slightly, the redoubtable Mr. Keiller also built a very impressive 2½in. gauge 4-cylinder compound, the low pressure cylinders of which were equivalent to full size 22in. dia., and somehow managed to stay within two inches (full size figure of course) of the British loading gauge. But his freelance 4-6-0 produced over 50 years ago had the low pressure cylinders outside the frames, which is obviously not an option if you wish to build a reasonably accurate model of one of Walter Smith's Atlantics. To anyone intending to use compound expansion in any model locomotive however, I would strongly recommend reading through Mr. Keiller's two articles, which are listed in the references at the end of this article.

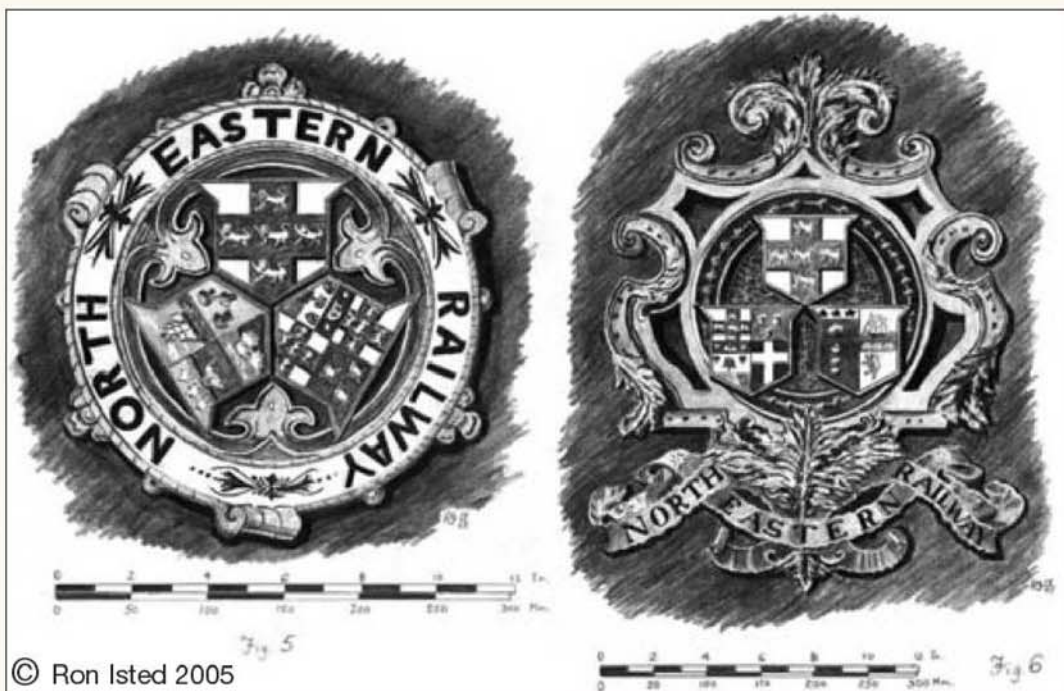
Another difficulty, though not quite such a potential minefield as the above, is those extremely large driving and coupled wheels, 7ft. 1¼in. diameter, with only 20 spokes. The short answer is that you either chew them out of the solid or make up your own patterns, in which case you may very well have to cast them yourself, as the days of the small jobbing founder seem to be over. Once again, a wheel exactly to scale over tread is probably not a good idea on a working model for two reasons: first because the distance between the 7 ft 1¼in. coupled wheels on the full size engine is a mere 7ft. 6in., secondly because the combination of over-scale flanges and overscale up and down movement could give rise to clearance problems with scale size splashes.

The boiler should translate to miniature size rather well, as the very large grate area is an advantage. Please note I (nearly) resisted the temptation to call it a grate advantage. Unlike the de Glehn layout discussed in the previous article, there should be no problem on this engine with concealing the main, high pressure steam pipe when using a superheated boiler, as the high pressure valve chests are offset towards the centre of the engine, inside the smokebox lagging. They are also completely hidden by the 'box-like structure' mentioned earlier, which could probably be used to conceal all sorts of strictly non-scale items, even an outside whistle or a mechanical lubricator perhaps? Because the prototypes were fitted with three safety valves, the outer cover is larger than usual, and it should therefore be possible to equip the miniature version with two practical valves within a scale size cover. This avoids the irritating business of having to make two sets of valves, one true to scale set for show and the working pair (which

have even been known to remain unpainted!) hurriedly substituted when the engine has to set to and earn its keep. On the other hand, the lengthy cab with the rear overhang of the roof is most definitely not helpful to the builder/driver of a miniature version, although as it is fitted with both a central ventilator and straight rain strips, disguising a removable portion for driving purposes should not be too much of a problem. The cabs of North Eastern locomotives were in fact not so generous as they appear to be, since as shown in fig. 1, the backhead protrudes at least a quarter of the way across the first side window, but that is an advantage in a miniature version.

The colour scheme for North Eastern Railway locomotives was rather more consistent over the years than on some other lines, and a reasonable number of the company's engines has survived, including four at the National Railway Museum at York, itself once an NER engine shed. So it should not be too difficult to check colours and details, although as always, there are one or two pitfalls for the unwary. The main colour, green, was not unlike that of the Great Northern, but containing slightly more yellow, and it has indeed been described as 'light yellow-green', though more usually as 'Saxony' green. Apart from the boiler, including the dome, the green was applied to the cab, splashers, Westinghouse brake gear, the 'box-like structure', cylinders, wheel centres and the tender. The lining consisted of a black band edged with either white or gold depending on the engine's position in the locomotive hierarchy: as far as I can tell, all North Eastern Atlantics, Worsdell, Smith and Raven designs, were lined in gold as befitted their status. I am not sure about the colour of the tops of the splashers: a contemporary oil painting by F. Moore shows them black on one of the later Z class Atlantics, but the NER 4-4-0 No.1621 preserved at the National Railway Museum, has them green, fully lined out and they are similarly painted on a photograph of a V class Atlantic. The boiler barrel on the 4CCs had no fewer than six cladding bands, and be warned, they are not evenly spaced nor are the handrail supports.

The following items were black: smokebox assembly, including chimney (apart from the brass cap, of course), cab roof, wheel tyres and axle ends, coupling hook, brake rigging, footplate valance, guard irons and footsteps, these last three being lined out with a single red line, which I believe was $\frac{3}{16}$ in. wide. The 4-4-0 preserved at York, No.1621, also has a red line round the axle ends, but whether this applied to the 4CC Atlantics I rather doubt, as the official photograph of No. 731 (black and white) shows a light coloured circle, which implies white or gold. If it were red, one would expect it to show up very dark on the photographic emulsions available at the time. The large brass cab-side number plate had a black background, and I apologise for not producing a detail drawing of it, due to uncertainty about the exact dimensions.



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Other brass adornments included the safety valve cover, beading round the splashers and cab windows (front and side).

Buffer beams and buffer stocks were vermilion, with a black line round the edge of the beam and a thin white line separating the red from the black. The coupling hook and links were black. The engine number was displayed as shown in fig. 2, in gold, shaded right and below in blue. I do not think the engine class was painted on the buffer beam, at least in the case of Nos. 730 and 731, until after the formation of the LNER in 1923, but I could be wrong! They are not visible in any NER photographs I have seen, but Mr. Tucker in his *M.E.* article (see references) shows them on his front elevation drawing. The F. Moore painting mentioned above shows the buffer stocks outlined in black and white on one of the later class Z Atlantics, but all the photographs of the 4CCs I have seen imply a plain buffer beam except for the edge lining and the number.

The North Eastern Railway's two armorial devices appeared a total of six times on each Smith Atlantic: the older circular emblem (fig. 5) measured $11\frac{1}{2}$ in. wide by $12\frac{1}{4}$ in. high including embellishments and was used on each splashers. Incidentally, this version was also used on official stationery not to mention the company's hotel chamber pots (in full colour). The shields represent the three original companies that combined to form the NER a century and a half ago: top is the York & North Midland, bottom left the Leeds Northern and bottom right, the York Newcastle & Berwick. The second rather more exuberant device (fig. 6) is larger, measuring $15\frac{1}{2}$ in. wide by $18\frac{3}{4}$ in. high and as far as I know, was used only on locomotives, appearing on the side of the tender between the words North and Eastern. Note there are minor differences in the items portrayed on the shields in the two versions. The name of the railway company was in 5in. high, gold sans serif letters, shaded red to the right and below, with black shading beneath the horizontal parts of each letter. By the way, this proliferation of armorial devices seems to be unique to the two Smith Atlantics: all the other 4-4-2s, and even Sir Vincent Raven's massive Pacific, contented themselves with just one circular version on the

rear splasher (centre one in the case of the 4-6-2) plus the larger device on the tender.

If Walter Smith had lived longer, at least the ten further 4CCs authorised in 1906 would have been built and the compounds may very well have ended up as the standard North Eastern Railway express passenger locomotive. If so, would they have influenced Nigel Gresley, who was very open-minded towards the locomotive practice of the constituent companies that formed the LNER at the 1923 Grouping? An unanswerable question, but a hundred years ago, when Walter's two Atlantics first emerged from Gateshead works, quite a fierce debate on compound versus simple locomotives was raging in the pages of the British technical press. This included a long and verbose article in *The Engineer* in March 1907, that claimed to be 'dispassionate', but was actually quite the opposite. Using the editorial and royal 'we' throughout, it puts forward as facts several contentious opinions that are very opposed to compounding and in such a high profile technical journal, this no doubt had its effect on railway design offices. I cannot help feeling that one way and another, fate has rather loaded the dice against compound locomotives in this country, but those that did see the light of day, or even only the drawing board, were all fascinating engines.

One fact that has received little acknowledgement over the years, is how quickly British footplate (and maintenance) crews learned to cope with these complex machines and produce some brilliant performances. The railway press these days frequently contains items about special workings of new diesel or electric locomotives 'for crew training purposes'. As far as I know, such things were unheard of in the days of steam. To quote a specific example, I have often wondered about the initial reaction of the crews at Norwich shed in 1951 to the arrival of the new BR Britannia pacifics, a rather different proposition to the Great Eastern and LNER 4-4-0s and 4-6-0s they had been used to. There were no 'training trips' and the firemen were expected to cope more or less instantly with the demands of the 42 square feet of grate in that cavernous firebox (about the area of the bathroom in my house) on schedules very much faster than anything previously attempted on that piece of railway. The magnificent way the footplate crews

rose to the occasion to produce some of the most consistently outstanding running this country has ever seen, is now a matter of history and I am sure the men of the North Eastern, Midland and Great Western Railway were no different. But while the Britannias were big engines compared to what had gone before, they were deliberately designed to produce plenty of steam from inferior fuel and to be as simple as possible to drive, fire and maintain. On the other hand, the Smith NER 4CCs, the first two Midland compounds, and the GWR French Atlantics, were, half a century earlier, probably the most highly sophisticated examples of locomotive design in existence in this country, if not the world.

In conclusion, I would like to acknowledge a great deal of help from Lorraine Cornwell, Collections Officer at the Darlington Railway Centre & Museum, which possesses a quite amazing amount of North Eastern Railway archive material. I would also like to thank Keith Moore and the library and information staff at the Institution of Mechanical Engineers, London, and the staff of the Reading Room at the National Railway Museum, York.

References

1: General Arrangement Diagram D.O.6906 D. GA side elevation and plan of NER No.731, the Walschaerts engine, scale 1¹/₂in. to the foot (full-size for 7¹/₄in. gauge!) Obtainable from Darlington Railway Centre & Museum, their catalogue number NERA D170. This is photocopied straight off the original, so unlike those produced via microfilm, all dimensions are legible, the scale is the same horizontally and vertically and even more importantly, remains the same across the sheet - a joy to work with! It also ties in well with photographic records.

2: GA side elevation & plan of NER No. 731. Obtainable from National Railway Museum, York, their reference number 4/GW/7 105. This is produced via microfilm, so the scale is variable and more seriously, there are errors in details of springs, sanding gear, brakes etc. as mentioned in the text. However, certain items such as bogie details, which are omitted from the Darlington drawing, are shown.

3: GA side elevation & plan of NER No.730 (Stephenson engine), NRM ref. 4/GW.7108.

Same comments as item 2 above.

4: 'Pipe & Rod Arrangement' Dwg. DO Q6306 D. Obtainable from NRM, their ref. No.4IGW/7 124. Side elevation, plan, front elevation and cab layout, but no motion details shown.

5: Motion details of Walschaerts gear on No. 731. NRM ref. 4/GW/7107. Useful side elevation and plan, but few dimensions.

6: Side & Front Elevation of C8 (LNER). NRM ref. 4/GW/4239. Side and front elevation outline only, but very useful list of dimensions for both locomotives.

7: *Model Engineer and Electrician* Vol. 21, No. 430, 22 July 1909. Side elevation, plan, section through cylinders of No.730 (Stephenson). Excellent drawings, but few dimensions (metric).

8: *Model Engineer* Vol. 118, No.2967, 3 April 1958. Very good article by Wilfred Tucker, including excellent side and front elevation of

both locomotive and tender. But beware, his drawing of the cab side number plate shows Darlington instead of Gateshead as builder!

9: *The Railway Engineer*, July 1906. Very good photograph of No.730 and list of dimensions.

10: *Locomotive Compounding & Superheating*. J. F. Gairns pub. Griffin 1907. Good sectional

drawings of Smith reducing valve as fitted to NER No. 1619, identical in principle to the 4CCs.

11: *Model Engineer* Vol. 102 Nos.2561 and 2562, 22/29 June 1950. Two excellent articles by C. M. Keiller on 2¹/₂in. gauge freelance 4-cylinder 4-6-0, with detail drawings and photographs.



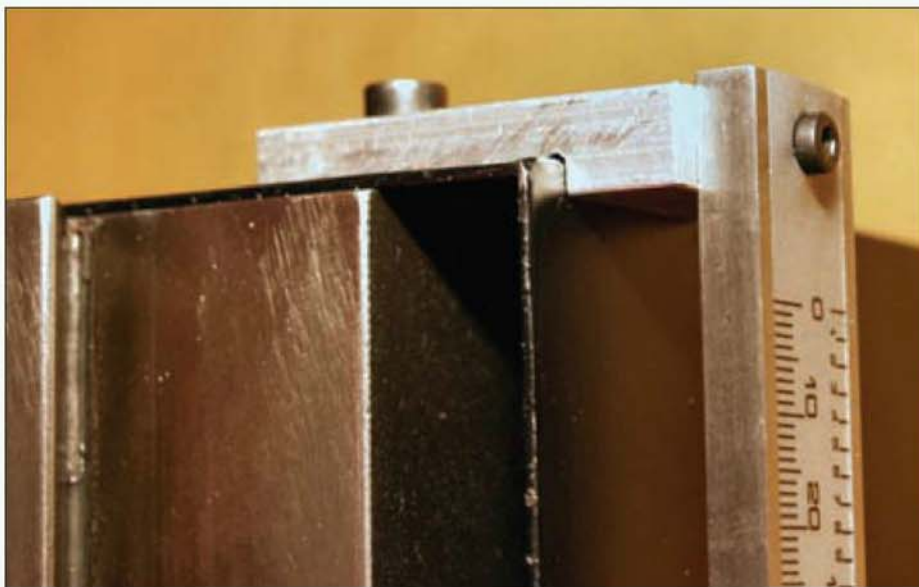
NER Nos. 730 & 731: Main Dimensions

Note: these are intended specifically for use in producing a miniature version of this locomotive, so 'internal' measurements, such as heating surface and internal diameter of boiler sections are omitted. The figures for 3¹/₂in. and 5in. gauge have been calculated to the nearest 1/64in., using 3/4in. and 1¹/₁₆in. to the foot respectively.

For gauge 1, halve the 3¹/₂in. gauge figures, for 2¹/₂in. gauge, halve the 5in. gauge figures, for 7¹/₄in. gauge, double the 3¹/₂in. gauge figures. Dimensions prefixed by = are approximate only.

Description	Full Size	3 ¹ / ₂ in. scale (3 ¹ / ₂ in. gauge)	1 ¹ / ₁₆ in. scale (5in. gauge)
Length over buffers, engine & tender	= 63ft. 6in.	47 ⁵ / ₈ in.	67 ¹⁵ / ₃₂ in.
Overall length of engine	39ft. 9in.	29 ³ / ₁₆ in.	41 ⁵³ / ₆₄ in.
Length of engine main frame	37ft. 10in.	28 ³ / ₈ in.	40 ³ / ₁₆ in.
Overall length of tender	= 23ft.	17 ¹ / ₄ in.	24 ⁷ / ₁₆ in.
Length of tender main frame	21ft. 3in.	15 ¹⁵ / ₁₆ in.	22 ³⁷ / ₆₄ in.
Height to top of chimney	13ft. 2in.	9 ⁷ / ₈ in.	13 ⁶³ / ₆₄ in.
Height to top of dome	13ft 1 ³ / ₄ in.	9 ⁵⁵ / ₆₄ in.	13 ⁶¹ / ₆₄ in.
Height to top of cab roof	13ft. 0 ¹ / ₄ in.	9 ⁴⁹ / ₆₄ in.	13 ¹⁵ / ₁₆ in.
Height of footplate	= 4ft. 3 ¹ / ₂ in.	3 ⁷ / ₃₂ in.	4 ⁹ / ₁₆ in.
Maximum width over footplate	8ft. 9in.	6 ⁹ / ₁₆ in.	9 ¹⁹ / ₆₄ in.
Maximum width over cab roof	8ft. 5in.	6 ⁵ / ₁₆ in.	8 ¹⁵ / ₁₆ in.
Width of cab side sheets	8ft. 0in.	6in.	8 ¹ / ₂ in.
Length of cab roof	6ft. 9in.	5 ¹ / ₁₆ in.	7 ¹¹ / ₆₄ in.
Distance between main frames:			
At front buffer beam	3ft. 9 ¹ / ₂ in.	2 ²⁷ / ₃₂ in.	4 ¹ / ₃₂ in.
Rear section	4ft. 2 ¹ / ₄ in.	3 ⁹ / ₆₄ in.	4 ²⁹ / ₆₄ in.
Exterior frame for trailing wheels	6ft. 2 ³ / ₄ in.	4 ⁴³ / ₆₄ in.	6 ⁵ / ₈ in.
Thickness of main frames	1 in.	(1/16in.)	(3/32in.)
Locomotive wheelbase total	28ft. 9in.	21 ⁹ / ₁₆ in.	30 ³⁵ / ₆₄ in.
Divided: bogie wheelbase	6ft. 6in.	4 ⁷ / ₈ in.	6 ²⁵ / ₃₂ in.
Rear bogie to front coupled	7ft. 3in.	5 ⁷ / ₁₆ in.	7 ⁴⁵ / ₆₄ in.
Front to rear coupled	7ft. 6in.	5 ⁵ / ₈ in.	7 ³¹ / ₃₂ in.
Rear coupled to trailing	7ft. 6in.	5 ⁵ / ₈ in.	7 ³¹ / ₃₂ in.
Tender wheelbase, equally divided	12ft. 8in.	9 ¹ / ₂ in.	13 ²⁹ / ₆₄ in.
Diameter of coupled wheels (20 spokes)	7ft. 1 ¹ / ₄ in.	5 ²¹ / ₆₄ in.	7 ³⁵ / ₆₄ in.
Throw of crankpins	1ft. 1in.	1 ³ / ₁₆ in.	1 ⁵ / ₃₂ in.
Diameter of bogie wheels (12 spokes)	3ft. 7 ¹ / ₄ in.	2 ⁴⁵ / ₆₄ in.	3 ⁵³ / ₆₄ in.
Diameter of trailing wheels (?12 spokes)	4ft.	3in.	4 ¹ / ₄ in.
Pitch of boiler above rail level	8ft. 10in.	6 ⁵ / ₈ in.	9 ³ / ₈ in.
Diameter of smokebox/boiler over cladding	5ft. 5 ¹ / ₂ in.	4 ³ / ₃₂ in.	5 ⁵¹ / ₆₄ in.
Visible length of smokebox	3ft.	2 ¹ / ₄ in.	3 ³ / ₁₆ in.
Diameter of smokebox door	=3ft. 9 ¹ / ₂ in..	2 ²⁷ / ₃₂ in.	4 ¹ / ₃₂ in.
Height of chimney above cladding	1ft. 7 ¹ / ₄ in.	1 ¹³ / ₆₄ in.	1 ⁴⁵ / ₆₄ in.
Outside length of firebox	=9 ft.	6 ³ / ₄ in.	9 ⁹ / ₁₆ in.
Bore of High Pressure cylinder (outside)	1ft. 2 ¹ / ₄ in.	5 ⁷ / ₆₄ in.	1 ¹⁷ / ₆₄ in.
Bore of Low Pressure cylinder (inside)	1ft. 10in.	1 ³ / ₈ in.	1 ⁶¹ / ₆₄ in.
Piston stroke (HP & 12)	2ft. 2in.	1 ⁵ / ₈ in.	2 ¹⁹ / ₆₄ in.
Distance C/L cylinders to driving axle	10ft. 6in.	7 ³ / ₈ in.	11 ⁵ / ₃₂ in.
Distance between C/L HP cylinders	6ft. 2 ¹ / ₂ in.	4 ²¹ / ₃₂ in.	6 ¹⁹ / ₃₂ in.
Distance between C/L LP cylinders	2ft.	1 ¹ / ₂ in.	2 ¹ / ₈ in.
Diameter of HP piston valves (inside admission)	7 ¹ / ₂ in.	15 ¹ / ₃₂ in.	4 ³ / ₆₄ in.
Diameter of LP piston valves (outside admission)	10in.	5 ⁵ / ₈ in.	7 ⁷ / ₈ in.
Distance between C/L HP piston valves	3ft. 10in.	2 ⁷ / ₈ in.	4 ⁵ / ₆₄ in.
Distance between C/L LP piston valves	1ft. 1in.	1 ³ / ₁₆ in.	1 ⁵ / ₃₂ in.
Length of connecting rods (HP & 12)	6ft. 4in.	4 ³ / ₄ in.	6 ⁴⁷ / ₆₄ in.
Length of eccentric rod (Walschaerts)	=3ft. 8 ¹ / ₂ in.	2 ²⁵ / ₃₂ in.	3 ¹⁵ / ₁₆ in.
Length of eccentric rods (Stephenson)	=4ft. 2in.	3 ¹ / ₈ in.	4 ²⁷ / ₆₄ in.

HP cylinders horizontal, LP cylinders inclined upwards towards crank axle at 1 in 38¹/₂.



1. Vertical bar mounting bracket fixed under one cover bolt

DIGITISING AN X3 MILLING MACHINE

Malcolm Stride describes how he fitted digital readouts to his mill

Having recently acquired an X3 mill from Arc Euro Trade (usual disclaimers) I decided to fit digital readouts to all axes before using the machine and to avoid the "I must do that one day" situation that existed for several years with my previous mill.

Many readers will be familiar with the X3 mill which is made by Sieg in China and sold by at least two of our suppliers. For those who are not familiar, the mill is a compact V-column mill with a variable speed DC drive and incorporates all the control electronics in the cover behind the column. I chose the machine because my workshop is not large (for that read extremely small) and I needed a compact machine that I could install on a purpose made bench with plenty of storage underneath.

Having spent some time deciding how best to install the readouts I felt that there may be many of our readers who are contemplating doing the same to the X3 or similar machines and that I could possibly save some serious brain ache by sharing my experiences.

I decided to use the familiar bar type readouts together with remote display boxes positioned for easy reading when using the machine. When fitting this type of readout it is necessary to ensure that the bars and decoder units are kept free from swarf and oil from the machine by means of suitable shielding. I used some 30x30mm thin aluminium angle obtained from the local DIY chain for this.

The first readout I fitted was the vertical (Z) axis and I decided to 'hang' the readout bar from a bracket mounted under the bolt holding the cover to the top of the column. I used a 600mm readout for this and shortened it to suit. I machined up a suitable bracket from aluminium alloy which was held by the bolt and located on the edge of the cover (photo 1). I had to relieve the under surface of the bracket slightly to clear

the weld on the cover corner joint. The readout bar was hung from this by means of a bolt into a tapped hole in the bracket end and the bottom end of the bar is left unsupported. The decoder unit was fitted with a bracket made from a piece of 3mm aluminium alloy sheet. The decoder unit fixing screws are M3 and the screws must not protrude so that they touch the bar and prevent free movement. The length of the bar supporting bracket was adjusted to ensure that the required 3mm gap was maintained between the bar and the mill head when the bar was parallel to the column. To set the position for the hole in the mill head to attach the decoder bracket, a dial gauge was used from the mill head to set the bar vertical and the bottom end of the bar was clamped to the rear machine cover. A hole was then drilled into the side of the head and the bracket secured with an M3 cap screw (photo 2). I did not fit any protection to the vertical bar; time will tell if this was a correct decision.

I took some time to make a final decision on how to fit the X axis (450mm) readout. The basic choice was whether to fit it to the front or the back of the table. In the end I opted for the front because the coolant drain hole would have been obscured at the back and also there would be difficulty with access to drill the mounting holes from the back.

I used the two brackets provided with the readout by drilling a 4mm hole at the top edge of each for an M4 mounting screw (photo 3). If brackets are not provided, then the bar can be drilled for the fixing bolts and spacers made to provide the correct positioning. The readout bar was cut to length and the brackets fitted at the ends as can be seen in the photographs. This assembly was then used to mark a length of the aluminium angle which was to be clamped behind the brackets to form a shield. The bar and brackets assembly (minus shield) was then positioned so that the shield would be a fraction below the top surface of the table when installed. One of the mounting holes was then marked and

drilled. This was tapped M4 and that end of the bar was secured.

The other end of the bar was then clamped with a toolmakers clamp and a dial gauge used to set the top edge of the bar parallel to the table. Once this was done the second fixing hole was drilled and tapped.

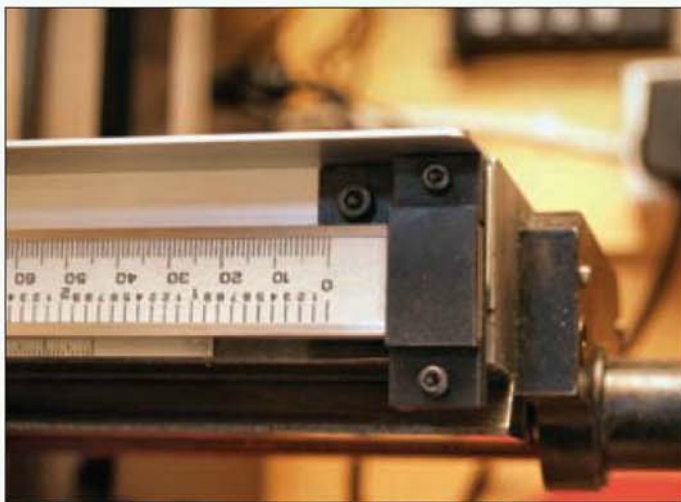
A T-shaped bracket was then made up from 16g mild steel and fitted to the back of the decoder unit. The complete assembly was then fixed to the machine with the decoder unit positioned to the left of the X axis locking screw. This allows just enough clearance to operate the locking screw and allow full table movement. The distance between the bottom of the bracket and the slide was then measured before removing the bracket. The upright of the T bracket was then bent to give the correct offset so that it would just touch the bed when in position. The whole assembly was then replaced and the fixing hole drilled through and tapped before finally fixing everything in place (photo 4).

The Y axis readout (300mm) was easier than first thought because there is plenty of space under the table and the surface of the machine base casting is smooth and flat so I decided to bolt one end of the bar to the side of the slide with the decoder mounted on a mild steel bracket near the column. The first thing to do was to make up the decoder bracket making sure that the two holes for the decoder unit were on a line parallel to the base of the bracket.

The bar already had two holes drilled near one end which could be used to fix the bar to the slide. I held the assembly in position with a magnet on the bracket and marked through the bar for the fixing hole. This was then drilled and tapped and the bar bolted in position (photo 5).



2. Z axis decoder showing the bracket fixing.



3. X axis bar mounting showing the bracket and angle shield



4. X axis decoder showing the bottom of the mounting bracket.



5. Y axis decoder mounting on the machine base.



6. Y axis bar and shield mounting.

Once this was done the holes for the bracket/bed fixing could be marked through and then drilled and tapped (photo 6). In the end, although I drilled two holes in the bracket, there is only need for one fixing. The angle shield was fixed to the bar using two screws with spacers between bar and angle to provide the necessary clearance for the mounting bracket and bolts. Unlike the others, on this axis the bar moves through the fixed decoder.

When fitting the readouts it is necessary to cut the bars to length and drill for fixing holes. I did this without removing the decoder units. I just moved the decoder unit out of the way to the other end of the bar and covered it to prevent swarf getting where it shouldn't. Be warned the bars are described as "hardened stainless steel" and are quite tough! The fact that I did not remove the bars from the decoders is why the scales are upside down on the machine!

Because the machine is very compact, there was no real room to fix the remote displays so I made a mild steel bracket to fix to the wall at the back of the machine (photo 7). The display units have magnetic backs so just stick to this.

When connecting the wires to the decoder units I felt it wise to clean the contacts before inserting the plugs. I also used plastic cable ties to fix the cables to the brackets ensuring that no strain was placed on the plugs when the table/head was moved.

The other point to make is that the decoders are powered from the remote display units when in use so you can remove the decoder batteries. When you plug the connectors in the decoder display will be switched on, they can be switched off which will save some battery power.

Photograph 8 shows the machine with everything fitted. I have now used the system in anger and can report no problems so far.

I have not provided any detailed measurements because the readouts will vary slightly depending on the source and also other machines will need

a slightly different approach but hopefully those wishing to carry out a similar modification to their own machines can get some ideas from the above description.



7. Z axis decoder showing the bracket fixing.



8. The mill with all readouts in place.



A trial assembly of the frames and pillars. The clock is already beginning to take shape.

Peter Heimann

continues his detailed account of how to build this superb clock.

●Part II continued from page 675
(M.E. 4262, 9 December 2005)

We will now turn to the lathe and deal with the pillars and washers detailed on drawing 3. It is vital that the length between shoulders of all the pillars is exactly the same. Form a slight under-cut to nearly diameter so that the plates pull up tight and even on assembly.



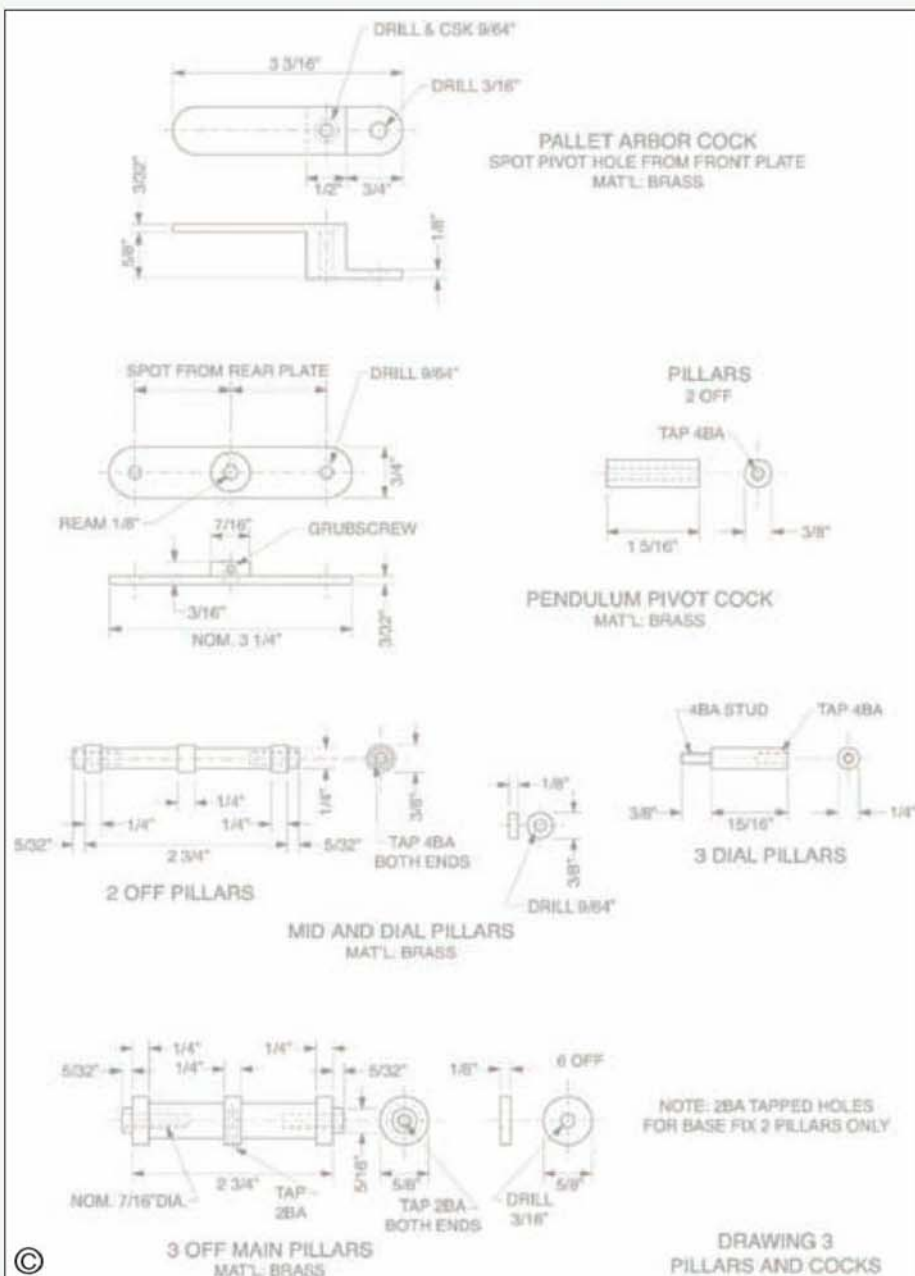
Another view of the frame/pillar sub-assembly taken from a different perspective.

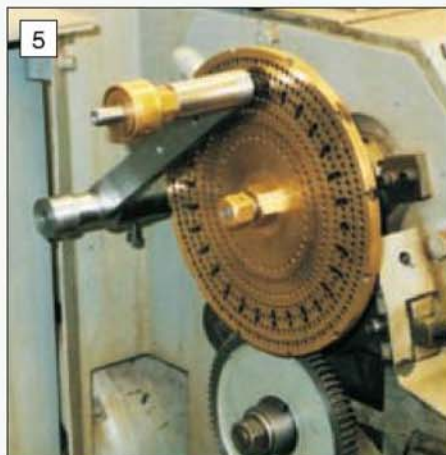
SIXTEEN DAY PEDESTAL CLOCK

The actual decorative shape of the pillars is your choice, but I would advise you to keep it quite plain. Two of the main pillars have a 2BA tapped hole on the centre bulge for the base fixing screws. These holes should not penetrate right through. The washers (nine off small, six off large) are a straightforward parting off job; one edge should be chamfered or rounded slightly. All pillar spigots must be a good but easy sliding fit in the plate holes. The assembly will be erected and stripped down many times with delicate arbors and wheels in place and there is nothing worse than jamming plates on those occasions. You will note that the three dial pillars have 4BA tails at one end. I find it more convenient to drill and tap for a short length of steel stud. The other end of these pillars is drilled and tapped 10BA.

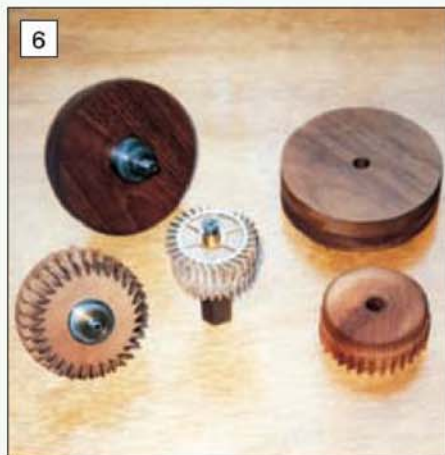


The optional but recommended brass base plate for the clock.

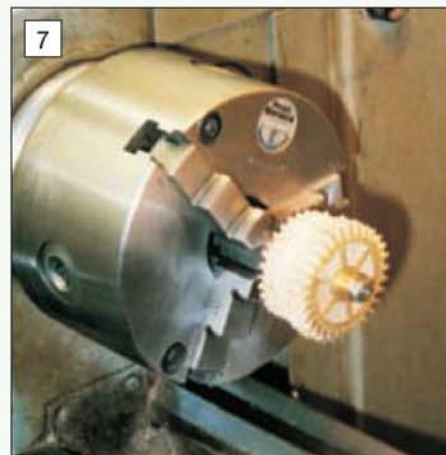




5
The authors dividing plate and detent arrangement fitted to his lathe.



6
Wooden backing rings are required to support the clock wheels during cutting.



7
Old wooden rolling pins are a good source of material for backing rings.

Still remaining with drawing 3 the pendulum pivot cock has a drilled and reamed $\frac{1}{8}$ in. shouldered bush soft soldered in its centre. A suitable grub screw is fitted as shown. On final assembly this bush will face to the back. The pallet arbor cock is best fabricated by silver soldering. Spotting of the pivot position will have to wait until this is known. We have now reached one of many moments of truth as all the components produced so far can be trial assembled as per drawing 4. Use 2 and 4BA cheese head screws in their natural colour. At the very end of the project these will be replaced with new, blued screws to keep things traditional.

I have previously mentioned the brass base plate with its four adjustable feet. I do hope that you will be able to fit this touch of luxury. It greatly adds to the visual appeal. Dimensions are shown on drawing 4. Photograph 4 also refers to this item and shows the slot for the weight line, which will not be machined until the barrel position is known.

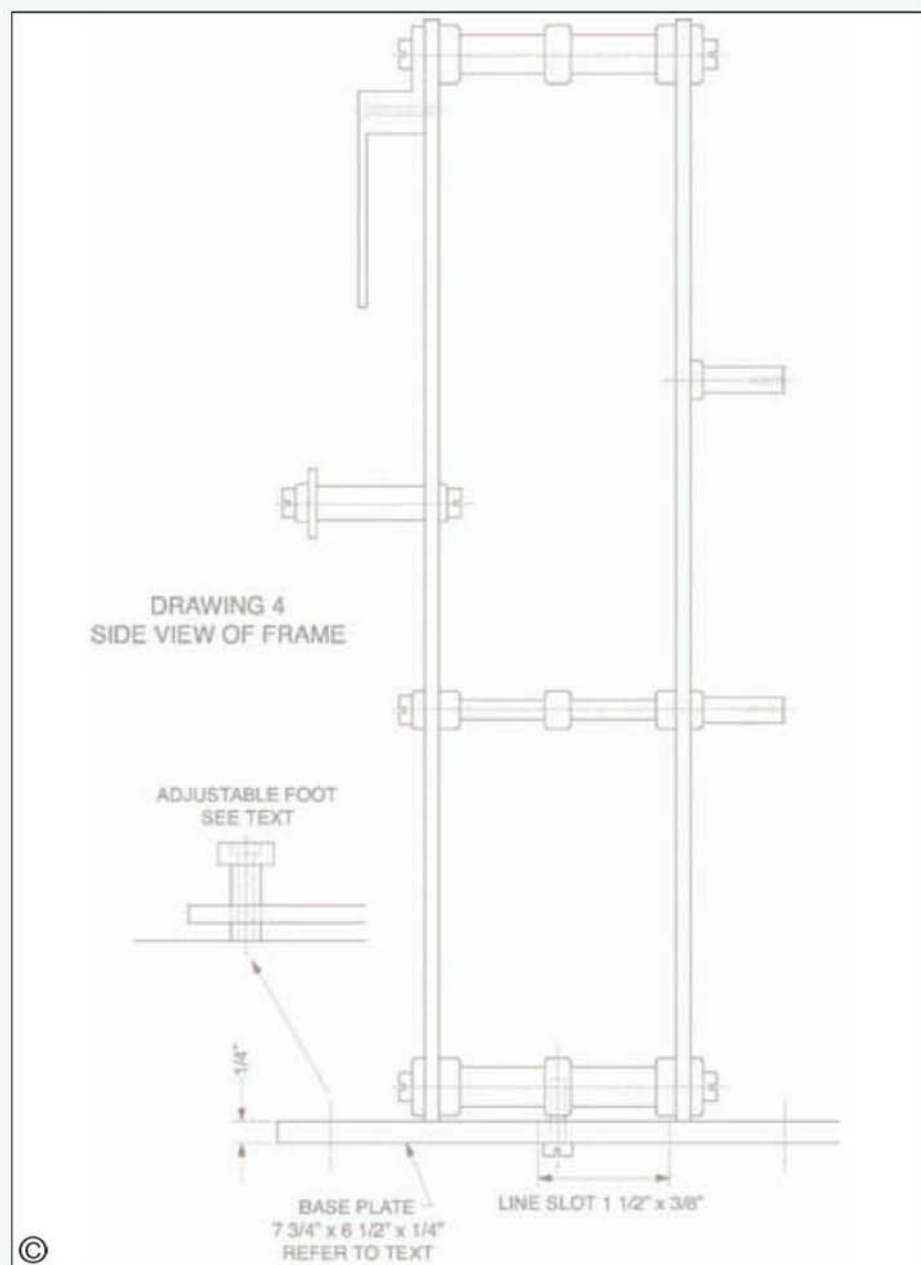
Fixing the base to the frame assembly is with two 2BA screws. Make sure that the frame

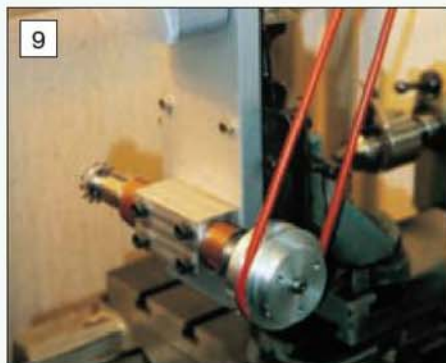
assembly sits flat on the base and adjust now if required by careful filing. Eventually the completed clock will be fixed to the wooden trunk top with screws passing through the recessed centre holes of the adjustable feet. If

these screws are not over tightened, height adjustment by turning the feet will be no problem. I suggest a 32 or 40tpi $\frac{3}{8}$ in. thread, say $\frac{3}{4}$ in. long will be suitable, but this can depend on what tooling you have available.



8
The author's home made wheel cutting spindle and drive arrangement.





9
A home made escape wheel fly cutter in use with the wheel cutting spindle.

I have discussed wheel and pinion cutting in my previous series, but at the risk of boring you, I will do so again for the benefit of newcomers to clock making. In my opinion a direct division plate mounted on the lathe is preferable, see **photo 5**. I know this has to be made in the first place using conventional methods, but then for ever after its use will avoid turning the air blue or worse when the last but one tooth of a large wheel goes wrong through a slip-up in counting revolutions on the dividing head. The two-sided plate shown in the photo has dealt with all my clocks and it is seldom that a required number will not 'go'.

For cutting, the wheel blank is mounted on a mandrel with a wooden backing disc (**photos 6 and 7**). Old-fashioned wood rolling pins are a good source for these. The blanks are turned to correct diameter and stay on the mandrel until after cutting. When drilling the bobbins of lantern pinions the work is simply held in the chuck. **Photograph 9** shows my homemade set-up mounted on the slide of the lathe with a Thornton gear cutter mounted. **Photograph 8** shows an escape wheel homemade fly cutter in position. In **photo 10** the set-up has been turned through 90deg. for drilling. Success here depends very much on the accuracy of the available chuck, especially if the flutes on the drill have to protrude inside the jaws. Under these circumstances it may be best to revert to using a rotary table on the drilling machine, see **photo 11**. The number of holes required is usually quite low and not subject to dividing error. I favour lantern pinions, as these are very efficient from a friction point of view when driven. Whilst gear tooth cutters work on all wheel-counts above 16, low count pinion cutters will only work on one or two sizes and cost in the region of £50 each. Need I say more! The speed of the milling spindle for use with CZ120 brass should be as high as



10
The set-up used for drilling lantern pinions. This spindle has been turned through 90 degrees.

practicable. Adjust the rate of feed to deal with the cut in one single pass once correct depth has been established. This gives a better finish.

Drawing 5 lists details of all gears. The last two items, whilst described as pinions, are in brass and can be cut with the standard M0.6 cutter. These are used in the motion work and are only lightly loaded. In fact all the last four items listed apply to the motion work and will not be required until later. I have included them as it may be found convenient to finish all gear cutting in one phase. As a point of interest, the pitch circle diameter stated in millimetres in all wheels is given by the number of teeth x module. For calculating the blank diameter one simply adds an addendum allowance of 2.76 to the number of teeth. For example a wheel of 84 teeth at M0.8:

$$84 + 2.76 \text{ multiplied by } 0.8 = 69.408 \text{ mm.}$$

Dividing by 25.4 gives an imperial size of 2.733 inches blank diameter.

The depth of cut is important in order to maintain the correct diameter of the wheel. It is



11
An alternative method of cutting lantern pinions utilising the drilling machine.

best achieved by gradual trial on two or three adjacent teeth. These should form a 'gothic' arch with a barely visible witness but no more. On no account must the cut be so deep as to reduce the correct wheel diameter. The cutter must be set to the centre line as otherwise 'drunken' teeth will result. I always centre drill the ends of all wheel-holding mandrels to accept a short point which enables easy aligning of the cutter by sight.

●To be continued.

WHEEL SPECIFICATIONS
MATL: CZ-120 BRASS
FIVE SPOKES

	P.C.D.	BLANK DIA.	THICKNESS	MODULE	No. OF TEETH	BORE	WIDTH OF SPOKES	WIDTH OF RIM	BOSS DIA.
RATCHET	-	1.500"	3/16"	FLY CUTTER	45	1/4"	-	-	-
GREAT WHEEL	3.024"	3.111"	3/16"	0.8	96	1/4"	-	-	-
INTERMEDIATE	2.646"	2.733"	3/32"	0.8	84	1/4"	1/8"	5/32"	7/8"
CENTRE	2.362"	2.427"	1/16"	0.6	100	3/16"	3/32"	1/8"	5/8"
THIRD	2.268"	2.333"	1/16"	0.6	96	3/16"	1/16"	3/32"	1/2"
ESCAPE	-	1.450"	1/16"	FLY CUTTER	32	3/16"	1/16"	1/16"	15/32"
+REVERSE MOTION	1.512"	1.577"	1/16"	0.6	84	3/16"	1/16"	1/16"	5/8"
+ HOUR MOTION	1.417"	1.483"	1/16"	0.6	60	1/4"	1/16"	1/16"	1/2"
+ REVERSE MOTION PINION	0.472"	0.538"	-	0.6	20	1/8"	-	-	-
+DRIVE MOTION PINION	0.375"	0.443"	-	0.6	16	3/16"	-	-	-

+ NOTE: MOTION COMPONENTS
NOT REQUIRED UNTIL LATER
BUT MAY BE MORE CONVENIENT
TO MACHINE TOGETHER

DRAWING 5
WHEEL DETAILS

* FROM SOLID BAR, GEAR
CUT 1/2" LENGTH BUT DO
NOT PART OFF AS FURTHER
MACHINING WILL BE
REQUIRED LATER

©

PETE'S PAGE

Peter Spenlove-Spenlove

discusses how these useful turning aids are made and used but starts with some general notes on chucks.

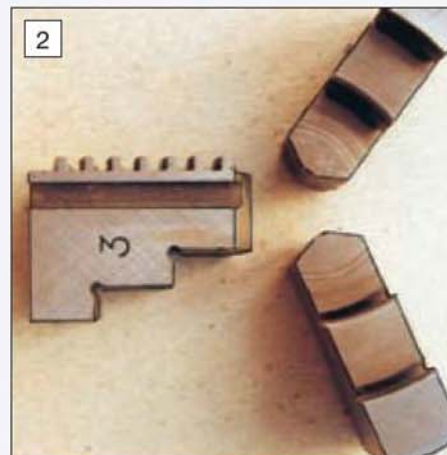
●Part 1

When you bought your first lathe you probably got a 3-jaw self-centring chuck. One of 4in. dia. is recommended for the Myford Series 7 lathes. Larger chucks can be fitted but are heavy and with considerable overhang. A larger chuck can grip bigger diameters but chatter and vibration can give poor results. When you select a chuck make sure you receive two sets of jaws. Both will be hardened and have steps. The normal set has the high step near the chuck centre (photo 1). They are for gripping small diameter bars. The other set has the high step near the periphery of the chuck and they are for chucking larger diameter work of short length (photo 2). The jaws are numbered 1 to 3 (for a 3-jaw chuck) and fit in the appropriately numbered slot one way round only. You should also receive a chuck key like the one in photo 1.

Do not mix the jaws from one chuck with those of another. Keep them in sets in the makers box or in the plastic tops fitted to aerosol cans. Now examine the teeth on the underside of the jaws and compare them to those shown in photo 3. Note how the teeth are different for each of the jaws. The teeth also look an odd shape but this is not an error. They are made that way so that they fit the scroll of the chuck at any position across its face. You can see the scroll in photo 1. The chuck key turns the scroll via bevel gears housed in the chuck body. Small chucks for instrument lathes sometimes have no key but a knurled ring on the outside of the scroll. These are hand-grip scroll chucks and are designed for the light work of the clock, watch and instrument maker. Sometimes a tommy bar hole is provided and then they are called lever-scroll chucks. These chucks, if of reputable make, are made to close limits and are costly. They often come with only one set of jaws, it being possible to remove the exposed part of the jaw by releasing a screw and then turning it round.



Typical 3-jaw chuck for an amateur's lathe fitted with its jaws for small diameter bar work.



Alternative set of jaws for the chuck in photo 1 used for short, large diameter work

SOFT JAWS FOR CHUCKS

Chucks suitable for amateur use are usually made of cast iron but industrial chucks are often made of shatter and burst proof steel or semi-steel. If you find a crack in a second hand chuck do not use it on rotating machinery in case it bursts. It is best to discard it. Very good quality cast iron is used for chucks and they are perfectly safe up to the maximum speeds found on amateur's lathe (3,000rpm or so).

Chucks should be cleaned before fitting the jaws. Brush swarf away and used a piece of wood to clear dirt from the scroll as you rotate it carefully. Opinions vary about whether to use oil or grease to lubricate the chuck. Grease stays put better but attracts dirt. Oil lubricates well but flies everywhere including over the lathe operator. I favour giving a quick puff from a domestic aerosol oil dispenser to the scroll through the three slots and a puff at the back of each jaw at infrequent intervals. The 3 in 1 brand seems as good as any and is sold at most DIY stores. Avoid lubricating too frequently particularly if much cast iron is to be turned. It will stick and form a grinding paste.

Periodically the chuck should be dismantled and thoroughly cleaned. When you do this make sure that all the parts go back in their original locations or concentricity may be lost. If unsure

place a piece of bar in the chuck and test with a dial test indicator.

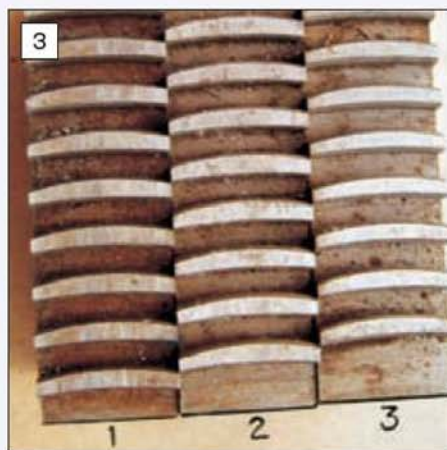
Soft jaws

Now we come to the subject of soft jaws. The makers of good quality chucks can usually supply soft jaws for use with their products. They are supplied with teeth and grooves in their sides to fit the chuck but have no steps machined in them (photo 4).

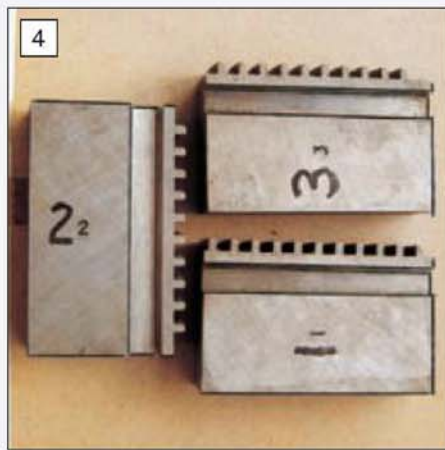
Being soft they can be machined on the lathe to fit special jobs, brazed (photo 5), drilled and tapped. Look at photo 5 and note the machined surfaces designed to grip very thin work of three different diameters. This set was made to grip short tubes made from a special alloy called Nimonic, which had to be bored to fit some brake pistons. These jaws supported the 3/4in. long parts around a large proportion of their periphery and avoided distortion of their 14swg wall thickness allowing them to be readily machined.

Round, square or hexagon bar can be bolted tightly on to a set of soft jaws and machined to suit a particular work piece. This is a popular jobbing shop or tool room trick. In fact even old and battered hard jaws have been softened for drilling and tapping in the past.

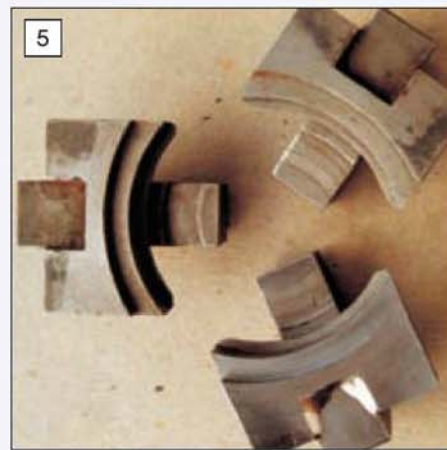
●To be continued.



Teeth on a set of chuck jaws are in a different position relative to one another.



Soft jaws are usually supplied in plain rectangular section ready for machining to suit the work.



Soft jaws can be modified with extension pieces to suit the work in hand.



Competitors line up for the photographer; from left to right: Jon Swindlehurst, David Neish, Martyn Reeve, David Wainwright, John Mills, Andrew Neish, Geoff Cocking, and Jim Fearn.

LIONSMEET 2005

Alan P. Bibby

reports that the *Lion* will never be steamed again. Fortunately the models are - and in record numbers.

It was very much a mixture of bad news and good news for the Old Locomotive Committee this last year. Early in the year a deputation travelled from far and wide to Liverpool to discuss the future of *Lion* with the trustees of the National Museums on Merseyside, who own the engine. Despite making an excellent case for restoring *Lion* to steam, they were told that the trustees had decided that *Lion* would never be steamed again and would remain forever a static museum exhibit, and that this decision was not negotiable. A bitter blow indeed for the many who had cherished the dream of seeing the old engine in steam once again.

On the brighter side, 2005 saw the biggest and best Lionsmeet ever held since the inaugural

event at Guildford in 1985, a fitting reward on its 21st birthday for all the work that has gone into promoting the event in recent years. Never a big event, most years have seen no more than four or five engines entered in the competition, and maybe one or two more on static display. This year we had eight competitors with seven engines, two more who could have competed but elected not to, with five more Lions and a very fine part built Rocket on static display. In all, eight 5in. Lions, a Tiger, four 3 1/2in. Lions, a Gauge 1 Lion, and a Rocket. Tiger is of course a Lion with a different nameplate. By way of comparison, The inaugural Lionsmeet saw seven 5in. runners, and the 1997 event at Peterborough saw eight in various gauges.

Lionsmeet 2005

This year's record-breaking event was held at the Ravenssprings Park site of the Brighthouse and Halifax Model Engineers in glorious weather on Sunday 7 August. Club members were there bright and early to prepare the site and make sure everything was in order, and the

competitors started arriving at ten o'clock for the morning practice session. It very soon became clear that the turnout was going to be good, and it wasn't long before the log-jam on the track prompted the thought that we may need to assign slots even for the practice runs in future years. The ladies had been busy making sandwiches during the morning and these were quickly disposed of as everyone downed tools for lunch at 12.30. More practice runs, then the track was cleared for the competition proper at 2.00pm. The drivers were briefed on the essentials of the competition and lots were drawn to determine the running order, the first to run, by convention, being last year's winner.

The proceedings

The aim of the competition is to find the locomotive capable of performing the greatest amount of work done during a run lasting ten minutes exactly in each of the competing gauges. A dynamometer car interposed between the locomotive and the train measures the work done. The competition is open to *Lion*



Last year's winner Andrew Neish was first to run, in accordance with Lionsmeet convention, and is seen here ready to leave the starting line with a total load of five adults. He finished in third place this year.



John Mills accepts the Mike Parrot Memorial Trophy from OLCO Chairman John Hawley. John entered the competition for the first time at Northampton last year when he did rather less well with a very new engine.



A brace of Secretaries! Runner-up Jon Swindlehurst (left) and winner John Mills examine Jon Swindlehurst's Lionsmeet veteran. Jon is Secretary of OLCO and John is Secretary of Bradford Model Engineering Society.



Geoff Cocking's Thunderbolt was the only 3 1/2 in. gauge model in the competition. The name explains the unusual colour scheme and reminds us that Curly Lawrence originally published the design as Titfield Thunderbolt.

locomotives in 3 1/2 in., 5 in. and 7 1/4 in. gauges, and prizes are awarded in each of these three classes. Sadly, 7 1/4 in. gauge engines have only featured in two of the 21 competitions to date and there were none this year. Reasonable modifications to the published design are permitted, but the addition of ballast external to the profile of the engine is not. Normally, drivers are free to select the load of their choice in terms of the number of trucks and number and distribution of passengers.

Each run starts at the same designated point on the track and finishes precisely ten minutes later, regardless of where on the track the train is. At the start and end of each run the dynamometer car meter readings are recorded and witnessed, and the distance travelled and work done are calculated. No account is taken of the amount of water or coal used. The aim is simply to achieve the highest rate of work output, regardless of efficiency.

At the conclusion of the competition the work done and distance travelled by each locomotive are calculated again from the relevant meter readings, checked with the earlier figures, and the results published. The driver of the locomotive producing the most work done in each gauge is declared the winner in his class, and a senior member of the Old Locomotive Committee then presents the prizes: the 7 1/4 in. Gauge Cup, and the Mike Parrott Memorial Cup for 5 in. gauge. Mike Parrott was the much-respected Guildford club member who co-founded the event back in 1985. As well as helping to get the event established, he won the 5 in. gauge class on a record six occasions. Sadly

he is no longer with us.

There is no trophy for the 3 1/2 in. gauge class, but it is customary for the chairman to make a presentation of wine. The cups may be held by the winners till the following year, provided they are members of OLCO. The wine may be disposed of at the recipient's discretion. It has been the practice in recent years for those involved to meet for a meal at a local hostelry before setting out on the journey home, and this year the jollifications took place at the Wyke Lion Hotel near Wyke on the Bradford road. Not well attended but enjoyable nonetheless, and we're working on the attendance for next year's event.

Notable runs

Rather than give a blow by blow account of each run in the manner of IMLEC, we will constrain ourselves to a mention of some of the highlights. We should then have room for a brief review of the first 21 years of Lionsmeet since its inception in 1985, within the space allowed by the editor.

It has been the convention at Lionsmeet that last year's winner will be the first to run. This effectively imposes a slight handicap, since the more observant of the later runners can learn much from the performance of the earlier runners. There has sometimes also been a tendency for a more relaxed interpretation of speed limits where they have applied, as the competition progresses and confidence in the track builds up. It was interesting to see a new dynamometer car at IMLEC this year which not only sounded a buzzer automatically when the pre-set speed limit was exceeded, but counted the number of infringements too! Three strikes and

you're out, without any 'ifs' or 'buts'!

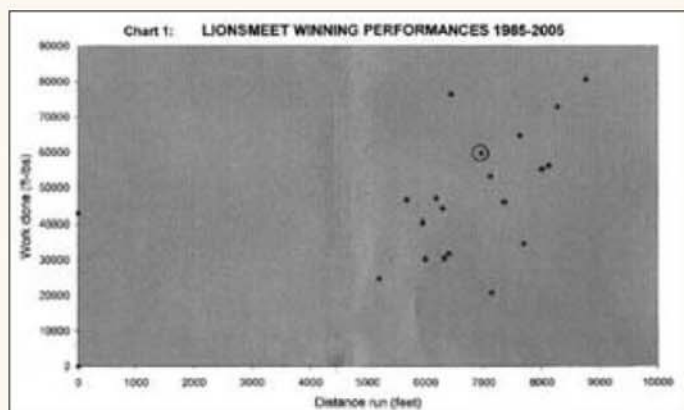
Last year's winner was Andrew Neish, who would have been knee high to a grasshopper when father David Neish was getting the event off the ground in 1985. Andrew has won the competition twice before, at Bromsgrove in 2002 and last year at Northampton. **Photograph 1** shows him about to leave the starting line. The engine was built by David many years ago and carried him to victory at the inaugural event at Guildford in 1985. Both the engine and the two drivers have proved themselves over the years to be strong contenders. Andrew's 'work done' figure has improved every year he has entered, but it fell short of what was needed this year to beat a relative newcomer to the event, and a seasoned old-timer.

Winner John Mills entered the competition for the first time last year with his newly finished Harrogate prize-winning model. On that occasion it was rather gracelessly adorned by a 'saddle tank' of solid lead. Since then he has raised the performance of the engine to match its appearance (by means we will not go into!) and increased its work capability from 19000ft-lbs last year to a winning 59800 this year. Another fast learner! John has certainly done his homework to have come so far so fast, even to the extent of visiting the host club the Wednesday before the event to check out the track! Needless to say, the lump of lead is gone (we banned it from last year anyway!). John's result is ringed on the scatter graph, and can be seen to be well up among the previous winners; in fact the fifth best ever result (**photo 2**).

Seasoned old-timer Jon Swindlehurst fell into

Table 1: LIONSMEET 2005 RESULTS in running order

Run	Driver	Builder	Distance feet	Work done ft-lbs
1	Andrew Neish	David Neish	5780	45040
2	David Neish	David Neish	4000	29590
3	Martyn Reeve	Martyn Reeve	5780	32560
4	Geoff Cocking	Geoff Cocking (retd)	0	0
5	John Mills	John Mills	6860	59800
6	Jon Swindlehurst	Jon Swindlehurst	6420	55400
7	Jim Fearn	Jim Fearn	5140	36700
8	David Wainwright	David Wainwright	5550	43140
9	Geoff Cocking	Geoff Cocking		13920





Secretary of the host club, David Wainwright, managed to finish in fourth place. Not bad considering that this was only his second appearance.



A Tiger among Lions! Martyn Reeve, just to be different, chose to name his model after Lion's sister engine, Tiger.

second place, having won the event on two previous occasions. At 55400ft-lbs his 'work done' was only a few hundred behind John Mills' and a failing boiler feed pump may well have cost him a third victory, although his previous best figure of 58605ft-lbs at Leyland in 2001 was still fractionally short of this year's winning performance (photo 3). These two will be the people to watch in future events!

Geoff Cocking is a member of the host club and was the only competitor to enter a 3¹/₂in. gauge engine. Photograph 4 shows him preparing the engine for his first run which unfortunately died on the starting line as the last embers of the fire fell through the grate. Things go wrong very quickly on these tiny engines and they require a great deal of concentration to keep them alive. To the surprise of many, he did actually move five people on two passenger trucks in this first attempt, but not by far! He was given a second slot at the end of the day, chose a more sensible total load of two adults and two children on a single truck, and amazed everyone with a very spirited performance yielding a work done figure of 13920ft-lbs. There have been times when 5in. Lions have done worse than that.

David Wainwright, secretary of the host club had no shortage of cheerleaders to urge him on to finish in fourth place. A very creditable performance given that this was only his second appearance in Lionsmeet (photo 5). Lion had a sister engine, or should it be 'brother' engine, which was named Tiger, and Martyn Reeve chose to name his model after the latter. A timely reminder of a largely forgotten piece of history (photo 6).

Looking back

The 21st anniversary of Lionsmeet seems an appropriate time to look back over the years and do a little statistical analysis on the results. Inevitably, the event has been dominated by the 5in. gauge engines, in fact 3¹/₂in. gauge engines have competed on only four occasions, and 7¹/₄in. on two, though the 1997 event at Peterborough was supported by no less than three engines in that gauge. Perhaps we should go there again!

Table 2 gives the winning performances for 5in. gauge engines over the years, and Chart 1 plots the work done against distance run for all these results. (In 1995, '96 and '98 the runs were longer and the figures have been standardised to ten minutes. The two plots on the vertical axis are for the 1988 event when there was no

competition since only a portable track was available, and for 1987 when the distance run was not recorded.) The remaining 19 plots show a surprisingly loose linear relationship between work done and distance run. It is often thought that if you keep going like the clappers for the full ten minutes then you will do well, but this is not necessarily the case. The average drawbar pull must be high also. Experienced drivers in Lionsmeet as in IMLEC know full well that choosing the right load for the prevailing conditions is absolutely crucial to the result, and this is a matter for fine judgement. It is said that good judgement comes from experience, and experience comes from bad judgement, and nowhere is this truer than in these competitions. Weighing up the condition and quality of the track, the gradients, the curves, the weights of prospective passengers, rolling resistance of trucks and the rest is a skill that has to be learnt. It would be nice to quantify these things and put them into a scatter chart, but where do you start?

Conclusion

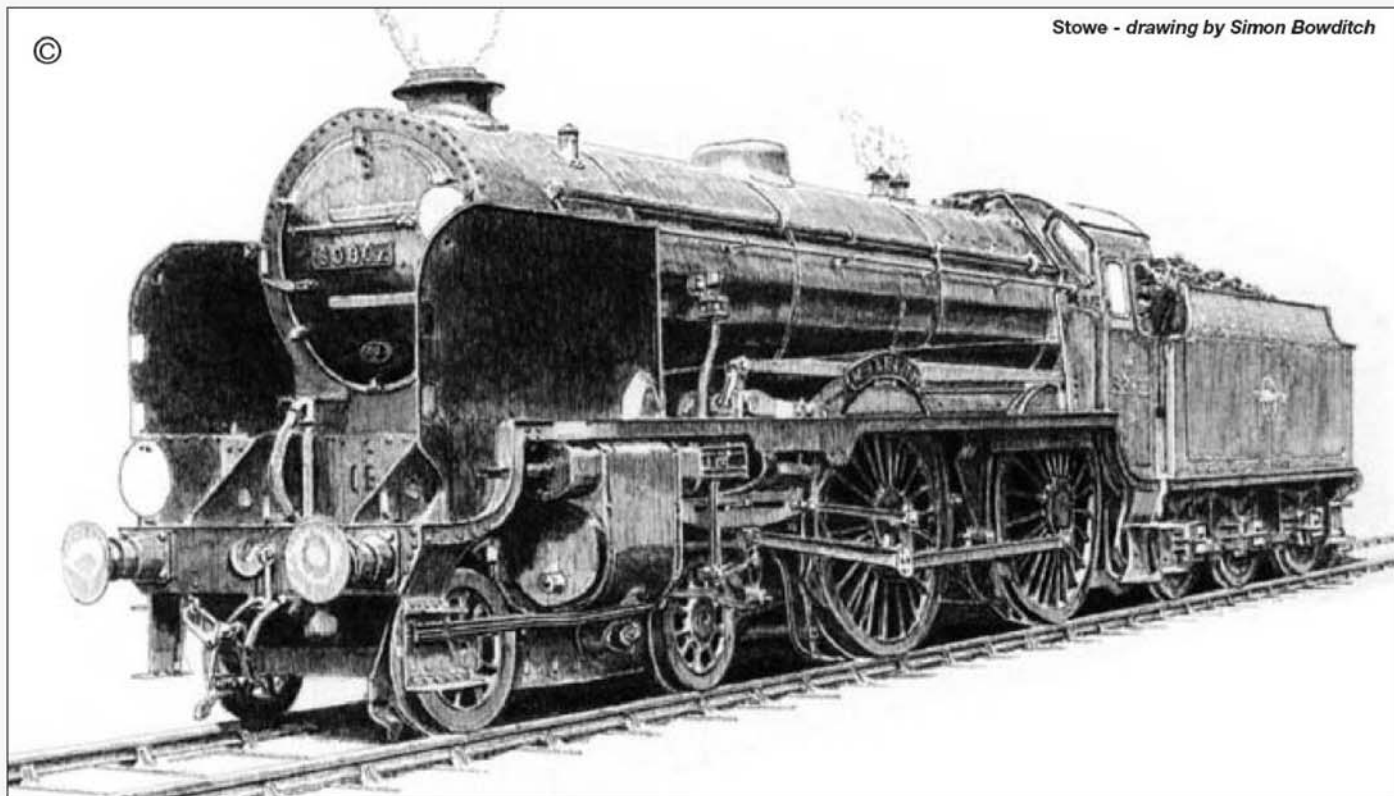
Before closing perhaps we could put on record our thanks to the Brighthouse and Halifax Model Engineers and their ladies for their hospitality, to the entrants and visitors who turned up in their droves to support the event, to OLCO members John Hawley who presented the prizes, Jan Ford who served as official observer, David Neish for providing the dynamometer car, Alfred Lloyd for generally helping out, and Charles Taylor-Nobbs who has played a leading role in OLCO since its inception and who rarely misses a Lionsmeet. They all travelled a considerable distance to be there and we are grateful for their support. We are indebted to John Hawley and others for the diligent record keeping which has made possible the statistical analysis above.

Next year's Lionsmeet will be held at Southport, a lovely old Victorian seaside town on the south Lancashire coast (well, it was), courtesy of Southport Model Engineering Club. Hope to see you there



Table 2: LIONSMEET WINNERS, 1985-2005

Year	Venue	No of Entries	Winner	Standardised feet run	Standardised work done
1985	Guildford	7	David Neish	8270	72810
1986	Runcorn	4	Dennis Cadsby	6290	44150
1987	Dinting	6	Jim Mercer	0	42900
1988	Wroughton	0	-	0	0
1989	Cheltenham	7	Mike Parrott	7360	45370
1990	Runcorn	6	Mike Parrott	7120	53190
1991	Falconwood	3	Mike Parrott	7620	64800
1992	Chesterfield	4	David Neish	5200	24765
1993	High Wycombe	5	Bob Davies	5670	48885
1994	Frimley	2	Mike Parrott	8000	55304
1995	Sutton Coldfield	3	Mike Parrott	7140	20685
1996	Bristol	5	Mike Parrott	8115	56300
1997	Peterborough	4	Jon Swindlehurst	6900	30180
1998	Cheadle Hulme	6	Peter Bainbridge	6400	31720
1999	Swansea	6	Geoff Wright	6180	47040
2000	Rugby	4	Alan Bibby	8760	80670
2001	Leyland	4	Alan Bibby	6440	76455
2002	Bromsgrove	5	Andrew Neish	7690	34575
2003	Erewash valley	5	Jon Swindlehurst	6320	30490
2004	Northampton	6	Andrew Neish	5850	40400
2005	Brighthouse	7	John Mills	6960	59800



STOWE SOUTHERN RAILWAY 'SCHOOLS' CLASS LOCOMOTIVE

Neville Evans

introduces us to *Stowe*, his latest design based on the Southern Railway Schools Class locomotives of the 1930s, and starts with the background which led to the development of the very handsome prototypes.

●Part I.

In 1852, a branch line of the South Eastern Railway was completed from Tunbridge Wells to St. Leonards. The only remarkable feature was that the civil engineers, presumably for reasons of expense, constructed it to a loading gauge that was even more restricted than the parent company's other lines. Frugality seldom pays off and often leads to far greater expenditure when expensive mistakes have to be rectified at a later date. The small double tunnel at Mountfield near Battle was the chief problem. It was too constricted as built and the problem was compounded when it had to be reinforced by an extra, inside layer of brickwork lining.

Various solutions were proposed a century later: enlargement of the tunnel, replacement with a cutting (it appears that it is very expensive to dig up a tunnel) or the installation of an automatically controlled, single, reversible line. The happenings that would occur in the tunnel when the automatics went wrong should not be dwelt upon.

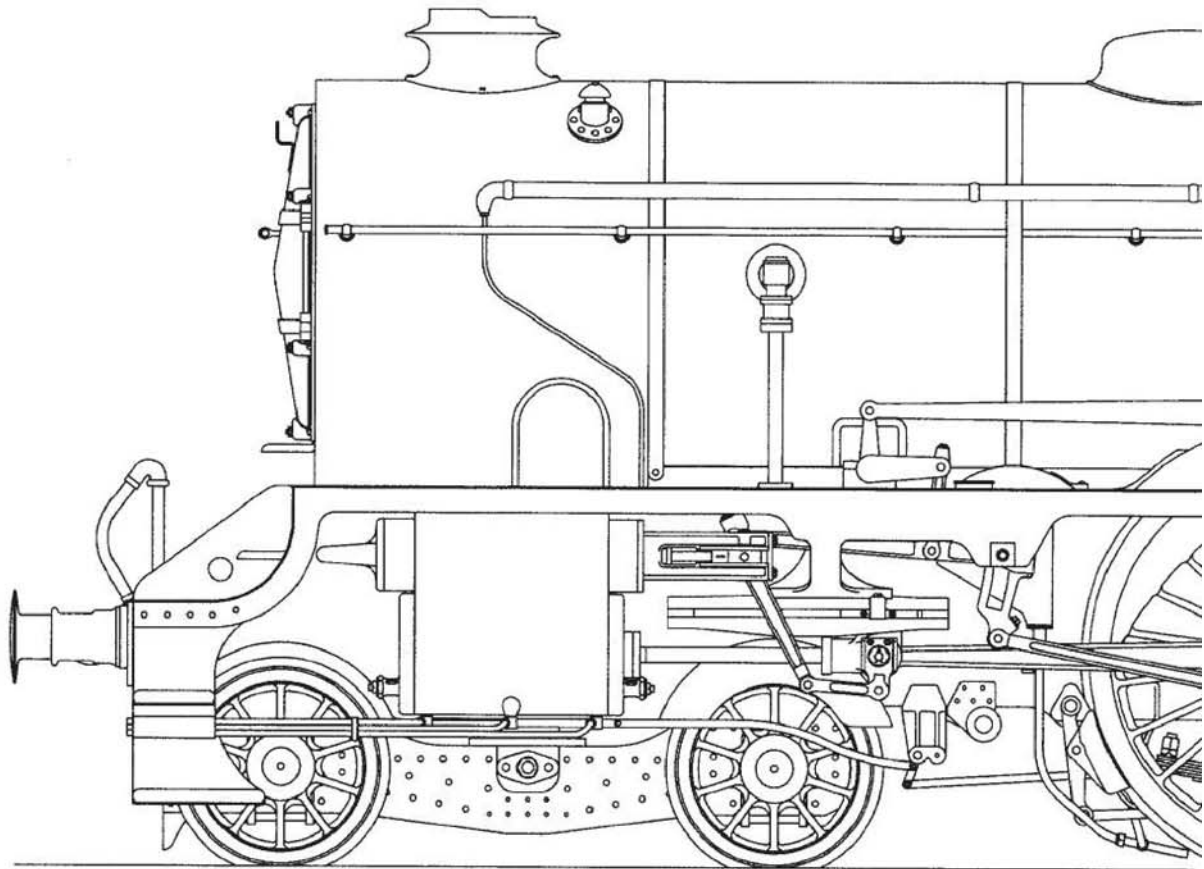
The Southern Railway succeeded in strengthening the former SECR main-lines so that they could take the extra weight of the 'Nelsons' and 'King Arthurs' but these locomotives were far too large for the Hastings route. The volume of traffic had grown to a state where more powerful engines were urgently required. The challenge was to design an engine that would fit into this miserable Mountfield tunnel and yet be powerful enough to haul the Charing Cross to Hastings trains to the same timings from London to Tonbridge, as the Kent coast trains hauled by the 'Arthurs'. In other words it had to be of equal power to a 'King Arthur' but much smaller. To conform to the maximum permitted width of 8ft. 6½in. an engine with two outside cylinders of sufficient diameter to develop the necessary power was obviously out of the question as the overall width would be too great. There was also the question of a limiting axle-load of 21 tons. A two-cylinder locomotive would have to have a lesser axle load on the coupled axle to allow for the hammer blow, which meant that there would be less weight available for adhesion on the serpentine road between Charing Cross and Hastings. A three cylinder design with cylinders of 16½in. (the same as a 'Nelson') was the obvious answer as it meant that it could be fitted into a width of just under 8ft. 6 inches.

A four coupled layout was decided upon which enabled a shorter frame to be used. This in turn reduced throw-over on the bends, a most

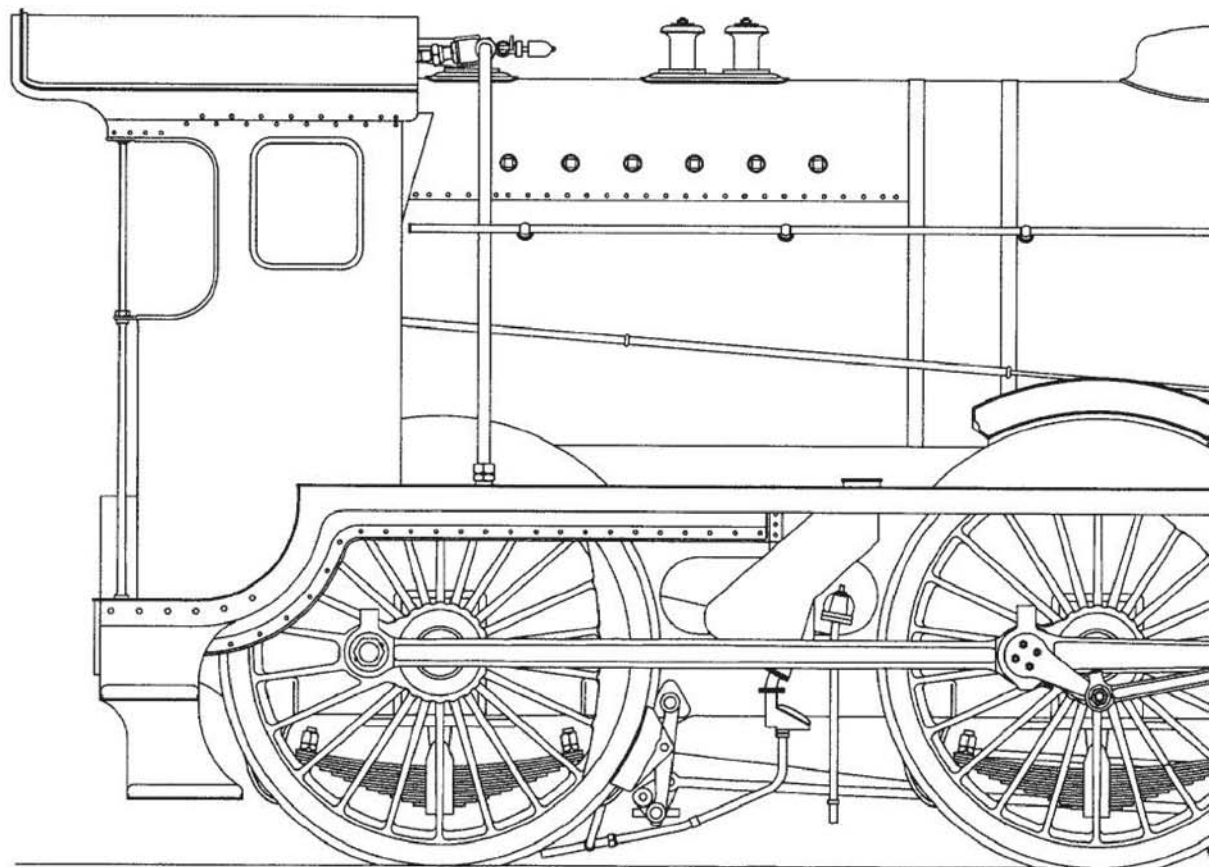
desirable feature which helped greatly to keep within the restriction on width, and also made it more suitable for the sharp curves between Tonbridge and Hastings. A further advantage was that it needed less power to propel itself as the internal resistance was lower. Added to which a four-coupled locomotive was lighter and therefore cheaper to build, and could use shorter, existing turntables.

A new turntable cost as much as a new engine, the 'Schools' could turn on a 50ft. diameter table, the 'Arthurs' needed 60ft. and the 'Nelsons' 65 feet. The decision was taken in favour of a four-coupled, three-cylinder locomotive with 6ft. 7in. dia. wheels and a boiler pressure of 220 pounds per square inch. The tractive effort at 85% boiler pressure was 25,150lb roughly the same as an 'Arthur', but the engine weighed one coach less. A slight snag was that the 21 ton axle loading meant that a sensitive hand had to be used on the throttle to avoid slipping.

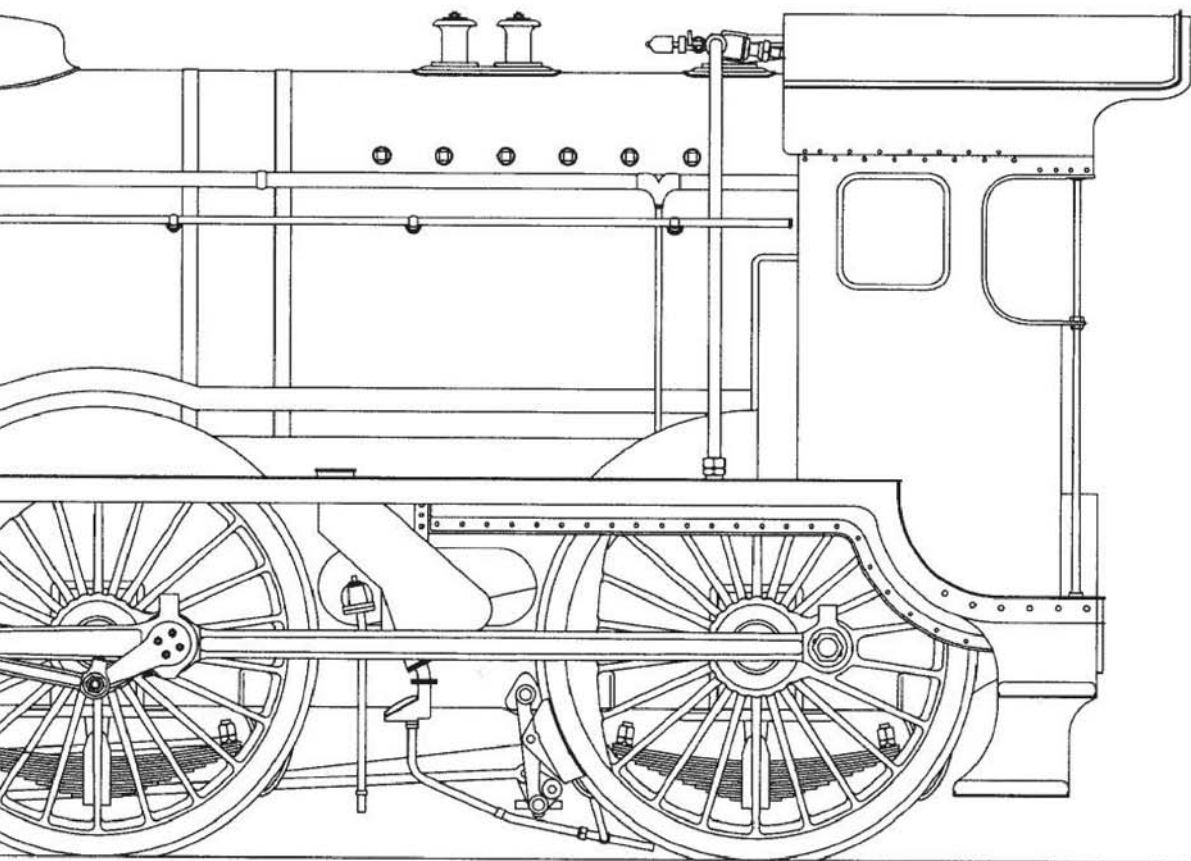
The 'Schools' class was developed from the 'Lord Nelsons' and was sometimes called 'a three quarter Nelson'. It possessed many parts in common with the 'Nelsons', the wheels, bogie, the outside cylinders, many of the motion parts and of course the ancillary details such as clacks, back-head fittings, etc. were similar, even the front cab windows were the same, turned upside down to suit the different spectacle plate required by the round topped boiler. The boiler was adapted from that fitted to



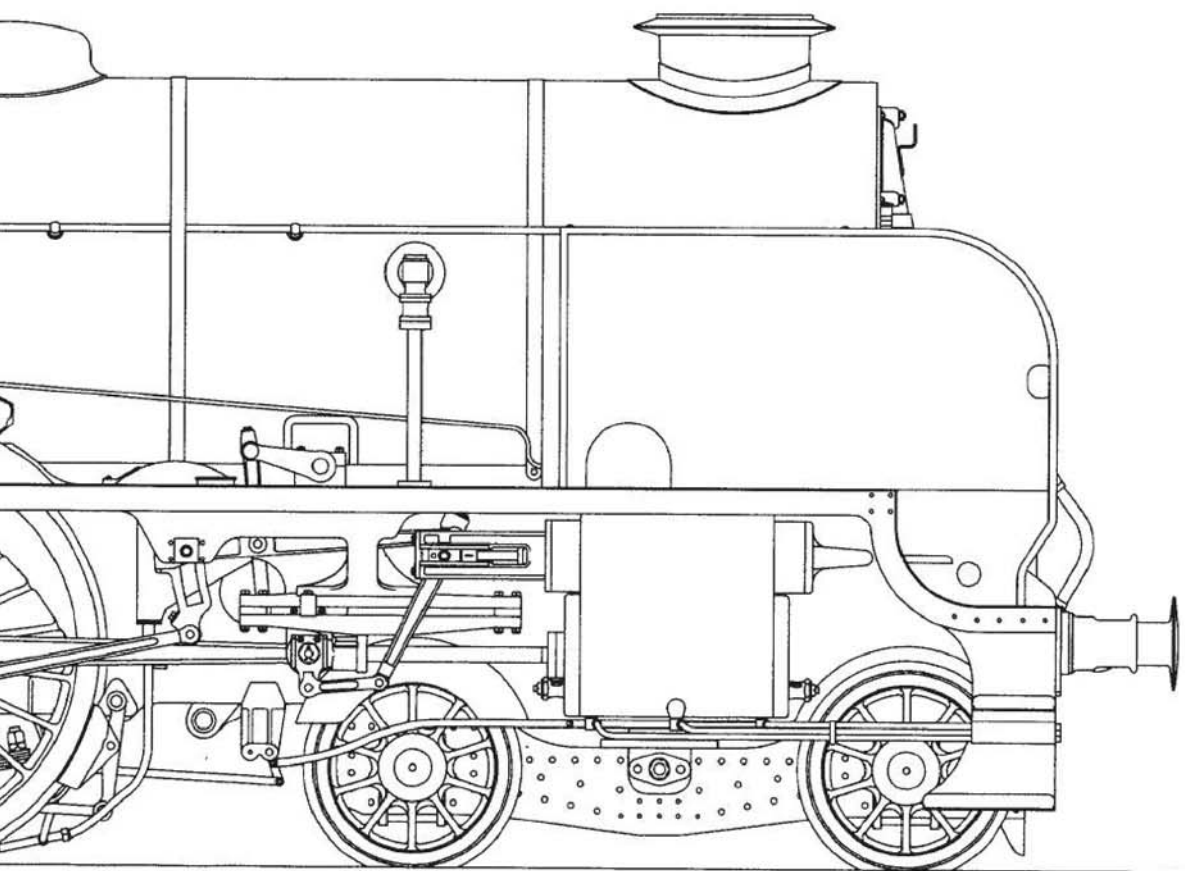
SCHOOLS CLASS. 6



SCHOOLS CLASS later s



early series as built



series with leMaitre chimney

the King Arthur class but with a shortened barrel. The cab had to be reduced in width at the top corners, to fit the reduced loading gauge and therefore the upper sides had to be canted inwards. This, to my mind, very attractive shape meant that a Belpaire firebox could not be fitted, hence the round topped type. The larger Belpaire box would also have been too heavy for the projected axle loads.

A further advantage of the 4-4-0 layout is that, by its nature, it tends to be quite short, which means that the driver can easily judge the position of front and rear buffers when coupling up. The short boiler improved the view in front of the engine although the smoke deflectors, when they were fitted, cannot have helped in this respect. A disadvantage of a shorter barrel was that it affected the length of the superheater tubes with the result that the steam temperature was somewhat lower than the optimum.

All in all however the 'Schools' class is an example of a design where everything seems to fit in perfectly. Elegant in appearance, economical, compact in size, easy to drive, and very powerful, they were right from the beginning. Few modifications needed to be applied. Steam sanding took the place of gravity in order to cut down on the amount of sand needed, and to reduce the amount spilled all over the point-work at the terminal stations which tended to interfere with the track electrical circuits. One slight problem was caused by leakage at the front edges of the original piston valves. According to Harry Holcroft, who carried out the entire investigation, when running at speed the steam had no time to leak, but at slow

speeds, especially when starting a heavy train in the up direction, on the awkward rising curve of the then Platform 7 at London Bridge, it could cause the locomotive to stall. A cure was effected by changing the design of the valve head, so that steam was controlled by the leading ring, in fact almost exactly as my favourite design as specified in the drawings for *Penrhos Grange*. At the same time the lead was standardised at $\frac{1}{4}$ in. measured from the edge of the ring, instead of at the valve head. There were changes made to the draughting arrangements of some engines in that Oliver Bullied modified the single blast pipe to a multiple jet le Maitre system. This modification didn't seem to have had much effect on the performance of the locomotives as only half were converted, the first being 914 *Eastbourne* in January 1939.

The 'Schools' were all built at Eastleigh in three batches, No. E900 to E909 in 1930; E910 to E929 in 1932/34; and E930 to E939 in 1934/35. Order No. 631 for the last twenty locomotives was standard with the first two batches, except that the look out windows were increased in height from 2ft. $1\frac{3}{4}$ in. to 2ft. 8in. and the cab windows were moved upwards by $6\frac{3}{4}$ in. so that they lined up with the top edge of the lookout. Presumably the Southern had taken on a new batch of drivers who were a bit taller than the previous ones. The tenders were also slightly modified in that they used rolled steel, disc wheels instead of the spoked variety and had a bank of tool and crew lockers placed across the front end.

These tenders could hold 4,000gal. of water and 5 tons of coal. They were very similar to

the tenders designed by the SECR Railway for the N and U classes, except that the coal rails were tilted inwards to match the cab for clearance reasons.

The plaque that read "Don't lean out of the windows" had a special significance on the Hastings line, and always reminded me of the three red bars and the same notice that was fixed to the sliding cockpit side windows of the dear old Vickers Wellington. We embryo aircrew actually cut our teeth on these antique death traps in 1951. During a familiarisation visit I enquired of one Master Pilot Green as to the seriousness of the warning. He pointed out that in 1940 all 'Wimpeys', as they were always called, were re-engined either with the rather feeble Rolls Royce Merlin or, as became standard, the far superior Bristol Hercules. The double row Hercules was far longer than the single row, poppet valve Pegasus that they replaced, which meant that the propeller had to be moved forward until the blade tip was only about 6in. from the window, which I kept firmly shut for evermore.

In conclusion I must add my appreciation for the unstinting help that was given to me by the Bluebell railway during my visit to inspect and photograph *Stowe* a few years ago, and for their loan of invaluable drawings of that locomotive. I would urge all those people who are interested in building this engine to go to your nearest centre and to inspect and photograph the real thing for themselves. *Stowe* is on the Bluebell, *Repton* is on the North Yorkshire Moors, and *Cheltenham* at the Railway Museum in York.

●To be continued.



Repton on the North Yorkshire Moors Railway (photo: Pete Thomas)

ROAD STEAM

Martin Wallis

describes a superbly detailed model of a unique vehicle.

Pride of place in the main hall of the Harrogate 2005 Model Engineering and Modelling Exhibition, and strategically placed in the main doorway, was the superb 1:3 scale Richard Hornsby & Sons' chain track tractor by Steve Baldock. The model had everything: the craftsmanship, the attention to detail, and made from the drawings of a truly stunning prototype. It was certainly a 'once seen never forgotten' model.

The model took eight years to complete, and Steve estimates that over 7,000 hours were spent on it. The model was built from original drawings for the most part, backed up with a collection of black and white photographs that have survived, examples of which accompany this text. The works drawings, while clearly an enormous bonus, have been the cause of some upset and worry as Hornsby made several modifications, both during the prototype's construction and as a result of steam trials, which were not referenced on the original general arrangements.

Before embarking on a description of the model a few words on the prototype might be helpful. Readers will no doubt have heard of the 'Klondike Gold Rush', either in history books or through various 'western' style films based on the period. The 'rush' started when gold was discovered on 16 August 1896 at Rabbits Creek, word quickly spreading, stories of untold wealth being common place. The reality was that the Yukon weather was harsh, the winter in particular, and one can only wonder at working



The Hornsby on test in 1909. The tendency to 'rock' on its tracks is an alarming characteristic shared by the model. Note the jockey wheel to support the top track has yet to be fitted and there is no rear guard (photo: Ray Hooley collection).

HORNSBY STEAM CHAIN TRACK TRACTOR

conditions the prospectors must have endured, so often without reward.

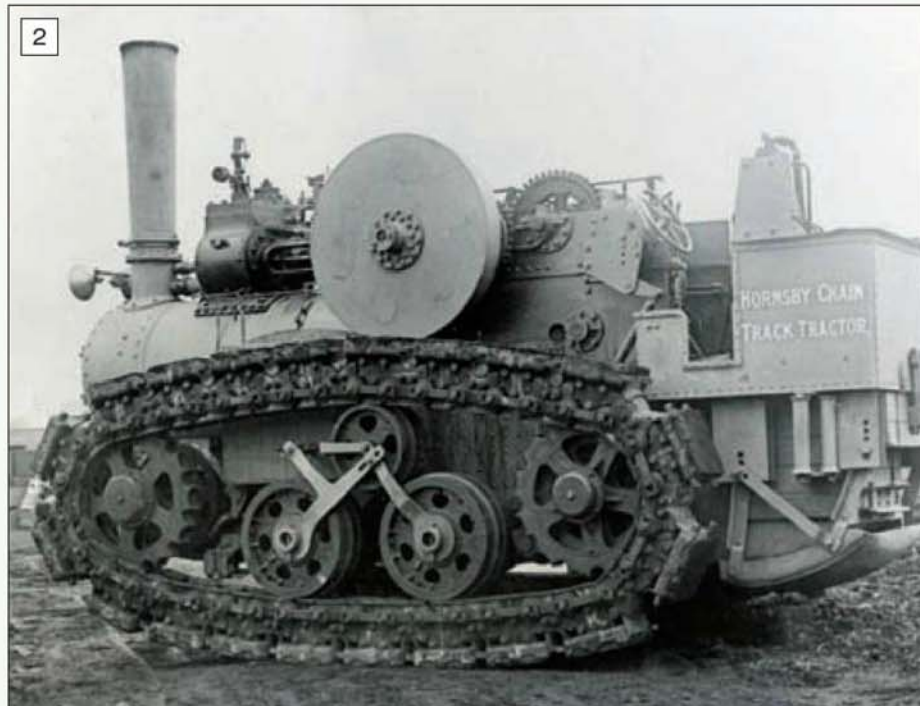
By the early 1900s Dawson City was a minor metropolis. The majority of the individual

prospectors had not made their fortune and, in consequence, had sold their claims to the handful of big mining companies who, through heavy and sophisticated machinery, were much more prosperous.

As the infrastructure developed so did the need for power and, in consequence, the Northern Light Power & Coal Co. was formed. Part of their remit was the production of electricity which they achieved with a power plant close to a coal mine at Coal Creek, some 44 miles from Dawson City. Another was the provision of coal to Dawson. This was rather tricky as the roads were very rudimentary; in the winter sheets of ice and in summer dangerously marshy.

Which individual in the Northern Light Power & Coal Co. had the idea of a 'chain track', or 'caterpillar' tractor and subsequently placed an order; does not seem to have been recorded. The specification was for a tractor capable of towing 100 ton gross loads of coal wagons a distance of some 40 miles. The order went to the British company of Hornsby, who with the war office, had developed the 'Endless Track' and were the leaders of this technology.

Unfortunately the Hornsby 'chain track' tractors were fitted with internal combustion engines; which due to the scarcity of oil combined with the readily available coal supply from the mine was unsuitable. The solution was for Hornsby to purchase a boiler, cylinder and motion from William Foster and to mount it on their 'chain track'. Thus the Foster boiler/engine assembly No.12459 was married up to Hornsby chain track No.35086 and a truly unique vehicle was conceived.



A later photograph, before export, with the jockey wheels fitted. A substantial steel plate construction protects the underneath of the back tank. Wood cladding insulates both fore and back tanks in anticipation of the Yukon winter (photo: Ray Hooley collection).

The Foster engine was substantial, rated at 80bhp with compound cylinders 7 $\frac{3}{4}$ in. diameter high pressure, 12in. diameter low pressure, both by 12in. stroke. The order for the chain track tractor was placed in July 1909, the Foster engine arrived at Hornsby's works in December 1909 and, by early March 1910, the completed engine was ready to test.

Tests

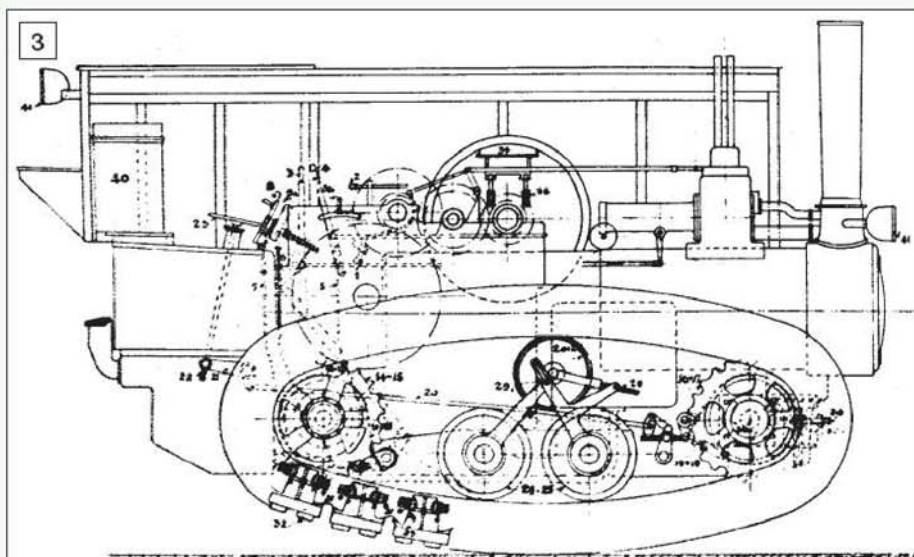
The tests or trials resulted in the addition of a jockey wheel to support the top track. This eased the motion of the tracks and prevented undue vibration. In the working instructions supplied with the engine these jockey wheels are detailed:

"If it is decided to run in the fastest speeds we recommend that the jockey wheels 26 and 27 be used The Jockey wheels are intended to just take up any slack in the top half of the chain track and must not be adjusted to more than effect this, as they will cause undue friction. They can be adjusted by means of the screws 28 and the locknuts 20."

It seems the engine was not altogether straightforward to control as at least once during the trials the driver 'lost control'. The recorded event was the descent of Spitalgate Hill where the engine crashed into a house. It is interesting here to note Steve's observations on steering the model, which likewise proved to be quite a challenge. At the Whissendine Rally just as Steve was beginning to feel more confident with his steering skills he tried the model on a tarmac road. A 'disaster' was his verdict, most of the 'control' he had achieved on grass evaporated - but as far as I know no houses were damaged! Steve commented that not only was it the most uncomfortable ride he had ever known but it was also impossible to fire the engine. Every time he got some coal on the shovel the engine would rock sharply and the coal would fly everywhere! The water level in the boiler was anybody's guess. Steve doubted he would venture onto hard roads again for a long time.

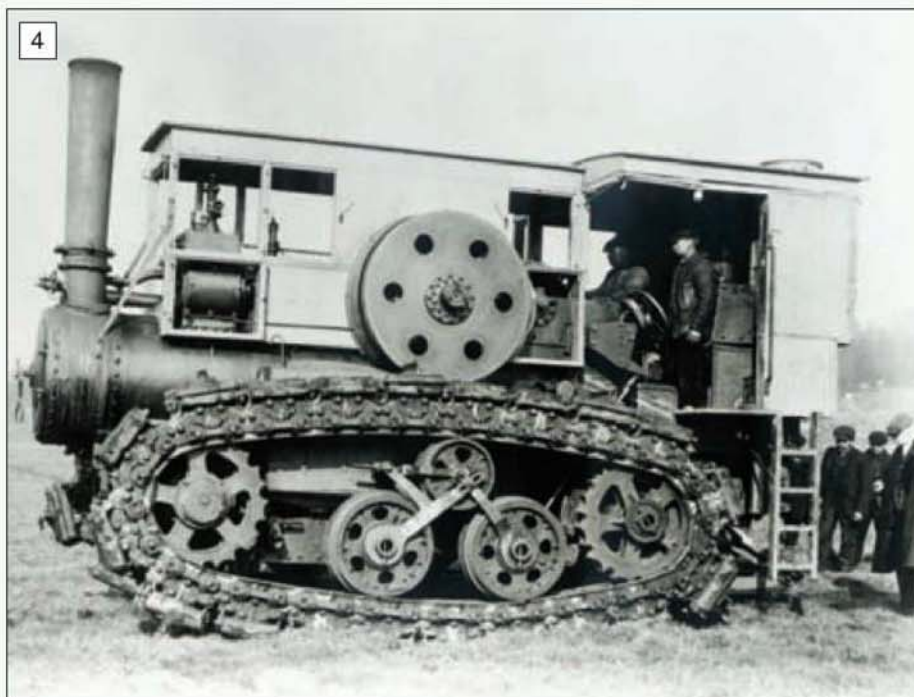
Back to the prototype. No time was wasted and by the end of March the tractor was shipped from London to New Westminster, British Columbia. It travelled presumably in knock down condition and was sent by river, the Canadian Pacific railway, and the White Pass & Yukon Railway to White Horse. The last part of its journey was by stern-wheeler and sled, the tractor's arrival in Dawson City being confirmed by a newspaper report dated 19 August 1910.

It seems that the engine's active life only lasted three years, as in 1913 cheaper hydro-electric power was available from the North Fork Power Project. The coal mine at Coal Creek was shut and the Northern Light Power & Coal Co. went bankrupt. The tractor remained somewhere in or near Dawson City as in 1932 the tractor was purchased by a Yukon gold miner and shipped back to New Westminster. Finding no work for it in New Westminster the engine was eventually sold to a pulp mill on Vancouver Island for timber haulage. Sadly it proved uneconomical and the boiler was removed to heat the workers bunkhouse. As fate had it the bunkhouse burnt down and the boiler, presumably with the cylinder, was used as in-fill for a baseball diamond at Port McNeil.



1 STARTING HANDLE	13 STEERING BRAKE DRUM, LEFT HAND SIDE	28 JOCKEY WHEEL LOCKING NUTS
2 HIGH COMPOUND VALVE HANDLE	14 BACK SPROCKET WHEEL, RIGHT HAND	30 ADJUSTING SCREWS FOR TRACK CHAIN
3 REVERSING LEVER	15 " " " LEFT " "	30A LOCKING NUTS FOR " "
4 FRICTION CLUTCH LEVER	16 FRONT " " RIGHT " "	31 TRACK CHAIN LINKS
5 DIFFERENTIAL GEAR LOCKING LEVER	17 " " " LEFT " "	32 " " HOOD TREADS
6 RIGHT HAND SPROCKET CLUTCH LEVER	18 FRONT SPROCKET BRAKE BAND, RIGHT HAND SIDE	33 OIL PLUGS FOR CHAIN TRACKS
7 LEFT HAND SPROCKET-CLUTCH LEVER (LEVER)	19 " " " LEFT " "	34 FRICTION CLUTCH HOOD SHOES
8 STEERING HAND WHEEL	20 " " BRAKE ROD	35 " " ADJUSTING NUTS
9 LEVER FOR CHANGING STEERING POWER AT BACK OF STEERING HAND WHEEL	21 " " " LEVER	36 SPEED CONTROL CHANGE LEVER
9A GEAR BOX AT BACK OF STEERING HAND WHEEL	22 " " " SCREW	37 FIRST-SPURGE FRAMES WITH SPURGE HOOK BOLTS
10 STEERING BRAKE BAND, RIGHT HAND SIDE	23 " " " HANDLE	38 PADDLES
11 " " " LEFT " "	24 TRACK WHEELS - RIGHT-LEFT HAND SIDES	39 OIL PLUG IN DIFFERENTIAL GEAR CASE
12 " " " JUMP, RIGHT " "	25 JET JOCKEY WHEELS " " " "	40 ACETYLENE GENERATOR (FLY WHEEL)
	26 " WHEEL ADJUSTING SCREWS	41 " LAMPS

A general arrangement drawing and key taken from the Working Instructions supplied with the engine (Ray Hooley collection).



A wooden structure was added to the engine to keep in the warmth of the boiler as a protection for the crew and mechanism against the Yukon winter (photo: Ray Hooley collection).

5

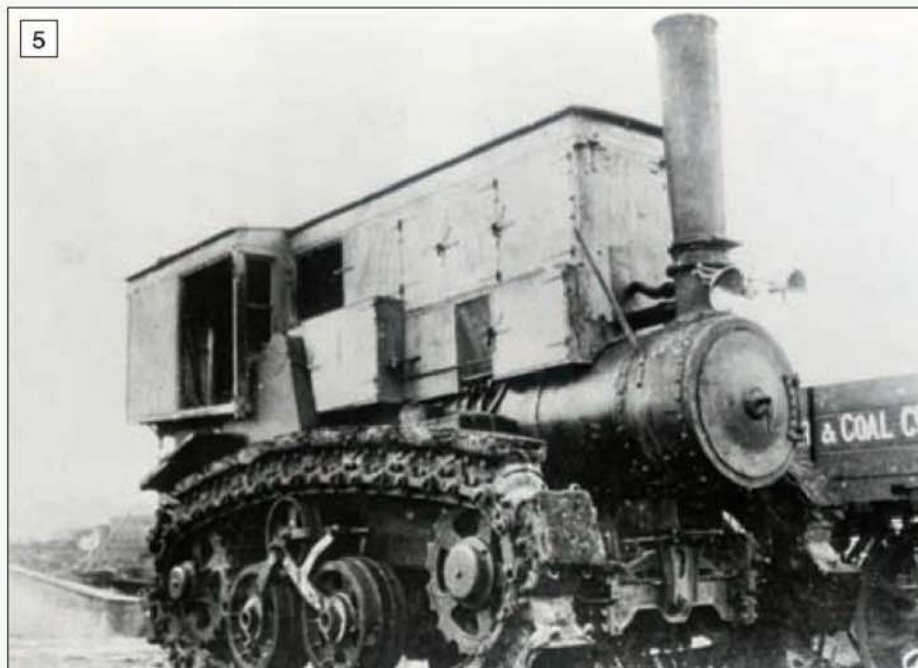
Happily the Hornsby part - the chain tracks - had better luck and were left undisturbed for 45 years overlooking the Broughton Strait at the Northern end of Vancouver Island.

In 1974 Ray Hooley, an expert in all matters steam and especially those of Lincoln, was informed by a friend of the remains of an 'old steam caterpillar engine' on Vancouver Island. Of course, Ray knew exactly what it was likely to be and, with the location verified, flew to Canada. The site was so inaccessible he had to hire a sea plane and an inflatable craft to reach it.

Since the Hornsby was on Canadian Forestry Commission Land Ray contacted them. The Commission were evidently of the view that since the remains were abandoned he could have them if he arranged collection. However the planned recovery was not to happen as the owner of the boat who had taken Ray to view it also decided he would like it. This was truly a spanner in the works as when he was informed the remains were already spoken for he wrote to the local heritage committee and got a preservation order placed on it, which prohibited export.

Ray did not give up, and made every effort to overturn the order, with the full support of the NTET, but without success. In 1984 Ray wrote to the Canadian National Museum of Science and Technology at Ottawa but the Canadians clearly would rather keep the Hornsby just as it is - with no realistic prospect of restoration - than allow it to be exported. In 1988 Ray suggested that if it were allowed to return to the UK to be restored (at no expense to the Canadians) it could then be rallied for 3 years and then returned to Canada for a further three years to appear at their vintage gatherings and events and then brought back to the UK for three years and so on. This suggestion was rejected too.

To their credit Canadian preservationists have moved the Hornsby to where it is possible to view it, see photo 6. It is certainly good news that it is safe and now possible to inspect; but such a shame it has not been re-boilered and re-built for us all to enjoy.



Judging from the condition of the engine this photo may have been taken in the Yukon. Note the wagon behind, one of eight sent out with the engine each one weighing 5 tons 3cwt unladen (photo: Ray Hooley collection).

Happily the spirit of the engine lives on in Steve Baldock's beautifully engineered 1:3 scale model. I trust the accompanying pictures give a flavour of the skill and attention to detail that Steve has put into it. The Hornsby is a truly outstanding model.

All the features of the prototype are incorporated. Even the pipe work to steam heat the belly and back tanks is fitted. The colour scheme of unlined grey is an educated guess as any number of enquiries, including the livery officer of the Road Locomotive Society, failed to come up with an answer. The model has an extra historical twist as most of the bright work has been made from an ex-back axle of a Fowler A3 road locomotive. Surely re-cycling at its best, and making some of the materials used older than the original.

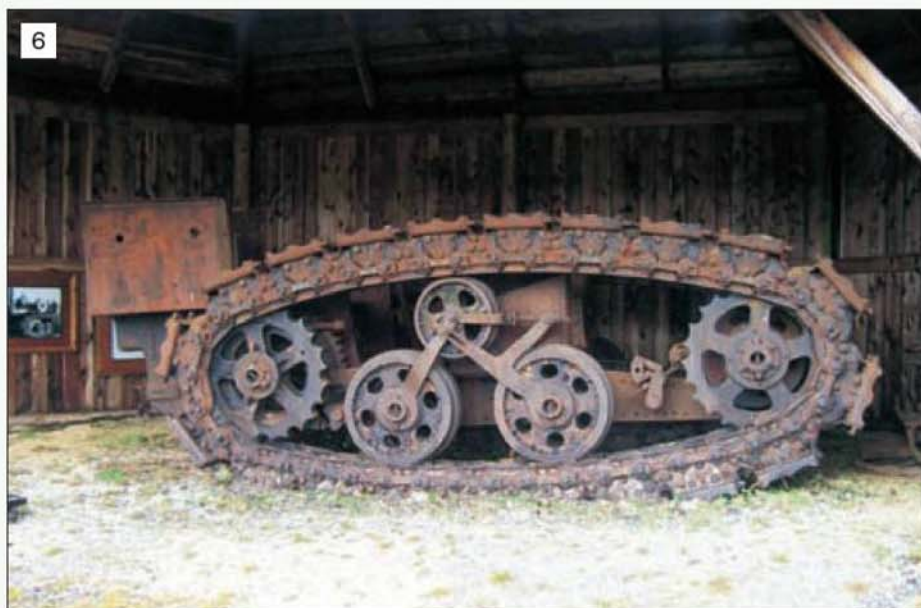
Two water gauges, one along the usual lines for a traction engine, and one with an extra long glass are fitted. Steve explained that if great care

is not taken when driving that the model adopts a 'nose up' position, shortly followed by a 'nose down' one. Steve felt the extra long water gauge was designed with this in mind, and it has proved as useful on the model as, presumably, it was on the prototype. He likened driving the model as a little like being in charge of a rocking horse!

The model may be steered by two methods, firstly by braking either the left or the right hand tracks using large band brakes situated just behind the front sprockets, see photo 7, or secondly by using the dog clutches. The dog clutch method involves firstly engaging the differential lock and then, using either the left or right hand dog clutches to drive one track alone. The braking method uses a steering gearbox, which is provided with a gear reduction.

The model weighs 1.3 tons empty, is a true compound and runs at 170psi., by comparison the prototype weighed 25 tons and worked at 180psi.

6

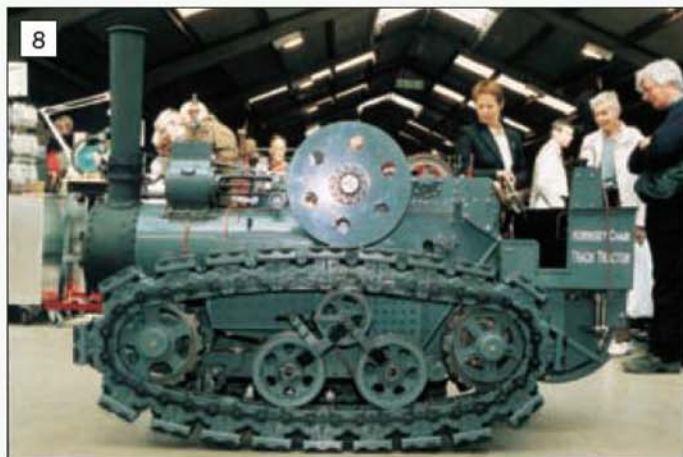


The remains of the engine as they are today, in the corner of a golf course car park on Vancouver Island (photo: Dennis Read).

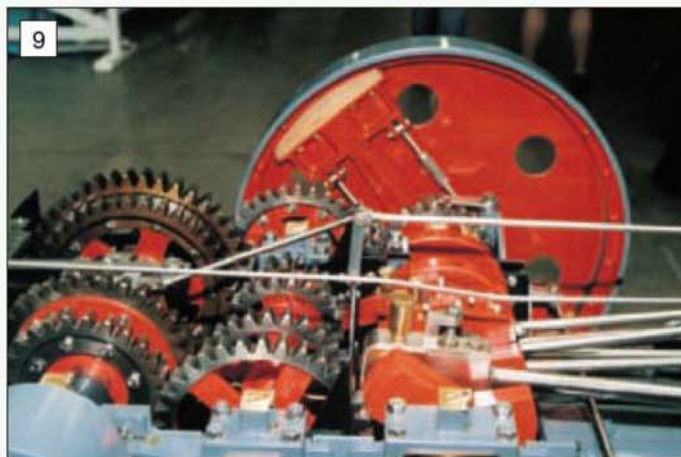
7



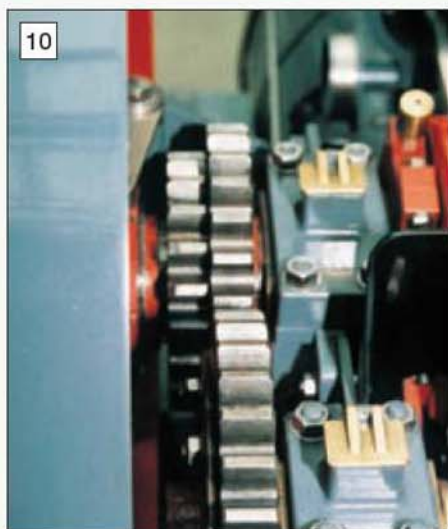
Front view of the 1:3 scale model taken at Harrogate (photos 7 - 13 Martin Wallis).



8
A side view of the stunning model collecting admiring glances. Compare to the makers photo (photo 2) shown earlier.



9
The four speed gearing between the second and third shafts. Note one of the wooden blocks of the clutch inside the flywheel rim.



10
The high and low range gearing between the crankshaft and second shaft.



11
The gear selector neatly engraved with the gear positions. The vehicle was unusual in having four speeds instantly available with an additional four provided by a change of gear if required.

The engine has no less than 8 speeds. A selection may be made between four pairs of gears on the second to third shaft (photo 9). In addition a 'high range' may be accessed by a gear substitution between the crank and second shaft, see photo 10.

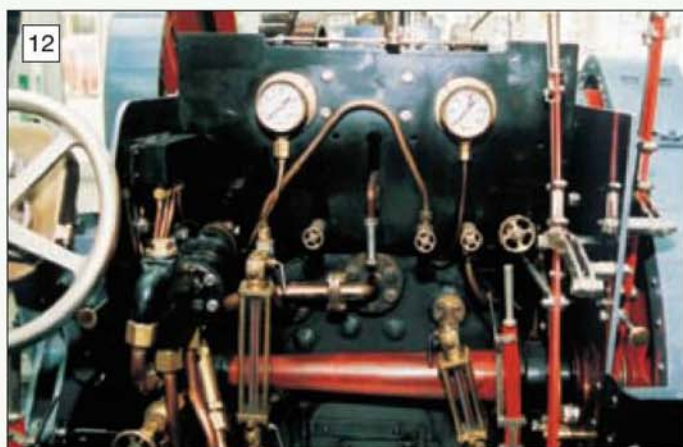
The speeds and gear change details are given in The Working Instruction for the Hornsby Patent Steam Tractor as follows: "The tractor is fitted with four speeds as follows: First speed 1 mile per hour; second speed 2 miles per hour; third speed 2.8 miles per hour; fourth speed $4\frac{5}{8}$ miles per hour. By taking off the 37

tooth gear ring on the left hand side of the first motion shaft which gears with the 18 tooth pinion on the crankshaft, and putting in its place the alternative 32 tooth gearing provided to gear into the 23 tooth pinion on the crankshaft, the speeds may be increased as follows: first speed $1\frac{1}{2}$ mph, second speed $2\frac{1}{2}$ mph, third speed $4\frac{1}{8}$ mph and the fourth speed 7mph." The change speed gear not in use is presumably stored in a tool box or on the footplate. Steve has so far only driven the model at modest speeds, leaving what might be achieved in the fourth speed to speculation.

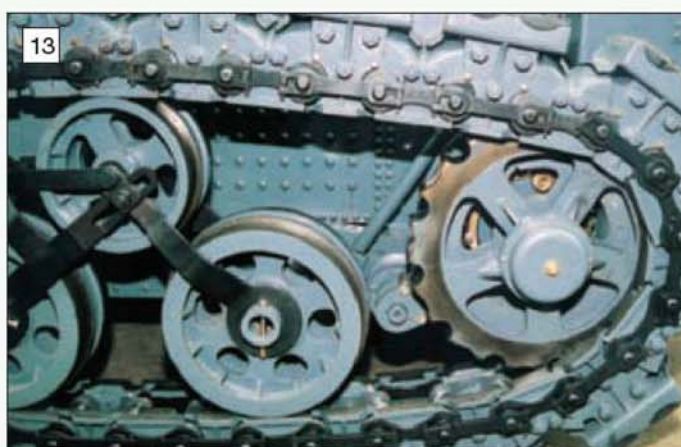
Thanks

My thanks to Steve Baldock for his time and patience in explaining the intricacies of his model. Also to Dennis Read who has researched the history of the prototype and prepared a booklet on same, and to John Crawley for detailing the recovery attempts (Old Glory November 2004).

Thanks are also due to Ray Hooley for kindly providing the black and white illustrations that accompanies these notes.



12
A view of the footplate showing the two water gauges and controls. Note the extra long water gauge.



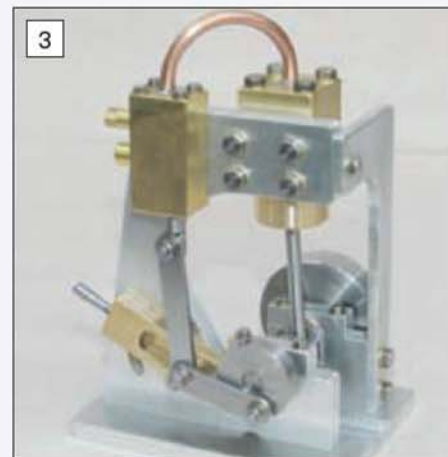
13
Detail of the chain tracks. Rubber blocks have been used on the tracks in place of the prototypical wood blocks.



1
The Sisson triple expansion steam marine engine that inspired the project.



2
A close up view of two of the three sets of valve drive and reversing gear.



3
The finished model engine turned to show the valve gear side.

DESIGNING A HACKWORTH VALVE ENGINE

Colin Pape

how a simple day out turned into fascinating design study and engine building project.

● *Part I*

Some time ago I made two visits to Markham Grange. It is near Doncaster and houses a very fine collection of steam engines. It is open every day and for anybody interested in seeing some fine engines this collection is worth a long trip. On Wednesdays several of these engines are run under steam. Incredibly, entry is free.

One of the engines on display is a 3-cylinder marine engine built by W. Sisson of Gloucester in 1927. This engine is shown in **photo 1**. It looks at first sight like a simple 3-cylinder in-line engine but in fact it is a triple expansion engine. The cylinders are all inside a large cover along with the valve housings so they are not visible.

The engine has an interesting reversing valve gear. It is described as a modified Hackworth valve system. It appears to be a very simple mechanism that adds only a few parts to a basic single direction valve drive. Moving a single lever can change the direction of the engine. This

lever is visible in **photo 1** with a cleaning cloth tied to it.

Each cylinder has its own set of valve drive and reversing gear. A close up of the reversing gear for two of the cylinders is shown in **photo 2**. Each set is driven from a large eccentric disc on the crankshaft. A very solid looking brass arm comes from the eccentric and ends in a slider that moves in parallel guides. From a point along the arm a rod runs up to the valve mechanism next to the cylinder. The guides all form part of a single frame that may be pivoted. By pivoting the whole frame under control of the lever with the cleaning cloth, the guides may be inclined up or down. With the frame inclined up the engine will turn in one direction and with the frame inclined down it will turn in the opposite direction.

On my second visit to Markham Grange I was lucky enough to see this engine running and I was very impressed by the lack of vibration. In fact the volunteer engineer who was running the engine placed an old style penny on its edge on one of the dashpot covers and it stayed there without any problem. I had never heard of Mr. Hackworth or his valve gear so I decided to find out more about its inventor.

Mr. Hackworth

When I started out on the hunt, the first Mr. Hackworth that I came across was Mr. Timothy Hackworth (1786-1850). I am sure that many readers are already well aware of this man but I admit to never having heard of him. I spent quite some time learning about the many achievements of Timothy. He actually entered a locomotive called *Sans Pareil* in the famous Rainhill Trials. It was a good performer but it broke down. George Stephenson with his locomotive *Rocket* won the trials. I have read that had Hackworth won, we would all know about him and virtually nobody would have heard of Stephenson. So it was perhaps natural that for some time I supposed it was he who invented the valve gear but I was wrong. He was not the inventor. The gear was invented by one of his children, John Wesley Hackworth (1820-1891). The design was introduced, as far as I have been able to find out, in 1853. It seems to have served as a base for numerous designs by other engineers who were

generally trying to improve the speed of opening and closing or the geometry of their valve gear.

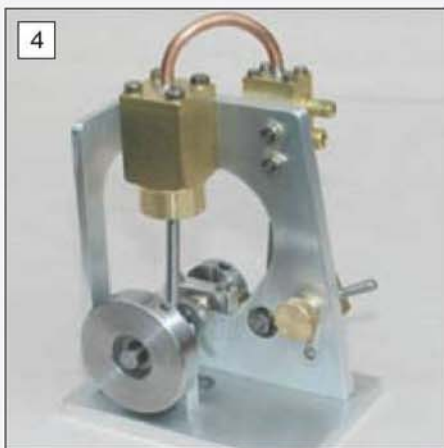
John Hackworth worked for some time for his father, Timothy. He must have been very capable because his father entrusted him with the delivery of a locomotive to Russia when he was only 16 years old.

Model engine

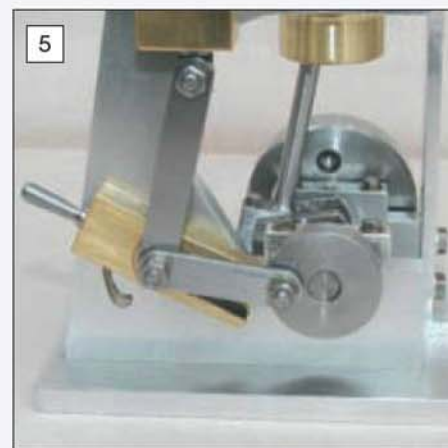
I was very taken by the idea of making a small triple compound. Not a slavish copy for which I do not have the time or the skill but something along the same lines and with the Hackworth reversing gear.

Eventually I decided that I knew enough about the way the valve gear was supposed to work but I was still puzzled by some aspects of compounding. In my reading and visits to other museums I had come across the existence of a device that was new to me called a receiver. I had not noticed anything that looked like a receiver on the Sisson engine and this and other reasons caused me to shelve the triple-compound project for a while and to concentrate on the Hackworth reversing gear.

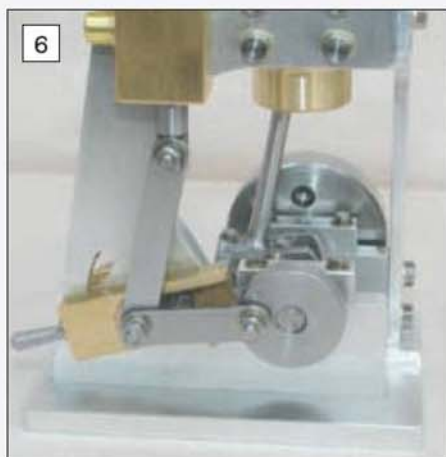
I decided to make a simple, single-cylinder engine with a working reversing gear based on my understanding of the Hackworth system. I wanted



4
The model engine viewed from the side remote from the valve gear.



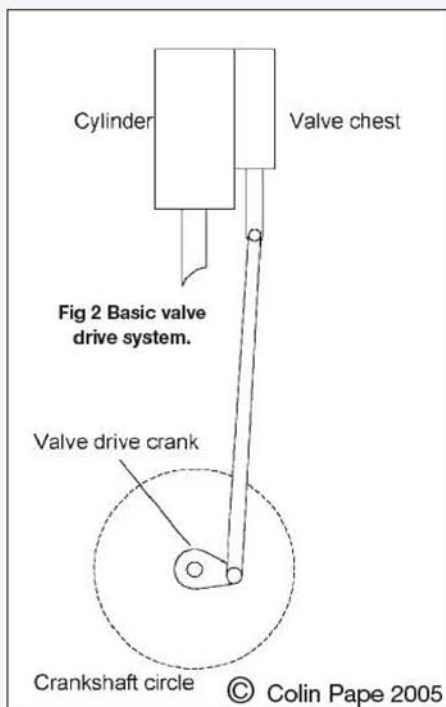
5
The model Hackworth linkage - this shot shows the gear up.



The model Hackworth linkage - this time the gear is down.

to make the valve gear operation very visible and easy to operate. This accounts for the somewhat unusual frame design that will be detailed later. Photograph 3 shows the finished single-cylinder engine from the valve gear side and photo 4 shows it from the other side. The engine works well and it runs well in each direction. The valve control lever can be moved from full forward to full reverse without stopping the engine but since this is not a self-starting engine it usually has to be given a push to start it again in the right direction. The engine will run with the reversing guide in almost any position. As the guide is moved towards the centre of its travel the valve travel diminishes to zero so moving the guide provides a sort of cut-off control.

Apart from the fact that my engine has only one cylinder, one obvious difference between it and the Sisson engine is in the way that the slider link drive is implemented. In the original, the three sets of valve gear are driven from eccentrics on the main shaft but in a small engine the eccentrics need to be unreasonably big and begin to overwhelm the engine. They tend to get in the way of the other moving parts. To keep things to a reasonable size I decided to use a simple crank at one end of the crankshaft



to drive the valve control gear. I was able to place all the valve drive mechanism outside the main frame so that the operation could be perfectly visible. A close-up of the reversing valve gear in the up position is shown in photo 5. In photo 6 the engine is shown with the crank in the same position but with the guide down.

Note the difference in the position of the valve in the two photos. The crankshaft has not moved.

The guide rails of the Sisson engine are implemented in the model in the form of a T-slot cut in the brass box with a small handle visible at the lower left of the photograph. This brass box has a pivot at its centre and may be inclined to any angle in the range of +25 to -25deg. and locked in the chosen position by a clamp screw on the other side of the front frame.

My engine runs on compressed air. To run it on steam, the piston and the valve spool should be made in a non-corroding material such as stainless steel and a lubricator should be fitted.

The main dimensions of the engine are as follows:

Bore: 13mm
Stroke: 20mm

The engine was built from easily obtainable materials. I used an aluminium-copper alloy for the frames, hard brass bar for the cylinder, valve link guide and valve chest, bronze for the bearings, silver steel for the shafts and free cutting mild steel for odds and ends. The screws and nuts are mostly 6BA and 8BA. No castings are required.

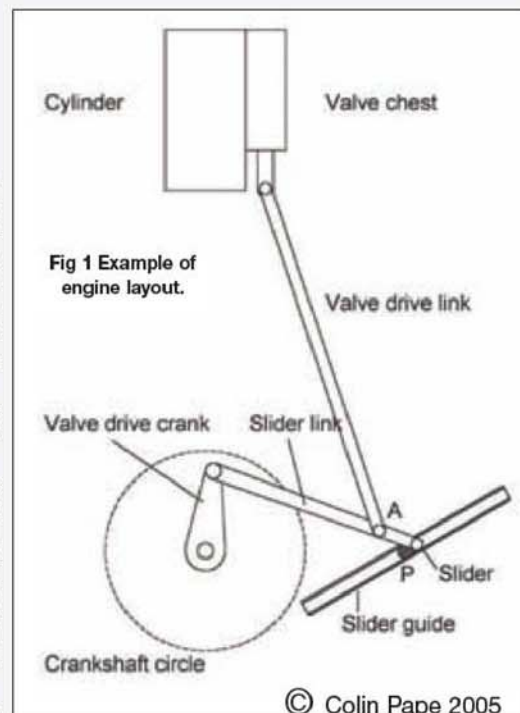
I will include the drawings of this engine but I will not go into detail of how it was built since most operations are pretty straightforward. I will however discuss the important aspects of the reversing gear design.

Basic Hackworth design

I think that my understanding of the valve gear is reasonably correct and could be applied to other larger or multiple cylinder versions of this type of valve gear.

Figure 1 shows a simplified drawing of the layout of the valve gear in a Hackworth type engine. The drawing represents a single-cylinder engine as seen from the valve drive end of the crankshaft.

In this example, a crank is fitted to the end of the crankshaft and a link is connected to this crank. The other end of this link ends in a slider that moves in a guide. The drawing shows the engine in the position where the slider is close to the mid-point of its travel along the guide. This guide has a pivot (P) and the whole guide can be turned about this pivot point. From a point (A) on the link rod I have shown another link going upwards. This is



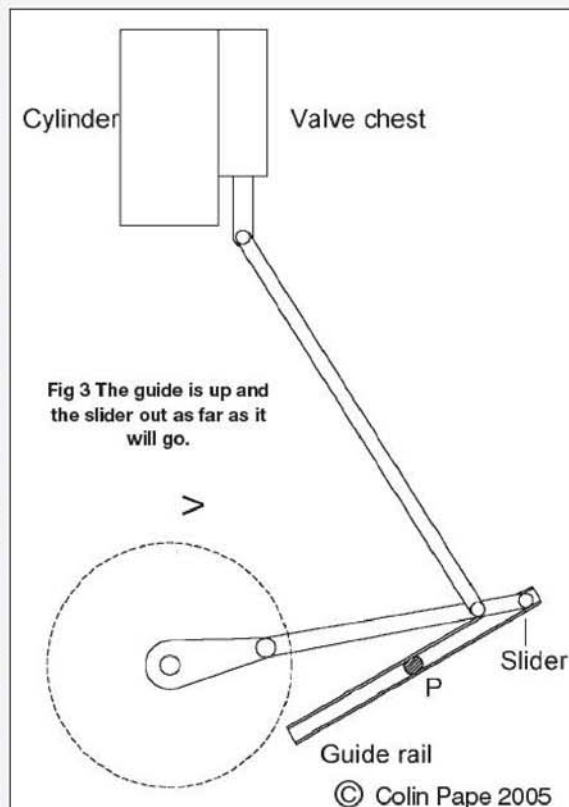
the connecting rod to drive the valve. In the engine that I designed and built, point A is at the slider.

Comparison with a simple valve drive

Figure 2 shows a basic valve drive for an engine that only turns in one direction.

It consists of a crank and a single link to the valve chest. In the Hackworth system there are just two additions to this basic system, a pivoting guide and a second link.

The simple engine in fig 2 can be made to run in the opposite direction by turning the valve drive crank through 180deg. on the crankshaft



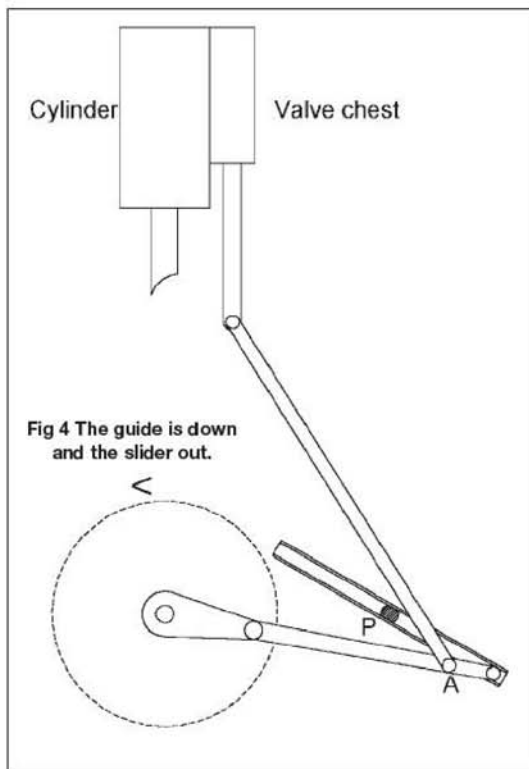


Fig 4 The guide is down and the slider out.

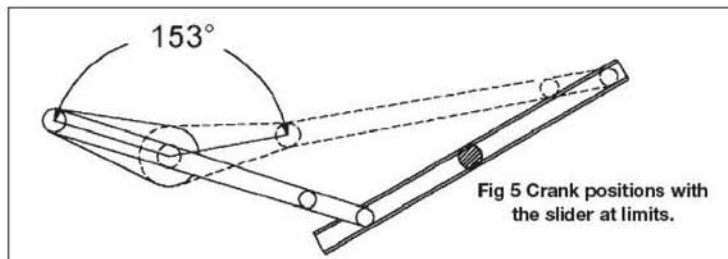


Fig 5 Crank positions with the slider at limits.

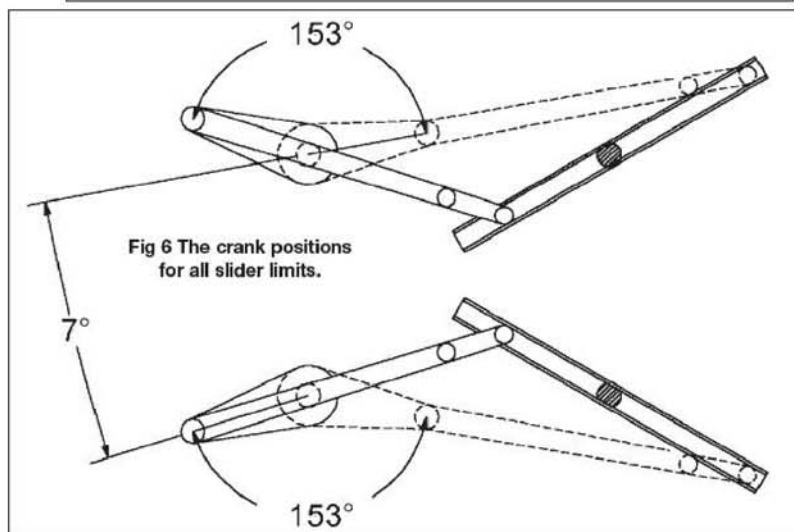


Fig 6 The crank positions for all slider limits.

© Colin Pape 2005

and fixing it there. There could well be other changes but they are not relevant here.

The way the Hackworth gear works

In fig 3 the example engine is shown with the guide inclined up by 30 degrees. The crankshaft has been turned clockwise and the slider has moved out to the end of the guide. The valve is now in its uppermost position.

Let us assume that the engine status at this time is that the piston is about halfway down, the inlet valve is fully open and the exhaust valve is fully closed. So, with the guide in this position, the engine will continue to turn clockwise if the steam is supplied to the engine.

In fig 4 the guide has been rotated so that the outer end is now down and by the same amount as it was previously up. Now, with the crankshaft almost in the same position as before, the valve is at its lowest travel and the exhaust valve is now fully open and the inlet valve is fully closed. The only way the engine will run now is anti-clockwise. Engine reversal has been achieved without touching the crankshaft.

More differences compared to a simple valve drive

What I learned in studying the valve gear so that I could use it was that this type of gear turns out to have less than ideal geometry and unequal performance in the two running directions. It is a very simple gear but simplicity comes at a price.

I think it is useful to extend the comparison with a simple valve drive to illustrate the problems. The main differences are:

- 1: In the simple system, the valve high and low points are obtained when the crank is at two points that are 180deg. apart.
- 2: In the Hackworth system the two points are not 180deg. apart.
- 3: With the simple valve drive the engine can

be made to run in the opposite direction by fixing the valve drive crank at a point 180deg. round on the crankshaft.

4: In the Hackworth system, the high point of valve travel in one direction is not 180deg. round on the crank from the high point in the other direction. This is a consequence of the situation described in point '2'.

5: In the simple valve drive, the valve travel is unchanged regardless of the engine direction.

6: In the Hackworth system the valve travel will not be identical in the two directions and will be considerably different unless special care is taken in the design.

These differences lead to design difficulties and to set up problems with the engine valve gear. It is not possible to have optimum performance in the two directions. A compromise must be obtained and normally this would be to favour the main direction. In a ship or a locomotive this would normally be the forward direction.

Problems with the Hackworth gear

I have included some drawings of a Hackworth engine that deliberately show up the differences mentioned above. They are based on the original drawing that shows an engine near the mid-point of valve travel. The first drawing is technically correct and the engine would turn over without anything breaking or blocking but...

Valve high and low points

If we consider the case when the guide is pointing up, the valve reaches its high point when the slider is as far out as it can get from the crankshaft. Conversely, the low point is reached when the slider is as close as it can get to the crankshaft. These two points are not 180deg. apart. They are reached when the crank arm and

the slider link are perfectly in line and when the slider link completely overlaps the crank arm. Figure 5 shows the two conditions.

In the example the two points are 153deg. apart. The departure from 180deg. gets much worse as the guide is brought closer to the crankshaft and as the angle of the guide increases. We can always arrange to get adequate valve travel but the valve timing can pose a problem.

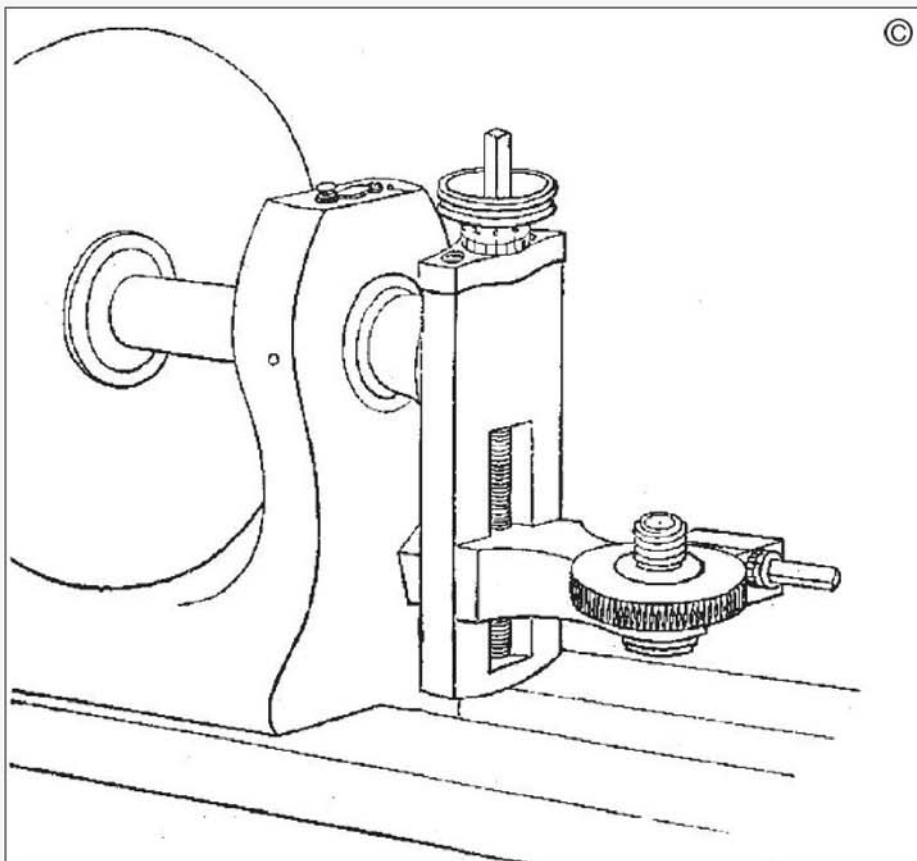
Non-symmetrical operation

Ideally, the crank points where the valve is fully up in the two rotation directions should be 180deg. apart. Similarly for the valve fully down positions. Figure 6 shows the crank positions for high and low valve travel points in both directions. In this example the crank points are 7deg. 'out of true'. As in the case above, the lack of symmetry gets worse as the guide is brought closer to the crankshaft.

I have seen comments about a locomotive that uses the Hackworth gear and does not run so well in reverse as in forward gear and I think the reason is due to this lack of symmetry. The engine timing will normally be set up once and for all so this problem means that some compromises will be required and an inevitable consequence is that equal performance in the two running directions will not be possible. I have reason to believe that, because of the relative closeness of the guide rails to the crankshaft, the Markham Grange engine has non-symmetrical valve motion just as in my model but since it is a marine engine the lack of symmetry was probably not of any real concern.

I cannot see any way around this non-symmetry characteristic except by adding more links. Other engineers did this many years ago. Sticking to the Hackworth design means adopting compromises in the valve settings and I did this in my model. Simplicity sometimes has a price!

●To be continued.



Dome or spherical chuck

PLAIN MAN'S GUIDE TO ORNAMENTAL TURNING

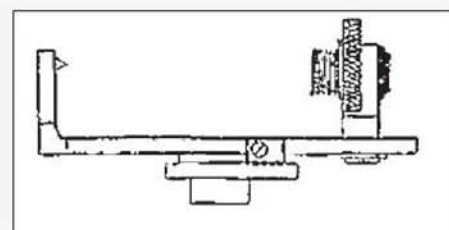
John Edwards

continues his examination of the principal ornamental chucks and their uses.

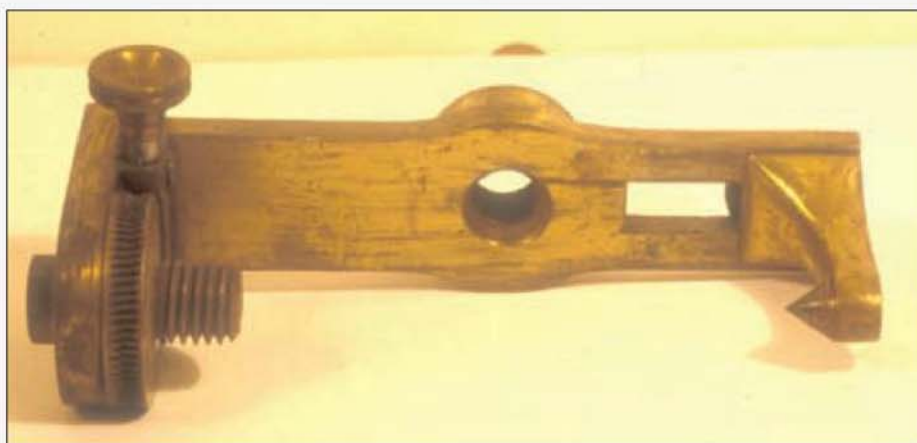
●Part VII continued from page 694
(M.E. 4262, 9 December 2005)

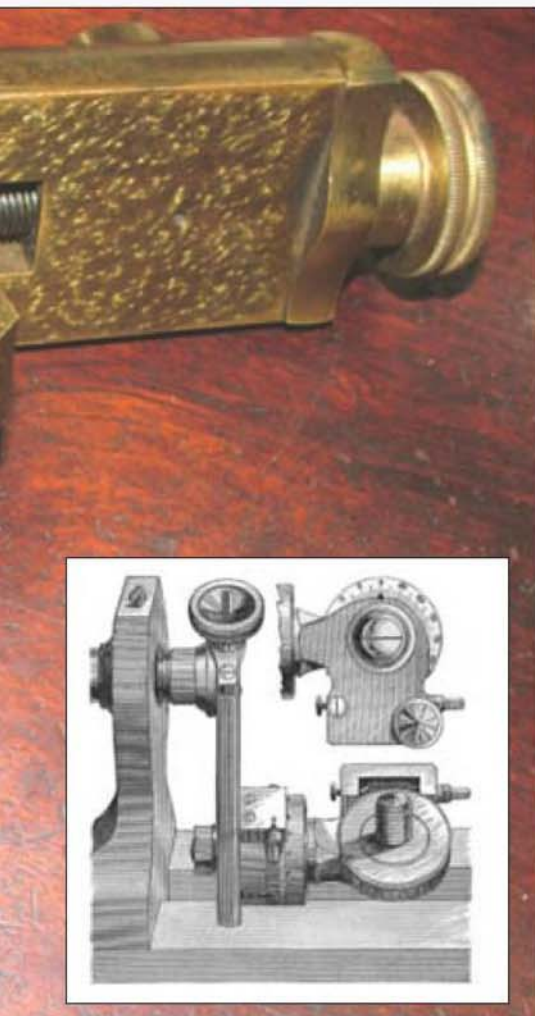


The Dome or Spherical Chuck is a work-holding device for placing the work on a 96-tooth nosewheel perpendicular to the axis of the lathe spindle. This enables domes and hemispheres to be shaped and ornamented and in



Pillar or pencil chuck





this respect it is a partial substitute for the Spherical Slide-rest.

The chuck is not intended to be 'run' but must be rotated under careful control, either by hand or under the control of the tangent screw; the index is not sufficiently strong to hold this chuck in position. In some applications the Dome Chuck is used in conjunction with a gear train and care must be taken to avoid any backlash when passing the point of balance; this problem can be largely overcome by the application of counterbalance weights.

With the slide-rest parallel to the bed a dome may be formed from a series of cuts taken to the same depth at successive intervals of the chuck nosewheel. Another use of the Dome Chuck is for cutting and ornamenting polygons; for this purpose the slide-rest is set across the bed and the facing surface is cut; successive surfaces are then cut following appropriate adjustment of the nosewheel.

The Pillar or Pencil Chuck is another form of Dome Chuck having a longer base with a dead centre at the opposite end to the nosewheel; this dead centre is to support long slender works such as pillars and pen and pencil barrels.

The Combination Dome/Rolling Oblique Chuck: for cutting and ornamenting round and pointed (gothic) domes.

The Combination Dome/Pitching Oblique Chuck: for cutting and ornamenting oblique facets and pyramids.

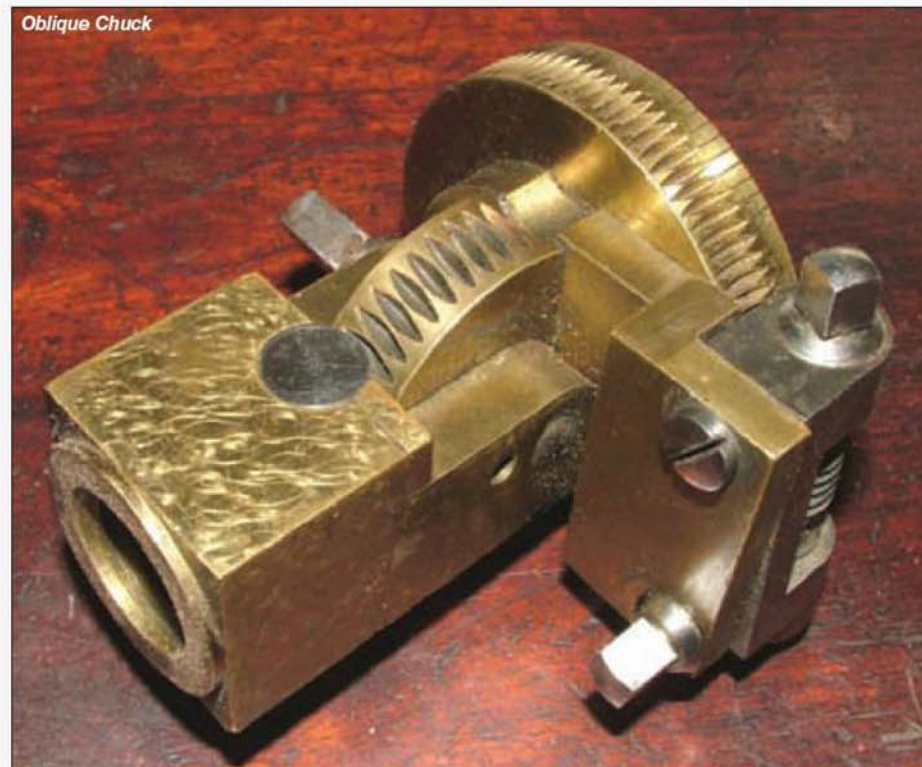


The pincushion box in the photograph was made on the Dome Chuck; each face was cut with a long round-nosed cutter at maximum radius in the Horizontal Cutting Frame while the chuck was rotated very slowly under control of the tangent screw. The Dome Chuck was counter-balanced to avoid the chuck coming unscrewed or the surface being marred by backlash. The visible crack was caused by leaving this box on the windowsill in bright sunlight!

The Oblique Chuck is used with the Rectilinear Chuck and in this combination can place the work in positions that are impossible with the Dome/Oblique Chuck combination; this is because the nosewheel of the Rectilinear Chuck can be adjusted below, on or above centre whereas the Dome chuck can only be adjusted below centre. The Rectilinear/Oblique combination is also more stable.

The next article will be concerned with the Spiral apparatus, the Reciprocator and the Geometric Chuck. If any reader wishes to know about the Society of Ornamental Turners or, indeed, anything about O T equipment and techniques not covered in this series, I can be contacted by telephone on 01732 355 479 or by email at johnf.edwards@virgin.net

● *To be continued*



A GWR 1400 CLASS LOCOMOTIVE IN GAUGE 1

G. R. Thornber

continues construction with the valve gear and lubricator.

●Part V continued from page 701
(M.E. 4262, 9 December 2005)

The valve gear is slip eccentric, with the eccentric rod operating the valve with a rocking lever. This arrangement was used by John Barrett in his *City of Truro* articles mentioned earlier. The valve motion is very nearly sinusoidal with only very small non linearity effects.

The eccentrics have small $\frac{1}{16}$ in. pins in them that bear against the ends of the slots in the crankshaft already described. It is essential

that these are correctly positioned diametrically opposite the eccentric centre otherwise the valve timing will be adrift. Although the valves themselves can be adjusted on their spindles the timing relies on the end of the slots in the crankshaft and the pins on the eccentrics. This is not as scary as it sounds but take care!

The eccentric sheaves are in one piece avoiding the necessity to split them in half, if the eccentrics are made of steel the eccentric straps should be brass - once assembled on the crankshaft there should be no requirement to remove them.

The two rocking levers rotate on a $\frac{1}{8}$ in. pin, which is a clearance fit on one frame and screwed into the other. These are best made with

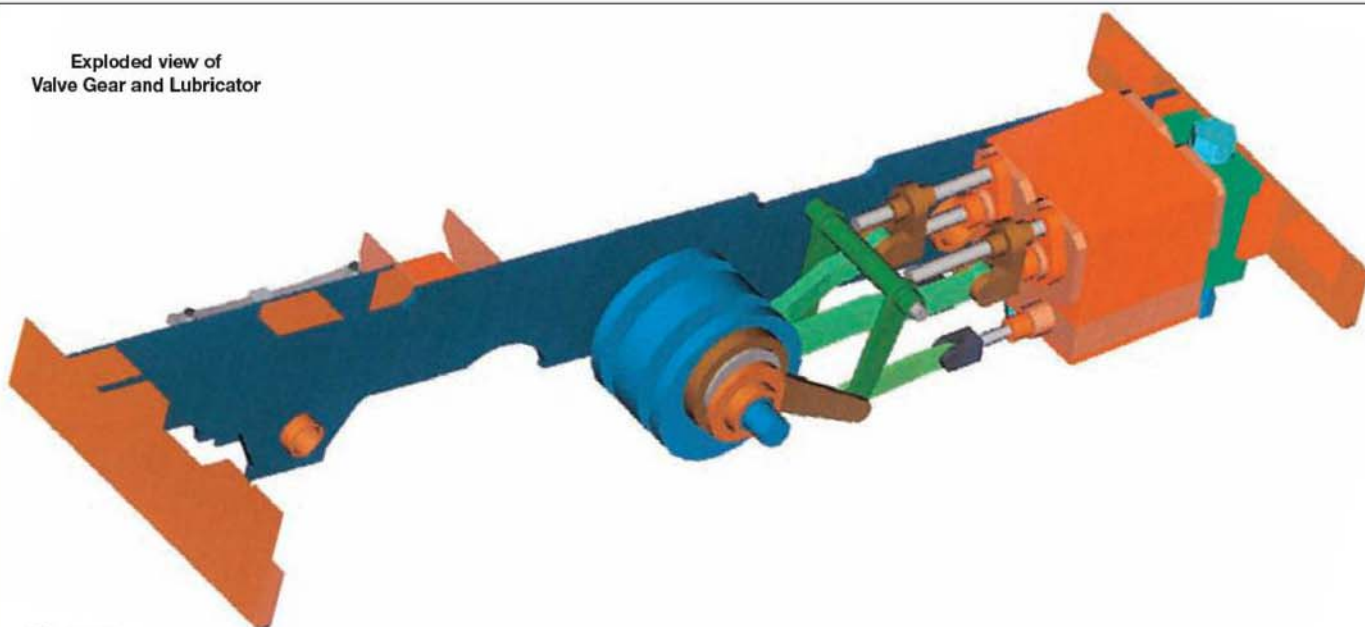
a steel lever and a brass bearing tube. The valve links should present no problem.

The displacement lubricator fits in front of the cylinder block and behind the buffer beam. This is conventional but don't forget that this tank is subject to boiler pressure.

The frames, cylinder, crankaxle, connecting rods and motion parts can now be assembled. Once the valves have been centralised, everything can be buttoned up and tested on air (or steam using a separate boiler). It is here that the large central disc on the crankaxle comes into its own acting as a flywheel. If all is satisfactory then the wheels can be fixed to the axles. Remember that once the wheels are on, the frames cannot be taken apart.

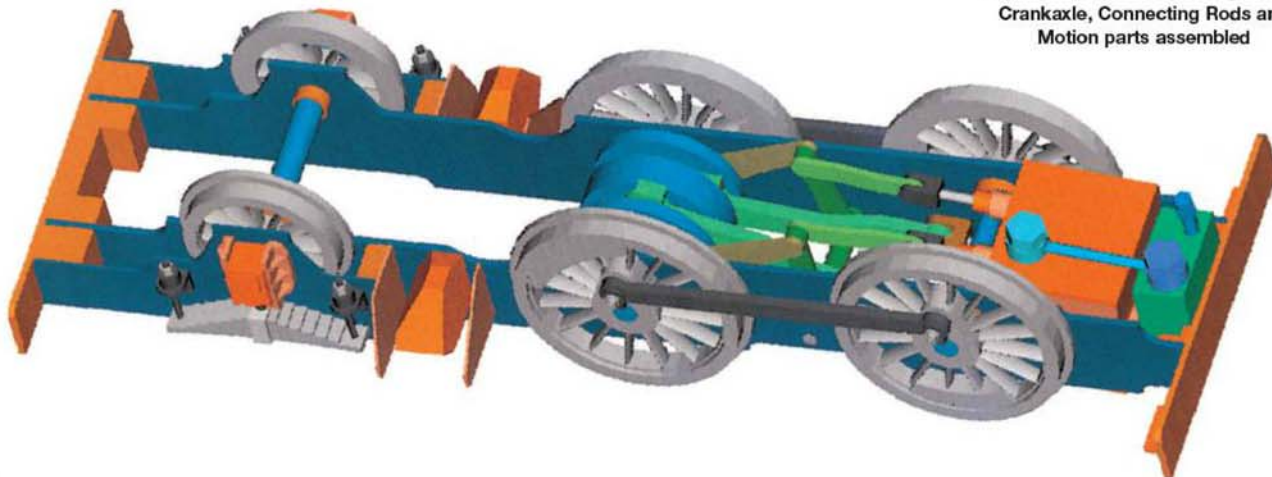
●To be continued.

Exploded view of
Valve Gear and Lubricator



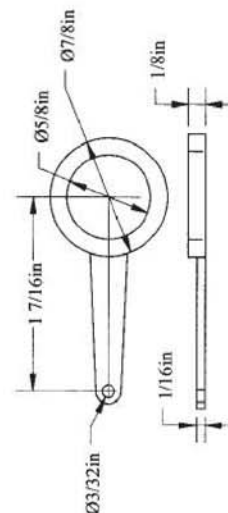
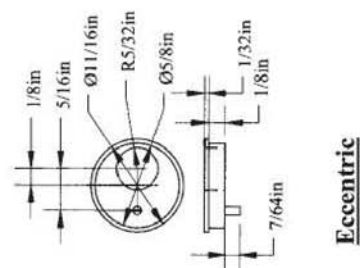
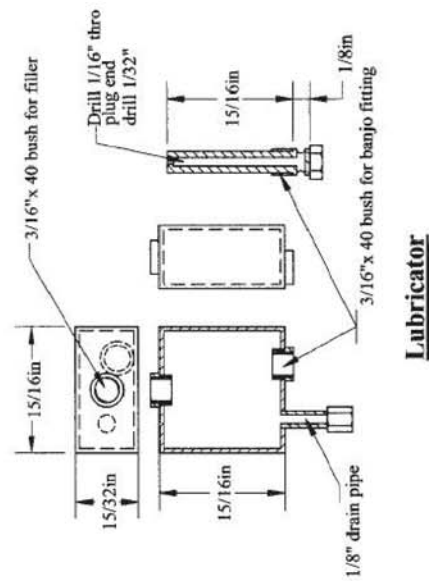
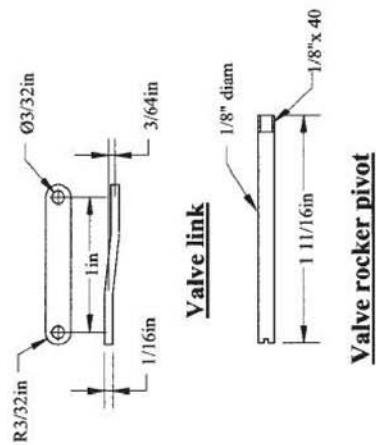
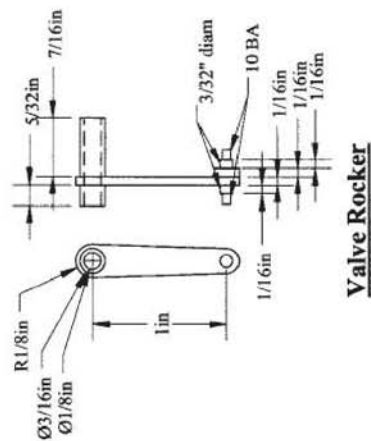
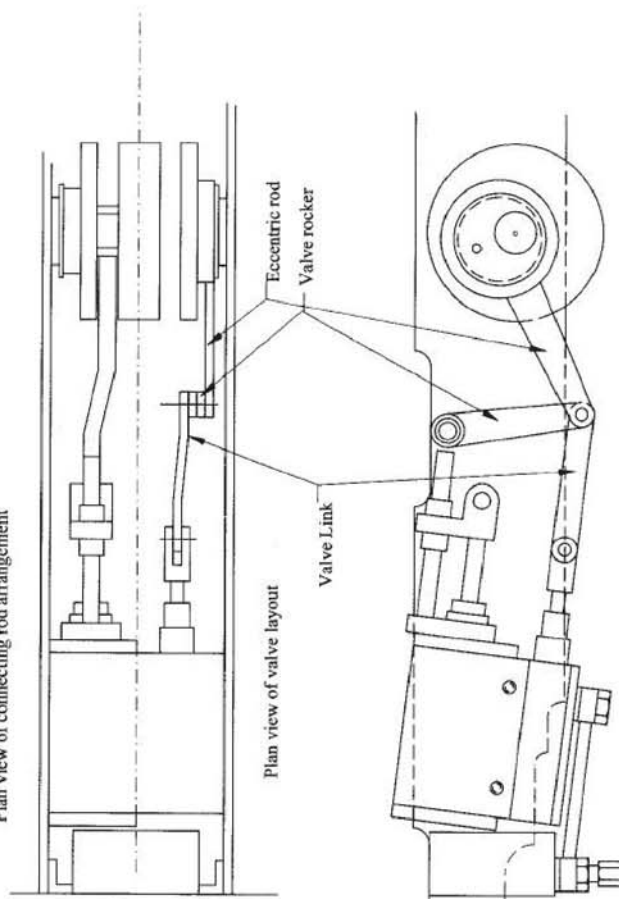
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Exploded view of Frames, Cylinders,
Crankaxle, Connecting Rods and
Motion parts assembled

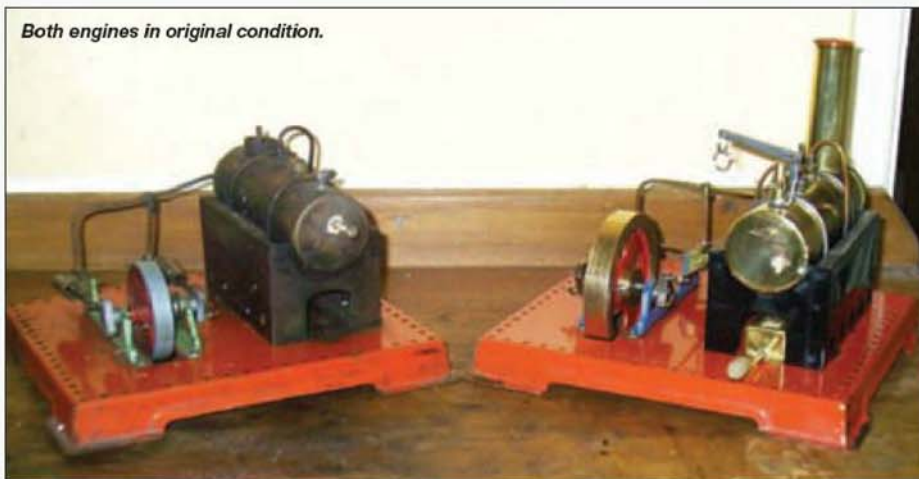


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Plan view of connecting rod arrangement



Both engines in original condition.



MAMOD STEAM ENGINE CONVERSION

Roly Williams
suggests a 3-cylinder Mamod?
Well, why not!

The project described here is not really up to the high standards normally expected in *Model Engineer*. However, I make no apologies for that. Even serious model engineers enjoy a little light entertainment occasionally. Toy steam engines (Mamod, Wileco, Bowman, Bing, SEL, *et al*) are good fun and I'm sure most readers have owned at least one in their formative years. (I have several and I'm well beyond my formative years.) As examples of engineering, however, they are variable and even the best are crude to say the least. But then, that's part of their charm.

The most common configuration - single cylinder, single acting oscillating type - suffers badly from vibration; caused, not only by the lack of balance, but also by the single short power impulse per revolution. Twin cylinder models are better. They are sometimes quite well balanced and have two impulses per revolution but there

are still dead points at top dead centre (TDC) and bottom dead centre (BDC). Surprisingly, double acting cylinders are not much better. Both single and twin cylinder versions are still unbalanced. (Twin double acting cylinders are usually placed 90deg. apart and cannot be properly balanced).

The obvious answer - three cylinders - has never been implemented (to my knowledge) at the toy end of the market. Three cylinder engines can, in theory, be perfectly balanced and, even with single acting cylinders, have three power impulses per revolution which can be a substantial percentage of the total cycle.

One day, looking at the two Mamod twin cylinder SE3 engines that I then had in my possession, I thought it would be comparatively simple to double up on the engine parts and produce a 4-cylinder engine. Unfortunately, without scratch-building a complete crankshaft, the two halves would have to be joined at the existing crank pins. This would mean that the cylinders would still be at 180deg. to each other and this would be no advantage over two cylinders. Effectively, it would be just doubling the size of the cylinders. However, by removing one of the cylinders and

adjusting the remaining three at 120deg. apart, the result would be (almost) perfectly balanced.

At this point, I wasn't seriously considering the conversion because one of the two engines I had was in excellent, almost original, condition and I wanted to keep it that way. Several months later, I saw advertised another similar engine up for auction in an extremely run-down condition which was likely to go for a song. I immediately thought about my previous musings so therefore entered a bid. In the event, it went for a bit more than a song, but was fortunately still quite cheap.

I now had two twin cylinder SE3 engines in less than perfect condition. One was in reasonable condition, especially the boiler. For the sake of argument, let's call it engine 'A'. The other had obviously just been dug out from the back of someone's garden shed and was pretty corroded (especially the boiler). I'll call this one engine 'B'.

A previous owner of engine 'A' had, for some reason, replaced the flywheel with a completely inappropriate one. It was extremely large, cast in bronze and seemed to be home-made, with the central hole inaccurately drilled; (It wobbled when running). Also, one of the frames, holding one cylinder and crankshaft bearing, was loose and the whistle was a new replacement. The paintwork was not original anyway so I had no qualms about cannibalising it.



Close-up view of engine 'B' showing the poor condition of the boiler.



Overall view of Engine 'A' after dismantling.



Overall view of Engine 'B' after dismantling.



View of engine A reveals the ridiculously large flywheel!

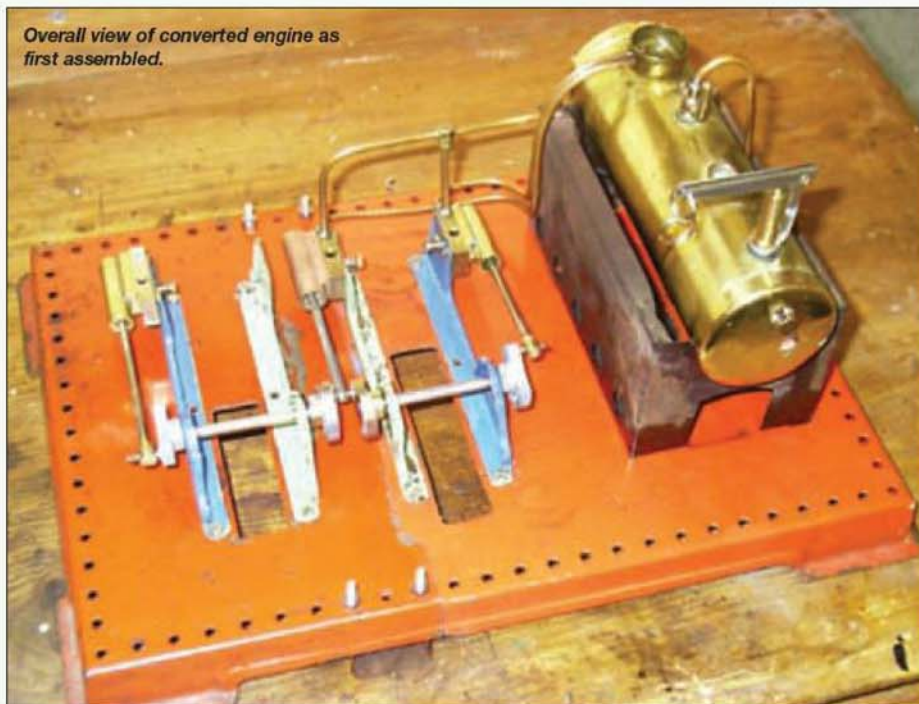


Crankshaft and frames only for alignment adjustment.

Engine 'B' was in generally poor condition and incomplete. What was there, however, seemed to be mostly original. The boiler was beyond redemption. With the exception of the safety valve, all other boiler fittings were corroded solid (despite the fact that they were brass) and couldn't be removed. The water level plug had been replaced with an ordinary screw which was jammed solid. The whistle had probably broken at some time and had been soldered back (at right angles!) just to plug the hole. The chimney was missing along with the exhaust pipes from both cylinders. The cylinders themselves, however, seemed to be in reasonable condition just needing cleaning up.

All together, therefore, I had all that I needed to make one good 3-cylinder engine. The first decision I had to make was how to mount the thing. The existing pressed steel base was not big enough to hold the extra works. The alternatives were to build a new base from scratch, to extend one of the existing ones with a plate or to, somehow, join the two existing bases to form a larger one. The simplest method would have been the extension. However, by this time, I was beginning to think that the new engine should be made entirely from genuine Mamod parts and in typical

Overall view of converted engine as first assembled.



Mamod style. That meant that the only alternative was to join the two together to make one large one. My initial thinking was to cut off just the ends and lap-join the remainders in such a way that the final size could be adjusted as required.

The next decision I made was concerning the boiler. I originally thought that, because I was adding a third cylinder, I would need 50% more steam. Then I realised that it could use the same amount of steam at $\frac{2}{3}$ the speed. This would be no problem because the three cylinder engine should run much smoother and should be quite happy at a much slower speed. I decided to make no changes to the existing boiler from engine 'A'.

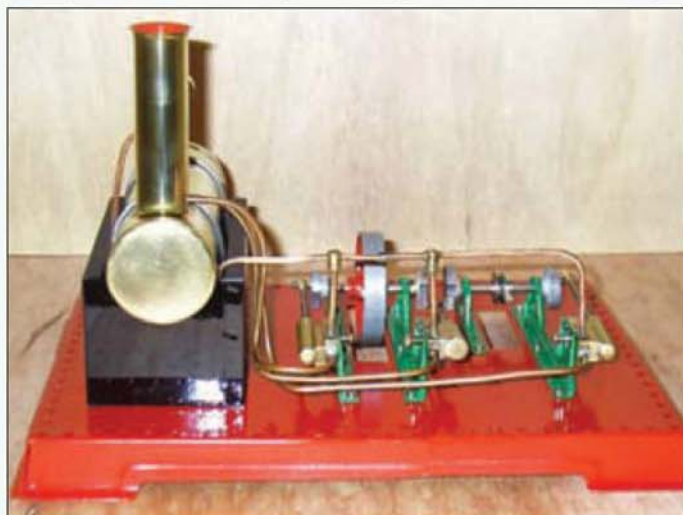
The final decision was how to join the two crankshafts. I wanted to make the joint dismantlable so I first thought of using a length of threaded rod in place of the two pins. This would have meant enlarging the big end of the con rod somewhat and would have looked wrong. I then realised that the joint didn't have to be rigid; in fact it would be an advantage to have some flexibility there. One of the pins could be drilled out and the remaining pin slid into the hole. The pin may have to be replaced by a slightly longer one but at least it would be, essentially, original. (As it turned out, the pin was only a push fit so it

came out with a good tug. I had to enlarge the hole slightly to let the other pin slide in and out easily. The original pin turned out to be long enough as it was).

One point noticed at this stage, though not a problem, was that the designs of the cylinders and pistons were slightly different in the two engines. Close examination proved that the differences were minor and the parts were interchangeable. In fact, the big end of the connecting rod was somewhat narrower on engine 'B' which would make it more suitable for the central crank and would almost look deliberate.

The pipe-work would be a simple extension of the existing on engine 'A'. The steam feed would be a combination of pipes from engines 'A' and 'B'. The exhaust for the cylinder furthest from the boiler would have to be a new length of copper pipe. I then had the new design complete in my head and started thinking about making a drawing. Unfortunately, I don't have a CAD package for my PC and I no longer have an old-fashioned drawing board. The changes were mainly re-jigging of existing parts so, in the end, I kept the design in my head.

I started by dismantling the engines. I had already had engine 'A' apart on a previous occa-



Front and rear views of converted engine after painting.

sion so I knew there would be no problems with it. Any ideas about salvaging any part of the boiler from engine 'B' were abandoned completely at this stage. It went straight into the bin. I gave all the parts (especially of engine 'B') a quick rinse in degreaser at this stage, just to better see their condition. There was not much time spent deciding which parts to use. Where there was a choice, the choice was obvious.

I then made some quick measurements to decide where to cut the two bases and here the first unforeseen problem presented itself. Because there is a depression pressed into the base for the burner, it seemed to make sense to position the cut with the depression in one half on the waste side. This was a mistake because, having done that, the join on the top came in an inconvenient point. I had to cut the bases back even further so that the join came between the two engine frames. At first, this didn't seem to be of much consequence but later found it to be a problem.

The bases are made of approximately 1mm thick steel which is too thin to cut with a hacksaw and a bit thick for tin-man's snips. Fortunately, I have the ideal tool for the job called a 'Goscut'. It is a cross between tin-man's snips and a nibbling tool. It doesn't distort the metal like snips do but is faster than a nibbler on long straight lines. Steel of 1mm is just about the limit of its capability but it did the job. I don't know if the Goscut is still available. I bought mine many years ago when it was sold under the Eclipse brand name.

Having cut the bases to size, I was able to assemble the main parts, temporarily, to check for alignment. This was when I discovered the requirement for a modification. I found that the step at the lap joint in the two bases was enough to cause a problem. This meant that I would have to fit shims under two of the frames to line up the shafts. These could be cut from the waste material to guarantee the correct thickness. Making and fitting the shims appeared to cure that little problem perfectly and I was also able to prove that my initial calculations and the design in my head did, actually, work!

I then turned my attention to the pipe-work and this is where the second unforeseen problem showed. My original plan was to use the existing tee pieces and pipes, which would have been long enough without making any joints except at the tees. This meant unsoldering the pipes from the tees and re-soldering them in a different order. Unfortunately, the pipes seem to be brazed or welded into the tees rather than soldered. Heating them with a blow torch, even up to red heat, still didn't release them. (Maybe they are crimped as well). I had to rethink the pipe-work. I was able to use the pipes and tees without separating them but this required a joint in the pipe between the two tees. This I made with a bit of brass tube from the junk box. Not genuine Mamod but not too obvious. I may be able to re-do this bit later if I can get hold of some replacement Mamod tee pieces. The exhaust for the third cylinder, the one furthest from the boiler, had to be made up from a new length of pipe. At least it was genuine Mamod $\frac{1}{8}$ in. copper pipe. I had to enlarge the hole in the funnel base to take the extra pipe. This was easily done with a needle file.



Overall view of converted engine after painting.

One annoying problem showed itself with repeated assembly and disassembly of the cylinder blocks. The small screws holding the blocks to the frames are totally inaccessible with any normal screwdriver while in-situ. This is not a result of this modified design; the same problem was present in the original. Hex heads to the screws would have been far better. I'll have to look some out in a suitable size. That just about completed the non-cosmetic work (I thought). The next stage was to reassemble the complete works, with screws instead of pop rivets, and see if it ran.

You've guessed it - it didn't! It didn't just run badly; it refused to go at all. There was obviously steam getting to each of the cylinders. Lifting each cylinder off its block against spring pressure proved that. After separating the three exhaust pipes I could also see wet steam exiting from all three when I spun the flywheel by hand. It felt very rough when I spun it so that was probably a clue. I applied plenty of oil but it didn't even start. One cylinder seemed to be giving some power but not



Set-up for running in powered by Bowman engine.

enough to drive the other two, which didn't seem to be providing any significant power. I loosened all the frame screws hoping that that would allow some free play to overcome any slight misalignment. That made very little difference. The three cranks were not exactly 120deg. apart but near enough. There was nothing else I could see whilst in steam. Disappointed in the extreme, I put out the burner, drained the boiler and left it to cool before dismantling it again. Engine 'A' had worked fine and two of the cylinders were from that engine. The third cylinder and piston came from engine 'B' (the one with the boiler I haven't fire up) so that could be something to swap when it cooled. Had I partially blocked a pipe when trying to remove the T-pieces? Probably not; the best cylinder was the one furthest from the boiler, but that would be something else to think about. Thoroughly depressed, I went and put the kettle on. At least that worked, which restored my confidence in steam somewhat!

After I had dismantled the crankshaft assembly, I peered down the row of bearing holes and saw that there was a significant misalignment. The shims had ensured that the holes were aligned vertically but not horizontally. The problem seemed to be that the two bases (I must start thinking of them as two halves of the one base) were not exactly in line. I could see from the holes in the overlapping section of base that there was an error of just a fraction of a millimetre. Was that enough to cause the problem? Fortunately, I had not yet riveted the halves together so I loosened the screws and re-tightened them in perfect alignment. I re-checked the bearings and saw an improvement but it still wasn't perfect. To get perfection I had to force all the components affecting the alignment to the limits of the play available. Obviously, the holes were not drilled in exactly the same positions in the two halves.

This done, it all felt a lot better when turned by hand so, full of confidence, I fired up again. This time it started - eventually. My theory that the engine would run much better than a two cylinder at slow speed was well confirmed. In fact, at first, it was a good job it did because it wouldn't go faster than about 200rpm. (I don't have any means of measuring the speed but, at that speed, you can estimate the revs per second). Confirming my initial fears, it did seem to be short of steam. It didn't really get going until the burner got hot and provided a good flame. As soon as the flame began to die, so did the engine. However, for a few minutes, it ran at a moderate speed and quite smoothly. The stall speed seemed to be around 100 - 150rpm which was a satisfying confirmation of the theory.

Two things were learned from this trial run. Firstly, the bearings must be very carefully aligned. My method of 'optical alignment' seemed to work but won't be very convenient if I dismantle it often. Secondly, I need a good meths. burner in good condition. I've found, in the past, that this type of vapourising burner can be improved by cleaning out the holes in the vapourising plate. An old wick type probably wouldn't have worked at all well and a modern solid fuel one would probably be worse still. I'll have to do some empirical investigation (trial and error) to determine the best burner for the job from the few that I have. I may also try one of the

gas fired conversions available but that would be going away from my original Mamod-only policy.

Having proved that it worked, I thought the rest of the conversion would be mainly cosmetic. The half empty frame looked odd without a cylinder so I cut that in two leaving only the bearing end. I only need one flywheel so there's an unused rectangular hole in the base. I considered filling that in but decided against it. In the end I put a second pulley there so it didn't look too odd. I fixed the halves of the base together with pop rivets and drilled some extra holes for rivets to improve rigidity. The four frames could also be pop-riveted making sure that they stayed properly aligned. The slot in the chimney had to be filed out to make room for the extra exhaust pipe. I replaced the whistle with a (genuine Mamod) pressure gauge. This was partly to reduce steam loss and partly for looks - I think it deserves it. The felt pads in between the cylinders and valve faces were all worse for wear; new had disintegrated completely. I cut some new ones from felt pads bought from the local hardware shop. Not genuine Mamod but they are out of sight and can be considered consumables if you're pedantic.

Finally, I cleaned, painted and polished everything as appropriate. I made no attempt to reproduce the Mamod colours exactly but I kept the general scheme - red base, flywheel inner and inside of chimney, black firebox, green frames and everything else unpainted. Having done all the cosmetic work I reassembled it, photographed it in pristine condition, and then fired it up again. Disappointingly, I seemed to be back to the same alignment problem again and there was still a shortage of steam. Also, I found that

the red paint I had used on the base (an aerosol) softened in contact with alcohol! This was a problem when cleaning and also with any spilled meths. I tried a paint advertised as heat resistant but this was no better so I'll have to use good old-fashioned enamel paint with a brush (I left that for later).

The throttle in the live steam line was leaking quite a bit. I didn't have a spare so I replaced it with a direct connection (again, genuine Mamod - taken from one of their kits). This means I've lost all speed control but then, in most of the early (pre-reverser) engines, it was a luxury anyway, fitted only to the larger engines. If I find a replacement in good condition at some later date I'll restore it. The alignment seemed to be variable and I found it was caused by flexing of the base. To provide some rigidity, I fixed a couple of rigid bars out of sight under the base. This resolved the alignment problem but I opened up the hole in the pin-less crank to make it a bit more tolerant of future misalignment anyway. Fired up again, it worked but not spectacularly. It was still short of steam most of the time. Turning the flywheel by hand I could detect a distinct rough patch at a couple of points in the cycle. It would definitely benefit from being run in but if it doesn't run well for more than a couple of minutes at a time, it would take ages to run in. I don't have a suitable electric motor to hand but I do have several other steam engines. One of these is a large Bowman engine with more than enough power. It will also run for 2-3 hours between refills. I set the two engines up with a belt from the drive pulley on the Bowman to the flywheel of the Mamod. I couldn't leave the set-up to chug

away on its own because the Mamod was running dry. I had to keep it well supplied with lubrication. The way the arrangement was in the most convenient positions for the belt, the Mamod was running backwards, i.e. it was pumping air into the boiler. This was no problem in itself but it meant that it was also pumping lubrication fluid into the boiler. For this reason, I used water rather than oil. This could be conveniently dripped down the funnel into the exhaust! After a couple of 2-3 hour sessions like this, the Mamod seemed to be a lot smoother. Encouraged, I fired it up again and was amazed at the result. It ran better than it had ever done before and with no shortage of steam! This roughness had probably been the main problem all along.

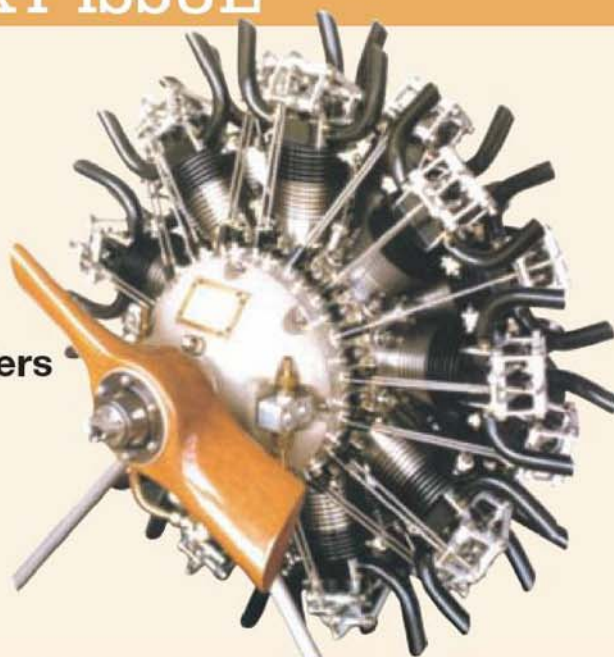
So that was it - I now had an engine I was happy with (apart from the paint). All in all, it was an interesting project both from the technical and aesthetic viewpoints. Considering the problems I had, perhaps it's not surprising that Mamod haven't done something similar. But, then again, Mamod wouldn't have to join two half bases; they would make a base specifically for the job. I suppose one of the attractions of these toys is their simplicity compared with the real thing; and let's face it, they were originally sold as toys, although no self respecting 21st century child would be seen dead playing with one nowadays!

Incidentally, according to Steve Malins (grandson of the founder) Mamod should be pronounced 'Maymod' rather than 'Mammod'. Mamod is short for Malins Models and, presumably, Malins is pronounced 'Maylins'. I just thought I'd throw that one in for good luck! 

IN THE NEXT ISSUE

- Super new series:
Gorgon ship engine
- I/C engine collection
- Britain's private locomotive builders
- Full index to volume 195

Plus all your regular favourites



ON SALE 20th JANUARY 2006

(Contents may be subject to change)

CLUB CHAT

With Malcolm Stride

Before I start the proper business for this issue of *Club Chat* I would like to remind all club officials of the option to have a profile of your club published. You will have seen some in recent issues but we have now exhausted our supply. It can be very good for your club, **Edinburgh SME** has gained five new members in past months following mentions in *M.E.*

We have been asked to point out that Des Adeley has succeeded Clive Young as National Secretary of the **National 2 1/2in. Gauge Association**. Des can be found at 30 Laleham Court, Chobham Road, Woking, Surrey GU21 4AX. Telephone 01483-761061 or e-mail at des@maynardsgate.freemove.co.uk. We should point out that this is a temporary address and we will update the details as soon as we receive them.

Can I also ask all contributors to check the address to which they send contributions for this column? We are still getting items forwarded (late) from at least two of the old addresses including Azalea Drive which ceased some years ago. The correct address is that on the title page of the magazine. Remember that incorrectly addressed items may not arrive in time for special events to be publicised.

UK News

Albert Stephenson who is secretary of the **City of Sunderland MES** has started contributing to our column. This society is new to my list so I will provide Albert's contact details for any readers in the Sunderland area. Albert can be found at 4 Thursby Grove, Hartlepool,

Cleveland TS25 2JT, telephone 01429-299649. The society had a stand at the

Pickering show with 34 member's models with a 1:2 scale Burrell Showman's Engine and a full-size steam car in steam outside. They also supported the National Railway Museum Modelling Weekend. The club operate at Roker Park and members have a variety of interests including locomotives, road vehicles and boats.

Member Dave Ball won the main award, the Hodgkiss Cup, at the **Guildford MES** rally for his superb 7 1/4in. gauge GWR 0-6-0 *Armstrong Goods* locomotive. This locomotive is superbly finished but will not be a "glass case" model and had already clocked up over 25 miles running at the time of the report. The engine was some 12 years in the making and is described by Dave as "the cheapest locomotive I have ever made. Most of the bits came out of the scrap box". John day has started his next I/C engine model, this time it is a *Pioneer* spark ignition 2-stroke engine with spring loaded valves and no cams. As John comments in the newsletter, this is yet "another infernal combustion engine and yet another strange early one". We look forward to seeing the results of John's labours in due course.

At the **OMLEC** efficiency competition in August, Lionel Flippance was the highest placed 5in. gauge locomotive with his BR Proposed 2-8-2 achieving an efficiency of 2.21%. Simon Batten achieved an efficiency of 0.87% with his RH&DR Pacific to take the 3 1/2in. gauge award.

Roger Curtiss has written an article in the newsletter explaining why ships don't fall over. This is

due to the relationship between the ships centre of gravity, the metacentric height and the centre of buoyancy. In a correctly designed ship the latter moves over in the same direction as the ship heels and the resulting force tries to push the ship upright again.

The society annual rally for 2006 has been brought forward by a week to avoid the clash with the music festival which takes place in the park on the same weekend. The new rally dates are 8/9 July 2006 and I look forward to seeing many of you there.

Harrow & Wembley SME is looking forward to celebrating its 70th anniversary next year and is considering various options to mark the occasion. The society is hoping to be able to sign a new 30 year lease early next year which will ensure a sound future. Member Laurie Greene describes the "cruise control" he has fitted to his locomotive. This controls steam chest pressure and speed, detecting the speed using a centrifugal detector and incorporates a pressure control system. The system is designed to "enable hands free operation from wheel start until the regulator is closed prior to braking". I have to say that I know several drivers who drive like that anyway!

The newsletter of the **Kinver and West Midlands SME** contains an interesting piece on the small gauge ('0' and '1') designs of LBSC. I certainly did not realise how many such designs he was associated with. The list totals some 39 designs of which 19 are in '0' gauge and 20 in gauge '1'. Many are based on his larger designs such as *Amy* (based on *Ayesha*) and *Dyakette* and *Mollyette* whose origins are obvious.

Whilst on the subject of steam locomotives, how many readers have noticed that the warning sign for an un-gated level crossing still shows a steam engine? Apparently this is still recognised by today's drivers because of the popularity of the steam engine. The symbol has changed over the years, being a 4-6-0 originally, and then an 0-6-0 before new regulations decreed a return to the 4-6-0 in 1964. I wonder, is there a "Minister for Un-gated Crossing Symbol Designs"?

A tip in the newsletter which might be useful is to use fine brass picture wire in place of silver solder if you have run out of fine silver solder when doing small items. If you walk into a model engineer's house in future and the pictures are

all propped against the walls, you will know what has happened!

The newsletter has a quote attributed to the actress Fanny Kemble who after a ride behind the locomotive *Northumbrian* on the nearly completed Liverpool and Manchester railway wrote the following "...the magical machine with its flying white breath and rhythmical unvarying pace ... The engine set off at its utmost speed of 35 miles an hour, swifter than a bird flies. You cannot conceive what the sensation of cutting the air was ... I stood up, and with my bonnet off, drank that air before me." I think we all know what she meant.

The **Maxitrak Owners Club** are thriving and the latest newsletter carries details of an electronic water level indicator which uses a sensor on the gauge glass itself and does not need any fittings in the boiler. This is used in the *Chaloner* locomotive to turn the pump on and off and should be available soon. The device only fits 5mm gauge glass so would need to be adapted for larger diameters. The same article also carries a comment on the life of the permanent magnets fitted in the traction motors used by many electric locomotives. The answer is apparently full power for ten years no problem, after 15 years there is a good chance of power loss and after 20 years most motors will have a significant power loss. This sounds like a good opportunity for some entrepreneurial type to offer a re-magnetising service!

Nottingham SMEE wrote to Tecumseh to check availability of spares for their 20in. lawnmower and was very pleased to receive a new starter motor completely free of charge. Congratulations to Tecumseh on their support of model engineering societies. Following a conversation about 2-cylinder engine ignition in the pub one Saturday lunch time, Steve Harris decided to experiment and couple two Suffolk *Colt* engines together to run as one. Various combinations of layout were tried (both with cylinders at TDC together and TDCs 180deg. apart) and eventually the engines were mounted on an angle iron base and coupled up with the cylinders timed 180deg. apart (photo 1). The existing magneto was used and driven at engine speed resulting in a wasted spark in each cylinder at bottom dead centre. Once everything was set up, the starter was pulled and the engine sprang into life. Future developments may include a common sump, a suitable



The experimental twin cylinder 'Colt' engine built by Steve Harris from Nottingham SME.

locomotive and a decent silencer.

The *Dreaming Spires* rally staged by the City of Oxford SME had an added attraction this year as the society celebrated its 50th anniversary and a celebration cake was made and cut to mark the occasion. The rally was attended by some 35 visitors during the weekend who enjoyed good weather on the Saturday but were somewhat dampened by heavy rain on the Sunday. The society provided anniversary mugs for all members and visitors as a memento of the anniversary.

Rugby MES are building a water tower at the 5in. gauge station in memory of the late Phil Bevan. The water tower is gravity fed from a 250 gallon tank mounted on top of the container and will also feed the 7 1/4in. gauge track.

The Southern Federation News carries a request for details of companies that can provide laser/water jet cutting services to model engineers. If any readers can help in this we will be pleased to pass the information on.

The boating section of St. Albans DMES is celebrating the removal of the silt from the boating lake in Verulamium Park. This is the first time in "about thirty years" that this has been done. The newsletter carries an advertisement for an unusual vacancy in the town. A local watchmaker and jewellers is trying to find a trainee watchmaker and has had no success so far with his advertising campaign. We will be pleased to pass on details to any



The three 7 1/4in. gauge 'Royal Scot' locomotives at Stockholes Farm Miniature Railway.

suitable (young?) reader who may be interested.

Stockholes Farm Miniature Railway has highlighted an issue which will be of concern to all clubs who run for the public. They have had passenger trucks overturn twice in the past few months and have put the cause down to passengers leaning out to video whilst on the move causing the truck to overbalance. Details of any similar incidents would be welcome. The railway has put extra signs up asking passengers not to use video cameras on the move unless they make arrangements with the society beforehand. Better news is that the society held a 7 1/4in. gauge Rebuilt *Royal Scot* 70th Anniversary Rally in July. This was to celebrate the running of the first 7 1/4in. gauge

Royal Scot at Charles Rinek's railway in Eastern Pennsylvania in 1935. The rebuilt versions of these locomotives are rare beasts in model form; there are only three in the world so the society was very pleased to have two of them at the rally. The drivers, David Mawdsley, Ivan Smith and Brian Lee posed for the photographer (photo 2) to record the occasion.

Wimborne SME report that its 30th anniversary celebration on 21 August was a great success with full loads of passengers being carried all day until it was time to cut the two celebration cakes at the end of the afternoon. All the locomotives carried a special headboard for the occasion and founder members Roy Tier and Tony Marshall were present.

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.

Jim Allum
Geoff Burlington
Keith Evans
Ron Roebuck
Vic Walton

Guildford MES
Sutton MEC
North Wilts MES
Guildford MES
Reading SME

CLUB DIARY

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

JANUARY

- 6 Aylesbury (Vale of) MES. Ray Orth: Restoration of the Wendover Canal. Contact Andy Rapley: 01296-420750.
- 6 North London SME. Bring & Buy Auction: Tool and materials etc. Contact David Harris: 01707-326518.
- 6 Portsmouth MES. Members' Videos. Contact John Warren: 023-9259-5354.
- 6 Rochdale SMEE. Meeting. Contact Mike Foster: 01706-360849.
- 8 British Columbia SME. Frostbite Meet. Contact Sean Laurence: (604) 931-1547.
- 8 Hereford SME. New Year Steam-Up. Contact Richard Donovan: 01432-760881.
- 8 Sutton MEC. Track Day. Contact Bob Wood: 0208-641-6258.
- 9 Crawley ME. AGM. Goffs Park Light Railway. Contact Allan Sinclair: 01293-888203.
- 9 Guildford MES. Small Boiler Testing. Contact Dave Longhurst: 01428-605424.
- 9 Melton Mowbray DMES. Auction. Contact Phil Tansley: 0116-2673646.
- 10 Hutt Valley MES. Post Convention Run, CLS, McLeans Island. Contact Gavin McCabe: 567-4487.
- 11 St. Albans DMES. Frank Barfield's Old Films. Contact Roy Verden: 01923-220590.
- 11 Staines SME. First meeting of the year. Contact Stan Bishop: 01784-241891.
- 12 Cardiff MES. Mike Denton: Laser Cutting Techniques. Contact Don Norman: 01656-784530.
- 12 Sutton MEC. John Kennedy: Railway Communications. Contact Bob Wood: 0208-641-6258.
- 12 Worthing DSME. Bits & Pieces. Contact Bob Phillips: 01903-243018.
- 13 Brighton & Hove SMLE. Jim Hatfield: The Tay Bridge Disaster. Contact Mick Funnell: 01323-892042.

- 13 Hereford SME. Meeting. Contact Richard Donovan: 01432-760881.
- 14 Glasgow & S.W. Rly Ass'n. Archie Thom: Steam Preservation UK. Contact Bruce Steven: 0141-810-3871.
- 17 Nottingham SMEE. Keith Hale: Silver-Soldering. Contact Graham Davenport: 0115-8496703.
- 17 Romney Marsh MES. Roy Clench: A Slide Miscellany. Contact John Wimble: 01797-362295.
- 17 West Wiltshire SME. Alan Rogers: Scale Model Ships in Bottles. Contact R. Nev. Boulton: 01380-828101.
- 18 Andover DMES. Brian Hayward: Guitars in the Making. Contact John Berry: 01960-882616.
- 18 Guildford MES. Bits & Pieces. Contact Dave Longhurst: 01428-605424.
- 18 Leeds SMEE. Tony Finn: Tanks. Contact Colin Abrey: 01132-649630.
- 19 Isle of Wight MES. Bits & Pieces. Contact Ken Stratton: 01983-531384.
- 19 Sutton MEC. Chat Night. Contact Bob Wood: 0208-641-6258.
- 20 North London SME. Members' Slides. Contact David Harris: 01707-326518.
- 20 Romney Marsh MES. Video/DVD Evening. Contact John Wimble: 01797-362295.
- 20 Rochdale SMEE. Video Night. Contact Mike Foster: 01706-360849.
- 20 Worthing DSME. Peter Hill: Pills, Potions & Patients. Contact Bob Phillips: 01903-243018.
- 27 Brighton & Hove SMLE. Geoff Mead: Sussex Industrial History. Contact Mick Funnell: 01323-892042.
- 26 Cardiff MES. Bits & Pieces. Contact Don Norman: 01656-784530.
- 26 Sutton MEC. Ian Currie: Frosted Earth. Contact Bob Wood: 0208-641-6258.
- 27 Hereford SME. John Mayo: The Titanic. Contact Richard Donovan: 01432-760881.

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LATHES

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Colchester Bantam 1600 5" x 20", (Late Type) Chucks, Lever Op Collet Att, Coolant, QCTP, Guards, Light, Manual, 3ph, VGC	£2500.00
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Pultra 1770 Cabinet Mounted Micro Lathe, Drive Unit, Well Toolset, 3ph	£1250.00

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Bordford Union Pillar Drills, Rack Op Table, 3ph	£ 325.00
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Thoka Arbo No 2 6 Station Turret Drill Head, 3MT	£ 175.00
Spares Available for Fobco Star, 7/8 and 10/8 Pillar & Bench Drills	£ POA
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Alexander Single Lip Cutter Grinder, Bench Mounting, 3ph, Collets	£ 750.00

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Canning 2HP Polishing Spindle, 3ph	£ 350.00
Feln Supercut FSC2 Construction Power Tool	£ 280.00

SHAPERS

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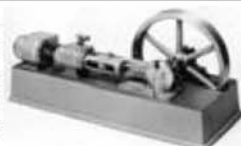
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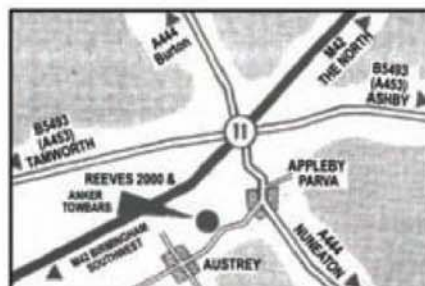


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