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HELICAL GEARS

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Editorial Administrator
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PRODUCTION
Designer
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SALES & MARKETING
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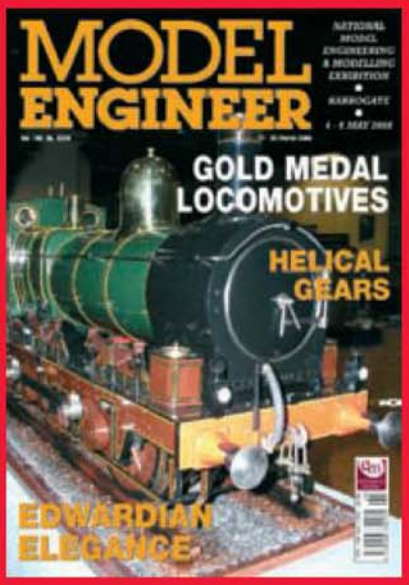

On the cover ...

David Ball's fine 7 ¼in. gauge 0 - 6 - 0 GWR Armstrong Goods Locomotive, winner of a Gold Medal and the J. N. Maskelyne Memorial Trophy at the 75th Model Engineer Exhibition at Sandown Park. The prototype was built at Swindon in 1873 originally as standard gauge, then converted to broad gauge, and eventually back to standard gauge. Details of this and the other excellent locomotives which won medals of every hue can be found in the exhibition report on the locomotive classes starting on page 344

(Photograph by Neil Read)

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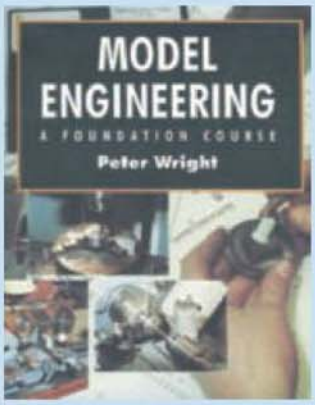

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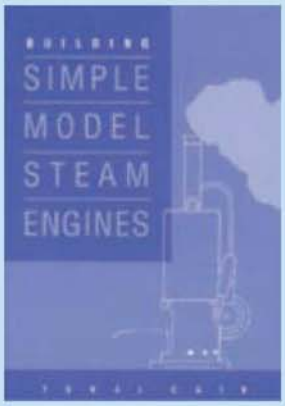

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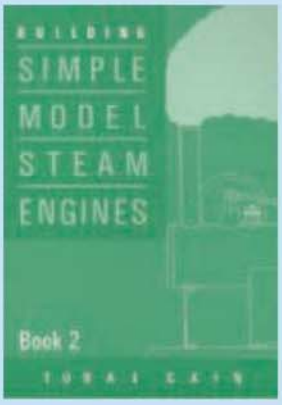

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SMOKE RINGS
With the Editors

A friend indeed

Most model engineers who have been in the hobby for some time probably take their workshops for granted. Although the workshop and the equipment in it are there to enable them to practice their hobby it also has a secondary role – that of enabling them to undertake any little domestic chore that needs carrying out either for their own household or that of a neighbour. So handy are our workshops for fixing the church clock, the local post lady's bicycle or our neighbour's boiler that we probably tend to think that most people have access to a few, rudimentary tools for handling domestic emergencies. Not so!

Neil recalls that a friend of his broke down recently while riding one of his vintage motor cycles. He had managed to 'cook a plug' while negotiating some congested traffic conditions in a nearby town. He was confident that he could soon get going again, as he had a spare plug. However, when he tried to unscrew the plug it came out still connected to the valve cap. For those of you who do not know, early side-valve engines often had cylinder heads that were cast integral with the barrel. Access to the valves was via large, screw in caps one of which (usually the inlet valve cap) carried the sparking plug. Our hapless rider lacked a spanner large enough to fit the valve cap spanner flats and was therefore unable to change the plug. What was needed was a valve cap spanner or, in default, a vice in which to clamp the valve cap whilst extracting the useless plug.

While all this was going on a gentleman working in his garden was watching the sad scene. He seemed friendly so he was approached to see if he had a vice. The answer was in the negative but he knew a man who might. Neil's friend was bundled into this gentleman's car and driven a couple of miles up the road to an old gentleman who was held in some awe as he 'owned tools'. Well, this old gentleman did not have a vice either but he did have an enormous pair of Molegrips, which were able to clamp the valve cap and enable the plug to be extracted.

There are a number of morals to this tale. First, riders of vintage machinery should carry a valve cap spanner if they are planning to cook their plugs. Second, despite the many troubles in this world people can still be kind enough to help a stranger. The third is that people who own vices are not as common as you might suppose. Your workshop may not be unique but is probably quite a rarity in your area – something to be proud of, in fact. Remember this the next time something goes wrong and you are tempted to take up a less demanding hobby.

De-mystifying I/C

The mysterious Nemett's photograph appears in this issue on page 325. Unfortunately only his right hand is visible, so his identity remains a secret.

You would be surprised how many people have phoned up to ask "*Is it so-and-so?*"

Even after being told that hours of torture would not force us to disclose his name, enquirers always say the same thing. "*Whoever he is its good for M.E.*"

Now on his tenth missive in this issue, he certainly has made his mark, striding into the all-time list of popular writers on I/C engines.

In this issue, he looks at the best materials to be used for the various parts of an engine. Invaluable information for I/C builders and designers, which is also practical, avoiding as it does the temptation to recommend exotic materials.

Nemett tells us that his new design for a 15 cc single cylinder 4-stroke engine is now well on the way. It is designed to be built without the need for castings, and is meant to show that building such an engine is within the compass of the average model engineer. He tells us that if you can build a steam engine, you can build this I/C project, even the cams.

Nemett plans to describe it fully in his column very soon.

Elegant model in the making

While we are singing the praises of our contributors, we must include Ron Isted whose occasional series on *Edwardian Elegance* has also proved most successful. Many readers have written in to say how much they have enjoyed his articles. His choice in this issue of the London Tilbury & Southend Railway 0 – 6 – 2T is most welcome. It is good to see this lesser known cousin of the elegant 4 – 4 – 2Ts.

This really should be a good locomotive to model. It is far from complex, especially when compared to his previously described compound Atlantic, but gives the modeller the chance to build an elegant model in relatively short order. It is a good wheel arrangement for most types of model, and this particular 0-6-2 is probably the most attractive prototype.

Ron gives some useful hints to potential modellers, as well as sharing the fruits of his usual excellent research. And, of course, there are his top quality drawings.

Elegant models made

The late J. N. Maskelyne would surely have taken great delight in Ron Isted's articles and drawings. No doubt he would also have been won over by the winner of the trophy in his memory at the Model Engineer Exhibition at Sandown Park in December. David Ball's 7¼in. gauge GWR Armstrong Goods is an outstanding model of a most elegant prototype. Almost unknown compared with the Dean Goods, the earlier locomotive has all the elegance of its age, Victorian this time rather than Edwardian.

A second model locomotive at the exhibition that had visitors smiling in appreciation was Clive Fenn's 5in. gauge LMS *Duchess of Abercorn*. It won the Crebbin Memorial Cup and, like the Armstrong, a coveted Gold Medal.

In fact, all the locomotive entries were of a high standard, and a full report can be seen in this issue. Between these competition models, the Duke of Edinburgh Award models, and the loan models, there was something there to appeal to everyone, and to send us back to our workshops with renewed ambition. Thanks to all those who entered, and for those who didn't, we hope to see you next time.

Clock clarification

Peter Heimann's 16-day pedestal clock series has raised some queries about missing dimensions in issue 4262. In fact, only critical dimensions are shown, leaving some choice to the constructor. The 2⁵⁄₁₆in. circle will avoid screws which eventually fix the dial from interfering with the graduations. On the prototype the two reamed holes came out at 3⁵⁄₈in. apart, but that is not critical. The curvature commenced at 4¹³⁄₁₆in. up from the base line, and overall frame width at this point was 4in. the actual shape of the curve was taken from an oval table mat!

Peter also gave details of a depthing tool. We should point out that this design was originally produced by John Wilding.

CHUCK, the MUDDLE ENGINEER **by B. TERRY ASPIN**

POST BAG

Otto Duetz gas engine drawings

SIRS, - In *M.E.* 4255, 2 September 2005 on page 252 was a photo of John Day's Otto Deutz Gas Engine. I am most impressed with this model and have been unable to find any drawings, plans or information on this engine. Can you help me? or perhaps pass my details on to John Day.

Alan Christie, South Australia.

Home brewed tools

SIRS, - I was intrigued by Harold Pearson's article on carbide tipped tools (*M.E.* 4258, 14 October 2005) particularly the copper 'shock-absorber'. I am in no position to argue with his mentor. I entered the lists by a completely different and totally unmentored route.

The boring tools I made for my small home-made lathe had a piece of 1/4in. square or round steel with a wee piece of 1/8in. round or square HSS secured in a hole by a screw. I forget what the smallest hole was in which I could start a bore, but it wasn't very small. There was no question of sharpening a tool bit in that case. It was a matter of starting again.

I never dreamed of brazing the tips. I had not then come across Sparey's, *The Amateur's Lathe.*

One day I wrecked a small masonry drill. The steel bit 'sort of' untwisted and delivered a small piece of tungsten carbide. It was of course 'tinned', and with the aid of a Primus torch, some spelter and Borax it was secured in a slot (paired hacksaw blades) in the end of a piece of 1/4in. round Silver Steel. It lasted well, and graduated to working on the 'Big' lathe when that came a year or so after my retirement.

That lathe came with 3/8in. sq tungsten carbide tools, and I discovered why when I started packing them up in the 4-seater toolpost. A 1/2in. tool would have its nose 12.7mm in the air instead of 12mm. I suppose 12mm sq tools were available somewhere in the Land of Oz, but I did not know where to look. (We lived 800km from the State capital). So I scrounged some used triangular throwaway tips from a local private firm whose main income came from the repair of farm and mining machinery. (No hole in the middle, no chip-breakers, and the sides about 13mm long).

I milled (using the lathe) suitable beds for the tips in 1/2in. sq mild steel. These were easily brazed using spelter and borax. The torch (LPG) managed to heat adequately with the steel bedded in charcoal.

Though degreased, the tips appeared most reluctant to join hands with the brazing rod. I stuck one on the end of a piece of dowel rod (I think I used Blu-Tack) and gently introduced its bottom surface flat against the side of the spinning greengrit wheel.

Though I had lots of forceps left over from a previous existence as a Veterinary Surgeon, it did not occur to me to follow Harold's excellent idea, but I did pick up the bit by its corners and drop it top down on a tin lid. The braze took perfectly.

After that our courses were much the same. Soon thereafter, the TAFE (2) welding class came to town, and I was able to join the farm welding class. I had wished for years to be able to weld, and though I had gladly taught myself fitting and turning, I wasn't game to approach welding in the same manner.

Though certainly not a part of the curriculum, I read in the Oxy-Acetylene text book about welding tungsten carbide tips. It agreed with us re grinding the seat of the tip, degreasing etc. (It mentioned Carbon Tetrachloride! but that was long ago). It also advised forceps handling - spot on Harold! Rather than 'tin' both areas, it is suggested that the surfaces are fluxed, and when the work is hot enough, silver braze material be applied from above. And keep the blue cone well clear of the work piece.

The lower melting point of the silver solder is reckoned to be better for the carbide tip. A push-me-pull-you tool is a great help.

I made some 3/4in. sq, tipped, tools for use with a solid tool-holder on the X-slide, and I did need the Oxy-Acet to heat the business end of the steel shank. Heating from below presented no hazard to the final result. I used mild steel - TAFE recommended steels of 0.4 to 0.6 % carbon.

In 1985, the late David Lammas came to my rescue with his tricorn toolholder (*M.E.* 3758, Vol. 155). Two minutes after reading it I was in the workshop making patterns, which a nearby (only 140km distant) foundry converted into a couple of CI embryonic tool holders which only required a lot of hours work to convert to adult status.

They, of course, were capable of holding 1/2in. tools at the correct height. When I was a youngster, I never dreamed of buying something I could well make myself, but when I passed the three score and ten mark, I realised that time could well be limited.

So I bought some 'shop' tools. But I still have some of those 12mm high jobs, and they do duty whenever an intermittent cut is needed, and stalwartly they cope, taking the risk from those posh (and expensive) shop tools. Nearly all my range of boring tools is home-brewed.

Derek Cooke, Western Australia.

Encouragement from Nemett

SIRS, - Thanks to the recent encouragement via *Smoke Rings* I shall most certainly try and enter an I/C project for the Model Engineer Exhibition at some future date.

A two-stroke design begins to appeal to me as a first such attempt, which leads me into a combination suggestion/request.

Two-stroke engines are notorious for the pollution via the exhaust pipe and one partial answer may be to use LPG (Propane gas). In researching this I eventually arrived at 'Mixing Valves'. Two such designs dated back to the 1930s and the most recent seems to be that designed by the late Edgar T. Westbury for the *Centaur* engine.

Could you possibly consider reviewing the available information and publishing such details towards evolving a more modern design?

Good luck with the new column it's certainly the sort of help that I've personally needed for a long time.

James C. Wells, London.

Nemett Comments: *I am very pleased to have provided encouragement to Mr. Wells. My main reason for starting the I/C Topics column was to encourage more model engineers to have a go at an I/C engine. Regarding the mixing valve carburettors, I have had limited success with them and am still trying to get the one on my* Wyvern *engine to operate consistently although I am running that engine on petrol. I would be pleased to hear from other readers who have had better luck.*

Froment engines

SIRS, - Mr. Winks' letter (*M.E.* 4264, 6 January 2006) and reference to the original article in *M.E.* 4246, 29 April 2005 nudged my memory and I found the following in one of the old engineering books I own; *A Manual of the Steam Engine, and other Prime Movers* by William John Macquorn Rankine, C.E. L.L.D. F.R.S.S.; F.R.S.S.A. revised by Edward Fisher Bamber.C.E., published 1874.

The following account is from that book:

"The Plunger Engine, invented by Mr. Froment, and made by Mr. Bourbouze, is represented in figures 178, 179, and 180.

It is now used to a considerable extent in France, for driving small machines in places where it would be inconvenient to have a steam engine with its furnace and boiler. It bears some analogy in its form and arrangement to a steam engine with four cylinders, pistons, slide valves, beam, crank, and eccentric. Fig. 178 is side elevation; fig. 179, an end view, showing two of the cylinders; fig. 180, a plan of the four cylinders. A A, B B, are four soft iron hollow cylinders, enveloped in coils of conducting wire j C C, D D, are horse-shoe magnets, each of which is so shaped that its ends form a pair of cylindrical plungers, moving up and down in the hollow cylinders, with just freedom enough to prevent contact; H G F E is the beam, from which the magnetic plungers are hung; F its centre; H K the connecting rod; K L the crank; L the shaft and eccentric. The shaft carries a fly wheel, a b a is a slide moved by the eccentric, the parts a a being of ivory, and b of metal; c d o, conducting wire from the metallic part b of the slide (2) to the negative electrode; p, conducting wire from positive electrode; q n, conductors from p to the coil round A A; r m, conductors from p to the coil round B B; g, conductor from the opposite end of the coil round A A, terminating in the spring e, which presses on the slide a b a; h, conductor from the coil round B, terminating in the spring,f which presses on the slide aba.

The reciprocating motion of the slide establishes the electric circuit through the coils round A A, and round B B, alternately, and thus magnetizes alternately those two pairs of hollow cylinders, which attract alternately the two pairs of magnetic plungers, C C, D D, and give a reciprocating motion to the beam, and a rotatory motion to the shaft".

Unfortunately no dimensions are included in the article but perhaps somewhere in France there is a prototype ready for modelling. However, considering the power source must have been by batteries and wet Leclanche Cells at that, not

much sustainable power would have been available.

I hope this letter and diagrams inspire some one.

Harry Kennedy, County Durham.

Great Eastern dock tanks

SIRS, - Does anyone know of a source of drawings for the Great Eastern dock tank locomotive? To my memory, these engines were 0-6-0 outside cylinder engines boxed overall. They were used at Yarmouth and Harwich Docks and perhaps in other places, possibly Southend.

Hugh Taylor, Hampshire.

Lathes, dates and floors

SIRS, - I seek help from a user of a Colchester Student Metric lathe with a 6mm pitch leadscrew. Can you tell me how many teeth there are on the gear which drives the thread dial indicator, and confirm the number of marks on the dial itself, I assume 8.

My indicator is missing from the right side of the carriage apron and I intend to make a new one and use a 16DP gear, with its spindle set over at the helix angle of the leadscrew.

I have an Imperial dial for the left side of the apron if anyone wants it for the cost of the postage.

Exhibition dates

May I applaud Mr. Stephen Atkinson's remarks regarding exhibitions at the end of December? (*M.E.* 4265, 20 January 2006). He failed to mention that the traders do not get a Christmas at home, because they are preparing their stock for the show, and they miss New Year on their way home after the event. This is on top of their considerable costs involved.

Workshop floors

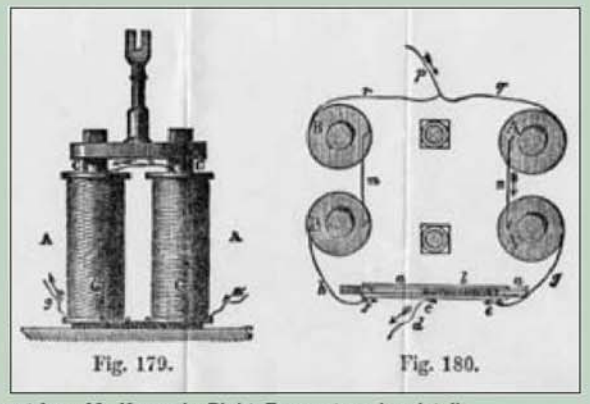
Concrete paint, rubbish-third grade plywood 3/8in. thick, underlay (Dunlopillow) carpet – ex-domestic residence work for me, but avoid foam backed carpet as the foam disintegrates, probably the reason why it was replaced in the first place. Also, use Fibreglass, pushed up between the roof joists, followed by hardboard or corrugated cardboard, nailed up with clout-nails. Avoid using Rocwool as it disintegrates before you can get the ceiling up to hold it.

Tony Webster, Northants.

MEX dates 1

SIRS, - Re. Stephen Atkinson's letter about MEX dates (*M.E.* 4265, 20 January 2006). I am closer to Sandown than Stephen Atkinson but, for what it is worth, have missed the Model Engineer Exhibition for the last two years on account of seasonal family commitments. Unfortunately, the child who used to provide an excuse for visiting the exhibition is now at university! I, too, would like to know the reason for the timing.

George Winspur, by e-mail.



Left: Froment engine general arrangement from Mr. Kennedy. Right: Froment engine details.

MEX dates 2

SIRS, - Your correspondent Stephen Atkinson (*M.E.* 4265, 24 January 2006) raises the question of the timing of the Model Engineer Exhibition, and asks whether he has any support. He certainly has mine!

I have raised this question before and have never received an answer. It seems to me that it is not a good idea to hold a major show in the middle of winter, when the hours of daylight are shortened travelling is unpleasant and sometimes dangerous due to snow, ice or fog.

If the reason is *"tradition"* as suggested in Mr. Atkinson's letter, then the traditionalists should look further back. I remember that in my younger days the exhibition took place in August or September, which seems a much more suitable time. I still have a junior award certificate issued in September 1938.

Derek P. Winks, London.

MEX dates 3

SIRS, - How I agree with Stephen Atkinson (*M.E.* 4265, 24 January 2006) with regard to the dates of the Model Engineer Exhibition. It really is difficult to travel at that time of the year, particularly if the weather is bad. I also take his point regarding the difficulty of hotels and meals for anyone living outside the south of England. Harrogate in May is excellent.

I find the Sandown Park venue very inaccessible from a northern perspective. A day trip even from South Yorkshire is just too far to make the visit worthwhile. When the exhibition was at Alexandra Palace, a day trip was fine. Even Earls Court was just about viable. This is a pity, as I enjoyed the visits.

What about the N.E.C., or Stoneleigh Agricultural Centre in Warwickshire as a venue, say in April? Both these are fairly central for most people in the UK.

Thank you for an excellent magazine.

David R. Machin, South Yorkshire.

MEX dates 4

SIRS, - I strongly support Stephen Atkinson's objection to the holding of the Model Engineer Exhibition on the last three days of December (*M.E.* 4265, 20 Jan 2006).

Social commitments at Christmas and at Hogmanay usually allow only one day being available for attending the show. This means something like 500-600 miles of travel in a day from North Lancashire or West Yorkshire at a time when railway services are often truncated and their catering cancelled, and including a cheerless suburban journey and an unscheduled courtesy bus. Even if three days are available, there still remain transport and hotel difficulties due to the season. It is only worth it to see a few superb models and to meet friends who have come 5,000 miles for the event. Otherwise it seems just a London show; there is no boat show or Harrod's sale on at the same time to make a journey better value.

H. S. McPherson, Lancashire.

ED: *Food for thought.*

GWR chairs

SIRS, - In reply to Mr. R. A. Chambers, *M.E.* 4264, 6 January 2006, I can not recall seeing a date such as 1892 on any GWR chair; what I have seen on many occasions is 92 and more rarely 95. I have taken this to mean that the chair was to fit rail of 92lb per yard or 95lb per yard, making identification easy for the permanent way men. In its history the Great Western used many different rail sections, each of which would have required its own pattern of chair. Further, I have assumed that the *'Sn'* cast into the chair stood for secondary and would be used in such situations as the Didcot Newbury Southampton and the Midland South Western lines, the situation is complicated by such track finishing its life as part of minor branches, for example on my local Lamboura Valley branch. These are the three lines of which I have personal knowledge. I cannot recall seeing PNB cast into a chair but I am sure someone will enlighten us!

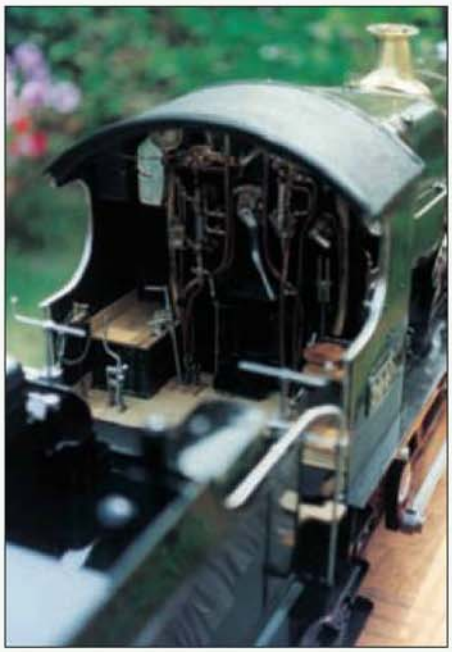
Roy Froom, Berkshire.

Springs

SIRS, - In *M.E.* 4264, 6 January 2006, Mr. Robin Howick from Devon requested details of a spring manufacturer. I have in the past had a great deal of help from Mr. Brimbell at Craftsman Springs, 75A Bridge Road, Uxbridge, Middx. UB8 2QW. Their phone number is 01895-811797, fax 811796.

Having given him specifications of O/D, I/D length and loading, he has manufactured small quantities to my requirements. Being a very satisfied customer I hope the above may be of use to Mr. Howick.

C. J. Bishop.



WATER GAUGE GLASS SEALS

Peter Rich

offers readers the benefit of forty years experience with gauge glasses

I have been following the comments and correspondence in *M.E.* on the subject of water gauges and their seals for the gauge glass. Since reading the letters I am reminded that I first designed and used this 'compression' type of water gauge some forty years ago for a model I was designing at the time. I am not constantly looking at the drawings so to remind myself of what I had done I have looked up my original work.

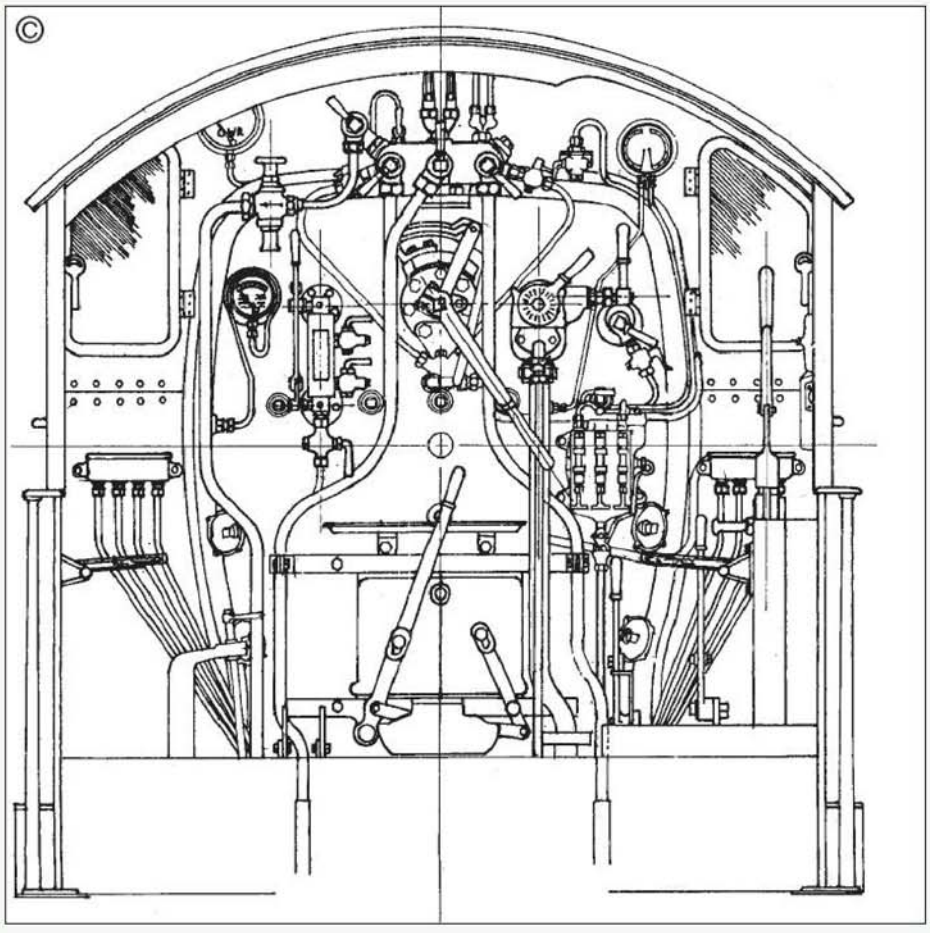
Messrs Moxham and Hobdell (*Post Bag M.E.s 4254 and 4260*) may be interested to know that in my original design the lower edge of the glass was chamfered at 45deg to allow it to force the seal out against the inner wall of the fitting to complete the seal. The top of the glass was square but the lower edge of the top cap is shown as chamfered for the same purpose and to squeeze down lightly on the glass.

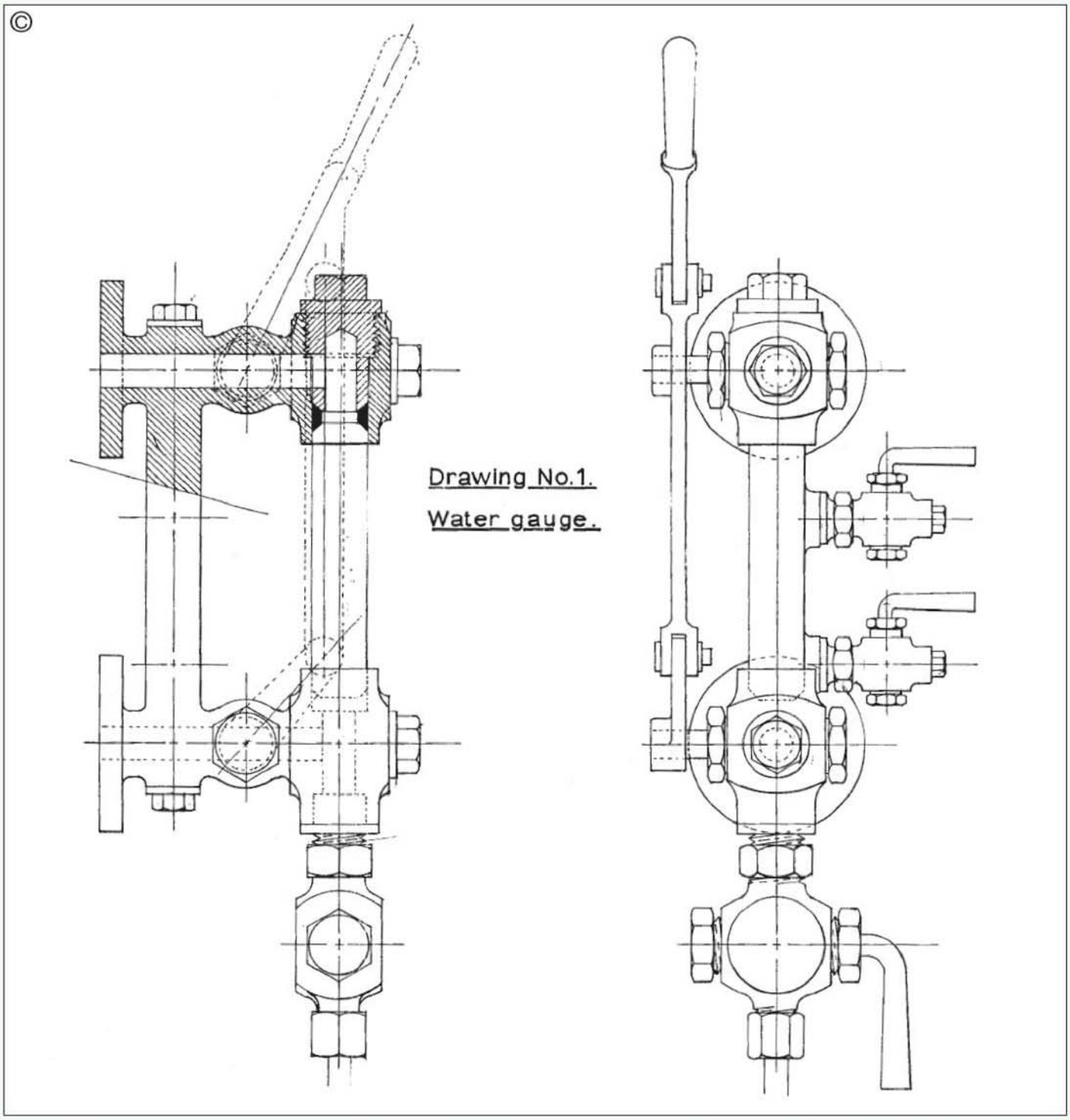
Over the years I have never had any problem with leakage with this type of seal. However, I did one day have a problem with the assembly of the bottom seal in that whilst assembling it would distort towards the centre of the gauge. I cured this in exactly the same manner as described by Mr. Hobdell in that I made two tubes with collars and entered them through the seals and then into the inside of the glass at its top and bottom making sure that I now chamfered the glass at both ends. This treatment cured the problem completely.

At this distance in time, 35/40 years later, I am surprised that our hobby has not generally moved on as far as gauge glass seals are concerned as, with modern seals, we can now make the gauge glass seals without any need to use a rubber ring or expensive 'O-ring' seals and without having to put any lengthways or sideways squeezing pressure on the glass. An added benefit with these types of gauges is that we can get much closer to 'scale' than with the 'nutted' types. For the past thirty odd years I have never fitted a gauge glass whose viewing length was more than $^{5}/_{8}$in. which I feel is perfectly adequate.

Shown above are a few photographs which show the boiler backhead of one of my models where the gauge glass can clearly be seen. My lost wax castings have been used for the gauge glass and all other boiler fittings and this is about as close to scale sizes that I have been able to achieve as yet. The gauge glass blow down valve has a parallel body sitting in a P.T.F.E. tube and operates through 90deg as per the full size.

I have included a drawing of my latest design of water gauge for my 5in. gauge designs. I have very much enlarged it for the sake of clarity which also shows the chamfered gauge glass and the seal. Readers should note that the mounting flanges are at the correct scale distance apart namely 1.0625in. I have also included a drawing



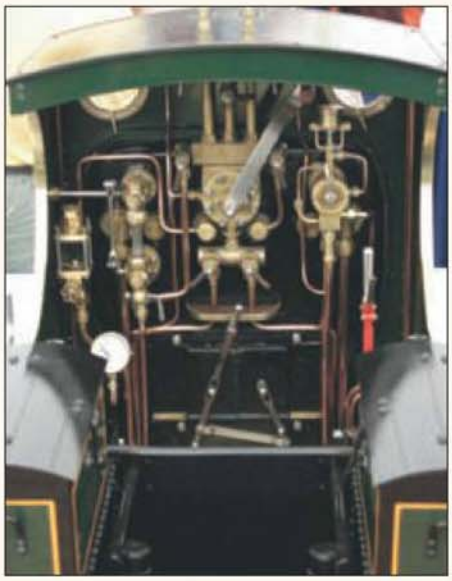


of my backhead showing how the water gauge fits in with the rest of the boiler mountings which I have tried to keep closely to scale and, in the main, working. The injector steam valves are secured with a single nut containing R.H. and L.H. threads as per full size, the threads being 0.1875in. dia. x 60 tpi. The R.H. thread can be tapped but I don't know of any L.H. taps in this size so I decided to screw cut them and was surprised at how easy it became with a little practice.

Returning to Mr. Moxham's letter and his reference to the GWR gauge glass dislodging the lower sealing ring, I have to observe that the gauge glass must have been fitted to the frame by a very inexperienced person and it is difficult to understand how this could happen with a properly fitted glass. My first employment on leaving school was as an engine cleaner at the old GWR engine sheds at Newport and was instructed how to change gauge glasses since when I have changed many gauge glasses both in my employment and in the preservation world.

The procedure was that shut off valves were closed and the gauge blown down before the top cap was removed. Any broken pieces of gauge glass would be removed and both top and bottom fittings thoroughly cleaned out. the new glass was entered through the top fitting until it protruded from the bottom of its fitting and the circular seal was pushed up over the glass followed by the top gage glass nut and the nut just slightly entered onto its threads without putting any pressure on the seal. The glass was then pushed further down and the bottom nut entered over the glass. The lower seal was pushed well up over the glass which was lowered into the bottom fitting until it contacted its seat. The lower seal and nut were entered onto its thread and lightly nipped up. The top nut was treated the same and the top cap fitted. The shut off valves were then opened to bring the gauge into operation and if there were any leaks the nuts were tightened up but only until the leak stopped.

In other words they were not 'hardened' up. If this procedure was followed there was no chance that the seals could distort. The only explanation I can think of for a distorted lower sealing ring is that the seal must have been placed into the fitting rather than over the glass and somehow when the glass was lowered it jammed the sealing ring causing it to distort. However, from what I recall of these seals, I believe it would be very difficult to distort the seal in this manner.



The backhead of David Ball's GWR Armstrong Goods locomotive.

David Ball's 7¼in. gauge 0-6-0 GWR Armstrong Goods was awarded a Gold Medal and the J. N. Maskelyne Memorial Trophy.

COMPETITION MODELS AT THE 75th MODEL ENGINEER EXHIBITION

Class B Locomotive Models

Reported by Dennis Monk

My records suggest that the locomotive entry was slighly down this year. Unfortunately, one model had to be withdrawn owing to the exhibitor being ill. However, the overall standard of the models presented was as high as in previous years.

Class B1 Working steam locomotives of 1in. scale and over.

There were four models entered in this category, one being of 7¼in. gauge. This was a model of a GWR 0-6-0 Armstrong Goods tender engine built by David Ball of Rusper, West Sussex.

Originally this model was to have been a freelance tank engine, based on Martin Evans' Dart, and built for passenger hauling on the Guildford track. However, very early on the builder felt that he wanted an engine of some character. Searching the books for earlier GWR locomotives, he came across the '388' Class Armstrong 0-6-0 Goods engines, of which 310 were built between 1866 and 1876.

Engine No.788, built at Swindon in 1873, was one of 20 that were convertible from and to broad gauge, by the comparatively simple expedient of changing axles and altering the brake rigging. This engine was originally built as a standard gauge engine, subsequently being altered to broad gauge before a final change back to standard gauge with the demise of the broad gauge lines. It was withdrawn in 1908.

Drawings for the model were scaled up from Russell's book of 4mm line drawings for the engine and 7mm drawings for the 1,800 gallon tender, which were supplemented by photographs. Most castings were those for Martin Evans' Dart. The cast iron pistons have cast iron rings fitted. Slide bars were cut from ⅜in gauge plate and the crossheads were produced from normalised mild steel with phosphor bronze inserts silver soldered in, milled to take the slide bars.

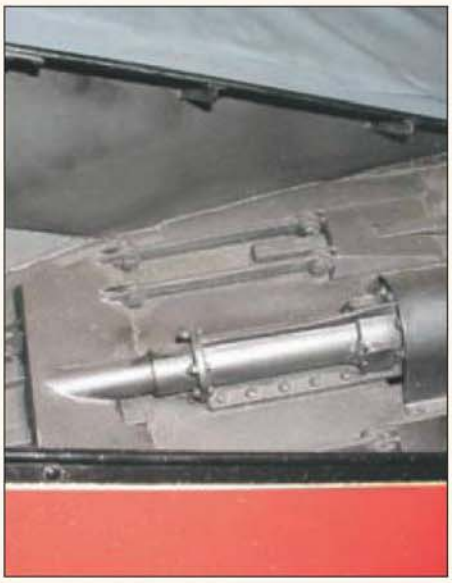
The connecting rods were cut from normalised mild steel and fitted with gunmetal bearings. Gauge plate and case hardened mild steel was used for the valve gear, with off-cuts of round cast iron for the eccentric sheaves and straps.

Mild steel of 4mm thickness was used for the

Edgar Playfoot's distinctive 5in. gauge Midland Railway 4-2-2 locomotive Princess of Wales *was awarded a Silver Medal and the Charles Kennion Memorial Trophy.*

The well detailed backhead of Mr. Playfoot's locomotive.

Clive Fenn's 5in. gauge Duchess Class Locomotive, No.6234 **Duchess of Abercorn.** *It was awarded a Gold Medal and the Crebbin Memorial Cup.*



The steam operated coal pusher fitted to Mr. Fenn's locomotive.

main frames, which carry split cast iron axleboxes. Bearing springs were made from spring steel strip with Tufnol inserts. The Tufnol was set in a wooden jig and heated in an old microwave cooker to produce the camber.

The boiler is to Keith Wilson's Dean Goods design, modified to fit between the frames. This carries a stainless steel ash pan, which can be dropped to aid ash disposal after running.

Water feed is by injectors and a two-cylinder axle feed pump mounted under the ride-on tender which has leaf springs, supplemented by coil springs. A vacuum brake is fitted, operated by a brake valve in the cab.

The engine is nicely detailed, with two toolboxes on the tender, front and rear vacuum stand pipes and a carriage warming pipe on the tender beam. A full set of lamps is carried, two of which are lit by battery, one red and one white.

The backhead is comprehensively fitted out with, unusually and in all probability prototypically, a lever mounted on the left-hand cab side with which to shut off the gauge glass in the event of a burst glass.

The model was very well finished in GWR lined green livery, though the yellow lining did appear to be rather wide. It was awarded a well-deserved Gold Medal and the J. N. Maskelyne Memorial Trophy.

Edgar Playfoot of Tonbridge entered a 5in, gauge model of the Midland Railway 4-2-2 locomotive No.2601 *Princess of Wales* the second of only two locomotives named by the Midland Railway, the first being *Beatrice* named after Princess Beatrice, Queen Victoria's daughter. No.2601 won the *Grande Prix* at the Paris exhibition of 1900. The model was built to Martin Evans' design, without any extra detail. There is one notable exception. The mechanical lubricator, which is of Jim Ewins' design, is relocated from the foot-frame to the much more acceptable position between the main frames in front of the bogie, driven from the engine motion.

The Midland bogie tender is fitted, as is correct for the period before the Midland had water troughs fitted throughout the system.

The model is very well finished and lined out in the Midland livery of the period, though the red was considered to be a little lighter than the true Midland lake of the period. This model was awarded a Silver Medal and the Charles Kennion Memorial Trophy.

Clive Fenn of Derby entered the third model in this category. This was a 5in, gauge LMS (officially) Princess Coronation but, perhaps better known as a Duchess Class Locomotive, No.6234 *Duchess of Abercorn*. This is a model of a class of locomotive that arguably reached the peak of steam locomotive design in this country. Towards the end of steam, one of these engines, No.6225 *Duchess of Gloucester* was taken on to the Rugby Test Plant and thoroughly tested. As a result of these tests it was found that the locomotive's performance could be considerably improved by altering the valve setting to take account of expansion and/or pin joint clearances. This was ultimately applied to the majority of Stanier locomotives, becoming a landmark in the Derby CME's Office, known as 'the day we pulled the (piston valve) heads back' and the alterations can be seen on the valve gear drawing.

After the tests on the Rugby plant, they were ▶

The backhead of Norman Barber's well made and finished locomotive.

Norman Barbers 5in. gauge locomotive has been built in the style of a Southern Railway L1 and was awarded a Bronze Medal and The New Zealand Cup.

repeated out on the road with No.6225 using No.3 Dynamometer Car and the Mobile Test Units. These three vehicles were bogie coaches carrying air-cooled resistance banks, which were used to load d.c. generators driven by the road wheels. They were in effect mobile dynamometers. It was possible, by means of controls in the dynamometer car to set the resistance banks so that the locomotive gave a constant draw bar pull, whatever the gradient.

On one such test, engine No.6225 put down no less than 2,000 horsepower consistently for half an hour. As a colleague who was privileged to be on the footplate during these tests said of the firebox: *"There were two firemen on the footplate at this time and one of them, a Scot, commented 'Its no a shovel ye want, it is a barrow and a plank'!"*

This model was built from works drawings. The only castings used were for the wheels and the chimney. All other 'castings' were fabricated. The model depicts engine No.6234 as she was in 1946, after the fitting of smoke deflectors.

It is extremely well detailed. There are the usual fittings such as lamp irons, vacuum and carriage warming pipes on the buffer beams, name, builder's plates and capacity plates fitted. In addition there are baffle plates inside the tender tank, lubricators and pipe work on the foot frame, which carries the hinged traps of the prototype, giving access to lubrication points. The boiler backhead is detailed as near as possible to that of the prototype.

This 2½in. gauge model of the very pretty B series Darjeeling 0-4-0 saddle tank locomotive No.777 was built by Jack Evans and was awarded a VHC Certificate and the Bill Deane Memorial Trophy.

Small but well detailed, Geoff Helliwell's 3mm Finescale 14.2 gauge model of Wantage Tramway locomotive No. 5 Jane gained him a Bronze Medal (photo: Geoff Helliwell).

A driver's steam/vacuum proportional brake valve is fitted with large and small ejector valves supplying steam to the ejectors at the smokebox.

Other items include a firebox arch of fire cement and a hopper ashpan with front and rear doors. The engine draw bar is slotted at the engine end to permit movement at the intermediate draw bar springs. Two auxiliary safety draw bars are mounted either side of the main draw bar. These have slots at the tender end, which are longer than those of the main draw bar, to ensure that the main draw bar always takes load, unless the main bar breaks in which case the auxiliary bars would take over.

The tender is fitted with water pickup apparatus and also a steam operated coal pusher, unique to this class of locomotive and ten of the later Britannias.

This engine is extremely well finished in LMS Maroon livery, not strictly correct for this engine at the period represented by the model but in this writer's opinion far better than the experimental green with which the engine was painted in 1946. It was disappointing to see 'pants' on the tender tank side. While these can be said to be prototypical they were rather deeper than scale.

The engine was awarded a very well deserved Gold Medal and the Crebbin Memorial Cup.

The final entry in this category was a 5in, gauge engine, as the builder puts it: *"In the style of a Southern Railway 4-4-0 L1"*, entered by Norman Barber of Frinton-on-Sea. This locomotive is based on LBSC's Maid of Kent design, but has a number of variations from it. The boiler blowdown valves have had to be repositioned and the sanding gear redesigned to permit the gear to operate on all four driving wheels, instead of just the leading driving wheels.

The Don Young modification to the Stevenson valve gear has been used instead of that of the original design and the steam brake gear modified to incorporate compensated linkage.

Simulated bolted flanges have been used on the boiler check valves and the bogie has been modified to incorporate bogie side check springs.

The injector is to D. A. G. Brown's design and the boiler fittings are the builder's own design, incorporating captive valve spindles with O-ring seals. The Ross Pop safety valves are to Paul Horth's design.

No.783, the prototype chosen for the locomotive, was built by the North British Locomotive Company in 1926 and the livery adopted is the light olive green used by the Southern Railway between 1923 and 1931, as associated with Ashford Works.

The cab side and tender number plates were etched in brass using dry transfer lettering and paint as the acid resist.

The locomotive is extremely well finished in the appropriate Southern Railway livery and was awarded a Bronze Medal and the New Zealand Cup.

Class B2 Working steam locomotives under 1in. scale.

The single entry in this category was a 2½in. gauge model of a B series Darjeeling 0-4-0 saddle tank locomotive No.777 built by Jack Evans of Sheffield, being completed in 16 months. Sharp Stewart were the original builders of this class, rebuilds were carried out at Tindharia in India. Asked why he had chosen this model for a first attempt at a steam locomotive, Jack's reply was simply that he loved the locomotive. He added that if he were starting again it would be to 3½in.gauge, for the small size caused difficulties in construction; in particular, the small smokebox created problems connecting the steam and exhaust pipes.

Boiler feed is by injector and hand pump. Backhead fittings include blower, injector and hand pump valves, with a single gauge glass. A mechanical lubricator is fitted and the snifting valve is carried in front of the chimney. There is a sandbox fitted between the frames at the front. This represents a later addition for manual feeding of sand.

The model is well finished in blue livery, making for a pretty little engine, which was awarded a Very Highly Commended Certificate and the Bill Deane Memorial Trophy.

Class B5 Scratch built model locomotives gauge 1 (10mm scale) and under

Again, there was a single entry in this category. This was a 3mm Finescale 14.2 gauge model of Wantage Tramway locomotive No. 5 *Jane* entered by Geoff Helliwell of Crowthorpe.

This delightful little scratchbuilt model was produced in brass and nickel silver on a Taylor Hobson pantograph engraving machine and a Cowells HS lathe.

The chassis has a split axle pickup and three point suspension, the rear axle being fixed and the front one mounted on a central pivot.

The motor, which is mounted in the boiler, has a small flywheel on one end and a scratch built gearbox at the other, transmitting the drive to the rear axle. Modular construction has been used, the chassis, footplate, boiler and cab being separate items.

The model was well finished in a green livery and nicely presented on a length of track. Of particular note was a curtain provided on the footplate to protect the crew from rain and drafts! It was awarded a Bronze Medal.

Class B12 Tramway vehicles

Reported by Neil Read

There was only one entry in this class this year and this was entered by regular exhibitor Mrs. May King. The prototype chosen for this model was the unique 'tram on stilts' devised by Magnus Volks which operated between Brighton and Rottingdean between the years 1896 and 1901.

Magnus Volks was a pioneer of electric railways who had the idea of a line that would lie under sea water for much of the time. The idea was to give the intrepid passenger an experience that was a cross between a walk on the pier and a sea voyage. Power to the vehicle was supplied at 500 Volts so a sense of adventure was probably appropriate for those using the device.

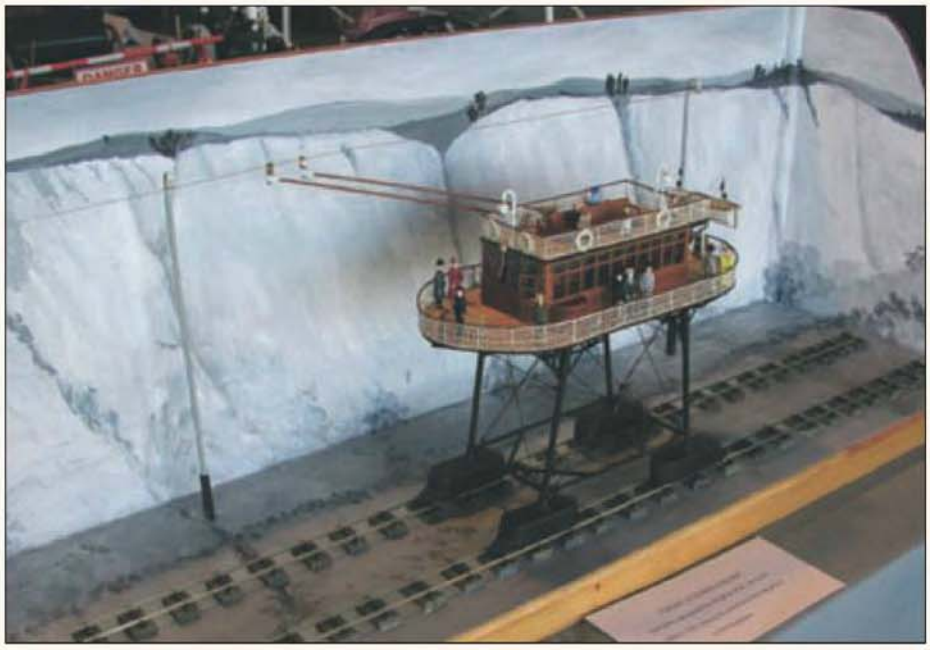
Never the less the railway enjoyed some popularity and even received royal patronage when, in 1898, the Prince of Wales made two journeys accompanied by the Duke and Duchess of Fife.

However, the construction of the railway and its vehicle coupled to its exposed position caused operational difficulties. It was also said to be under-powered whilst the use of only one vehicle resulted in a limited service. It therefore passed into the history books after only a short life.

Mrs King's model was built to a scale of 1:48 and showed a section of the line on the shore with cliffs forming a background. The tram, which was given the nickname 'Daddy Long-legs' for obvious reasons was modelled in some detail and showed a number of passengers enjoying the upper and lower decks and the saloon cabin. The model is fully operational and makes stately journeys along the track provided using electrical power just like the prototype and controlled by the flick of a switch.

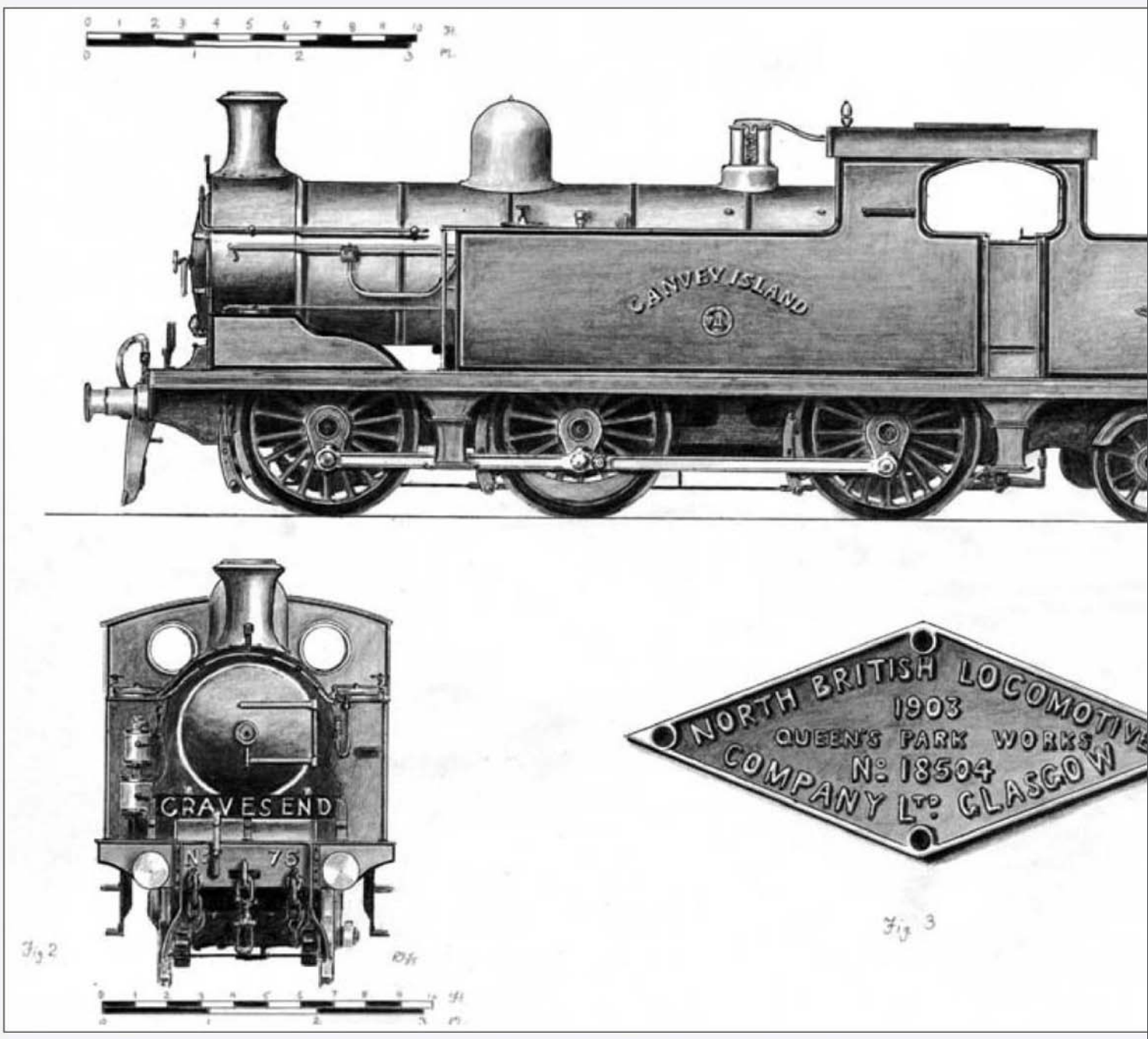
This interesting model was awarded a Silver Medal by the judging team.

● *To be continued.*



Mrs. May King's model depicting the unusual tramway designed and built by Magnus Volks in the late 19th century.

A close up view of the tramway vehicle often called, not surprisingly, Daddy Long-legs. The model was awarded a Silver Medal.



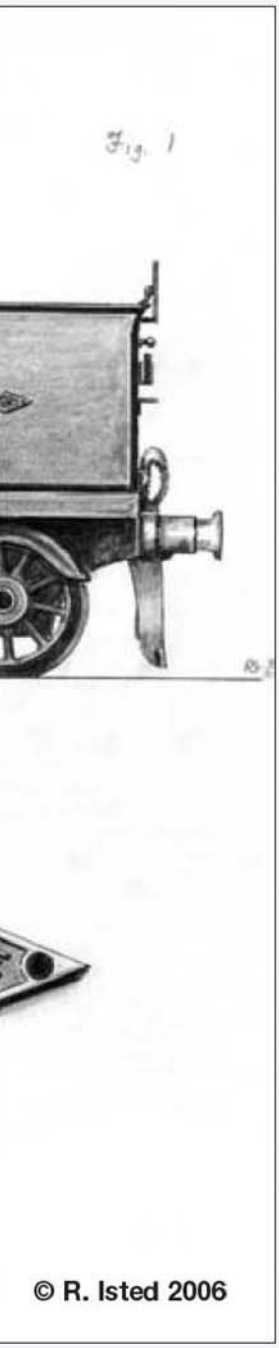
EDWARDIAN ELEGANCE

Ron Isted
continues this occasional series with a look at the London Tilbury and Southend Railway 0-6-2T locomotives.

The London Tilbury and Southend Railway began life as the offspring of a liaison between the London & Blackwall and Eastern Counties companies, both fairly disreputable and both invariably short of cash. It will come as no surprise, therefore, that the infant railway's own reputation in its early days was somewhat dodgy. Within a few months of the completion of the first section of the line from Fenchurch Street to Tilbury in 1854, the baby was abandoned by its parents and leased to the firm that built it, the well known railway contractors Peto, Brassey and Betts, who completed the extension to Southend a couple of years later. For more than a quarter of a century afterwards, the wheeling, dealing and in-fighting that went on behind the scenes can only be described as foul, even by Victorian business standards, but the long suffering shareholders finally managed to gain complete control of their own railway in 1882.

Within a few years, an independent and enterprising management had achieved a spectacular transformation, mainly by providing a frequent and reliable service of trains at cheap fares combined with a high standard of punctuality - desirable characteristics that some of today's train operating companies might care to ponder. As a result, the company became so prosperous that after 1898 its dividend never fell below 5%, and when the Midland Railway bought the line in 1912, (much to the annoyance of the Great Eastern), the patience and tenacity of the LT&SR shareholders was well and truly rewarded: no less than £240 of Midland preference shares for every £100 of LT&S ordinary stock. This is a return that makes most present day take-over 'windfalls' look pretty derisory, even more so when you remember that all this happened in those halcyon days before the advent of Capital Gains Tax.

As if that were not enough, the Midland had also agreed to electrify the line as part of the deal, but World War 1, followed by the grouping of the railways in 1923, the slump of the 30s, World War II and nationalisation all combined to ensure the retention of steam locomotion for



another half century.

For a period of approximately 80 years before the line was finally electrified, the railway was probably unique, at least among what one might call normal 'main line' companies, in conducting most of its traffic with only two types of locomotive. A series of over a hundred elegant and highly successful outside cylinder 4-4-2Ts that included the first of that wheel arrangement in this country, built in 1880 by Sharp Stewart & Co., remained standard for more than 50 years, the final series of 10 being built by the LMS at Derby in 1930. They were gradually superseded from the mid-1930s by a succession of equally successful 2-6-4Ts that worked most of the trains until electrification in 1962. Some of the previous generation locomotives were, however, extremely long lived and I had the good fortune to photograph one of the 4-4-2Ts still hard at work in the early 1950s - in fact to almost any ferro-equinologist, mention of the London Tilbury and Southend Railway conjures up immediate visions of these earlier 'Tilbury Tanks'. He will also probably volunteer the information that the engines were painted an extraordinarily impractical lavender colour, but in reality that lasted only a couple of years or so and was applied to few locomotives.

A less known fact is that alongside its fleet of tank engines, the Tilbury also possessed a pair of 0-6-0 tender engines built by Sharp Stewart in 1898. These were originally intended for the Ottoman Railways of all places - and for the benefit of those whose knowledge of geography is as minimal as mine, that system is now part of the Turkish State Railways. In spite of the exotic nature of their intended destination, the locomotives' appearance was very much that of a typical British 0-6-0, not unlike the contemporary Great Eastern locomotives of that wheel arrangement which also frequented London's Fenchurch Street station, except for an outsize cab with one very wide *unglazed* window in each side sheet. Why the LT&SR should have suddenly lashed out on these two particular locomotives is not immediately obvious, but the company evidently decided that six coupled wheels were a good idea, even for the relatively small amount of goods traffic it handled. In 1903, orders were placed with the North British Locomotive Co. (successors to Sharp Stewart) for six 0-6-2Ts, to be followed five years later by four more, one of which is the subject of this article, and a final four built by Beyer Peacock just after the Midland Railway takeover. The 10 LT&S engines were numbered 69 to 78 and, like all the company's locomotives apart from the 0-6-0s mentioned above, were named after locations on the system. The four Beyer Peacock engines were, however, nameless and turned out in plain black, with Midland Railway numbers from new.

My drawings, **figs 1** and **2**, show the first engine of the 1908 batch, LT&S No.75 *Canvey Island*, and **fig 3** is the NBL builders plate including, of course, the works number, 18504. The reason for such a high figure is that when the North British Locomotive Company was formed in 1903 by the merger of three old-established Glaswegian locomotive building firms, Sharp Stewart, Neilson Reid, and Dübs, the total number of locomotives built by each firm before the amalgamation was simply added together. As *Canvey Island* was built at the Queen's Park Works formerly belonging to Dübs & Co., the engine carried that company's characteristic diamond shaped plate, measuring approximately 13 x 5¼in. and made of brass.

Of all the 0-6-2Ts built by several British railways over a period of more than 40 years from the mid-1880s until the late 1920s, those belonging to the London, Tilbury and Southend Railway are, in my opinion, the most attractive. While their principal dimensions are typical of the era in which they were built, they possess an unpretentious elegance and grace that many of their contemporaries failed to achieve. I particularly like the small splashers over the trailing wheels and the graceful flare to the top of the footsteps, characteristics they shared with the standard 4-4-2Ts. Both items are, however, likely to cause anguish to the would-be builder of a miniature version, as will be apparent later. The engines also have a few little quirks that are all their own: for example, the wheel and handle of the screw reverse *appear* to have operated in a vertical plane, at 90deg. to the normal arrangement. In other words, the driver wound the handle in the same way as he would the one attached to the handbrake, and I *believe* his efforts were assisted by a horizontally mounted steam reverser. The engine also *appears* to have been equipped with a variable blast pipe, the aperture of which *seems* to have been directly linked to the lifting arm of the reversing gear, i.e. it was varied according to the cut-off.

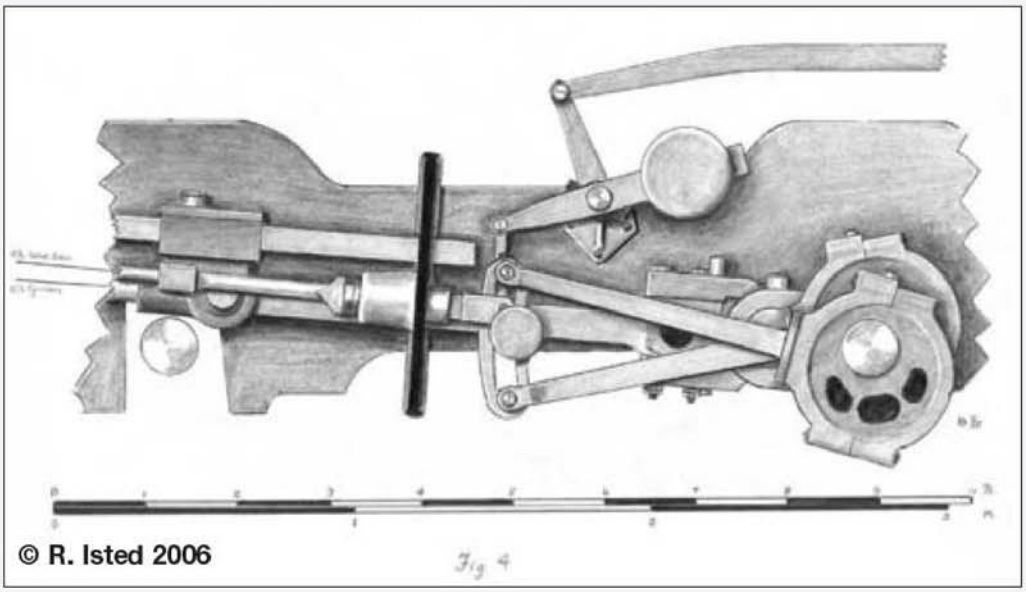
I apologise for the use of vague words like 'appears' and 'seems' in the previous paragraph, but my copy of the North British Locomotive Co's original general arrangement diagram, reproduced by the microfilm process, is extremely difficult to decipher. Apart from the usual problems with variable scale, many of the dimensional figures are completely illegible and various crucial lines simply converge into a muddy mess! In fairness, I should point out that this is no fault of the National Railway Museum who supplied the photocopies, as they are working from microfilms produced over 30 years ago by another organisation, and techniques have advanced considerably since then, but it does make life difficult. Things are not made any easier by the fact that many items appear either on the side elevation or on the plan, but not both: details of the cab reversing arrangements and blast pipe, for example, are both completely absent from the plan view.

The cylinders were 18in. diameter by 26in. stroke, fairly standard for the period, set at 2ft. 4in. centres with valve chests between them and fed by slide valves, which may or may not have been balanced. The port measurements are also illegible (of course), but scale off the drawing at 1½in. steam and 3½in. exhaust by 1ft. 3½in. long, with 1in. bridges between steam and exhaust.

Stephenson valve gear with locomotive type expansion links was employed, but while the centre line of the motion is inclined at 1 in 8, the figure for the cylinders is 1 in 10, both upwards towards the front (**fig 4**). Both inclinations have been scaled off the drawing, as the original is once again indecipherable. Although the piston stroke is 26in., the throw of the outside crankpins is only 12in., instead of the 13in. you might expect.

The locomotive is fitted with single slide bars, the design of which, together with the crosshead assembly, are very reminiscent of the practice of William Adams - and so, incidentally, is the general appearance of the standard LT&SR 4-4-2Ts mentioned earlier. This talented engineer was Locomotive Superintendent of the neighbouring Great Eastern Railway, (successor to the Eastern Counties and London & Blackwall, the LT&S's progenitors) in the 1870s, so it is more than possible that he had a hand in the design, although both the 4-4-2Ts and 0-6-2Ts were, nominally at least, the work of the LT&S Locomotive Superintendent, Thomas Whitelegg. I had originally thought that the 'variable blast pipe' mentioned above might have been a variation on Adams' Vortex blast pipe, but having checked another drawing of that interesting piece of locomotive equipment, I'm convinced the LT&S 0-6-2Ts were equipped with something completely different. If anyone has any definite information on the subject, I would be interested to hear from him or her.

The main frames of the 0-6-2Ts were of 1in. steel, 4ft. 1½in. apart at the front of the engine and parallel to a point about 1ft. 8in. beyond the rear coupled wheels. From there, over a length of 4ft. 1in., they were cranked in at a shallow angle to give clearance to the radial wheels, so that the frames were 3ft. 8½in. apart at the rear buffer beam. In view of the intended use of these engines on goods trains and shunting work, it is perhaps surprising that only one sand-pipe was provided for each direction of running: one in front of the leading coupled wheels, the other behind the rear coupled wheels. The rear draw bar was unusually long, in excess of 9ft., pivoted only a couple of feet behind the rear coupled wheels, and in their early days, the engines were equipped with the obsolescent safety chains either side of the main coupling hook. The guard irons were attached to the buffer beams rather than to the main frames and the outside lower sections of the buffer beams themselves were cut away in a graceful curve, (fig 2). Both details were standard practice on the London Tilbury and Southend Railway.



The boiler was pitched at 7ft. 7½in. (dimension scaled off the drawing) from rail level, its diameter over cladding a modest 4ft. 10½in., but was very well-proportioned, with a grate area of nearly 20 square feet. This is rather more generous than many otherwise similar contemporary locomotives: Ivatt's Great Northern 0-6-2Ts, for example, had to make do with just under 18½, while on the Brighton Railway E4 'radials', the figure was only 17¼ square feet. The LT&S 0-6-2Ts were unsuperheated and carried two 3in. diameter Ramsbottom safety valves set to blow off at 170 pounds per square inch. As well as the variable blast pipe, the engines appear to have carried some form of spark-arresting device in the smokebox attached to the lower section of the petticoat pipe, but once again, the GA drawing is not clear. I believe the overall height to the top of the chimney was 12 ft. 9½in., although this figure is yet another I have had to scale off the GA drawing because of the illegibility of the figures.

A miniature version of one of these attractive locomotives should not be too difficult to build - a far simpler project than the compound Atlantics discussed in the two previous articles for example and above all, one that should not take too long. I make that statement with some feeling, having been working on my current project for more years than I care to remember. The only real constructional problem with a model of an LT&S 0-6-2T is the familiar one caused by this country's obsessive passion for inside cylinders with valves between them. To take 5in. gauge as an example, 18in cylinders come out at 1 19/32in. diameter each, which leaves us with just 15/16in. to divide between four cylinder walls and the valve-chest, assuming the standard 4⅛in. between frames. This is obviously not practical, and there are two possible ways round this: the first alternative is to reduce the cylinder size, and I would suggest that the largest diameter that can be squeezed in with this configuration is around 1⅜in., equal to 15½in. in full size. This will reduce cylinder volume by not far off 25% if my maths is correct, so an increase in boiler pressure may be desirable. The second option is to abandon the 'valves between' layout altogether and put them above or below the cylinder bores. It all depends on how faithful you wish to be to the original design, but I would certainly favour the first alternative. In that case, the castings for Don Young's Isle of Wight 02, 0-4-4T would seem to be ideal, as, incidentally, is his design for the single bar crosshead, which is what you might expect, since the 02s were designed by William Adams after he moved from the Great Eastern to the London & South Western Railway.

The driving and coupled wheels of our LT&S tank are 5ft. 3in. diameter with 18 spokes and a crankpin throw of 12in. For a 5in. gauge engine, the driving and coupled wheels for Martin Evans' J39 Stratford would do nicely, except that they have only 16 spokes, as do those for the same designer's Metro 2-4-0T. On checking various other locomotives with wheels around this diameter, both full size and in miniature form, all have 16 spokes, so I doubt whether absolutely correct wheel castings are commercially available. On the other hand, the trailing wheels are 3ft. 6 in. with 10 spokes, a fairly common combination, and were guided by a radial axlebox. This is never an easy item to deal with, as I (and my scrap box) know from personal experience. Pony trucks are much less hassle, but again it depends on how closely you wish to stick to the full size design. In any case, the frames will need to be set in more than the strictly scale figure, as the prototype has a designed maximum sideways movement for the trailing wheels of only three inches.

The boiler is 4ft. 10½in. diameter over cladding (equivalent to 5 11/64in. in 5in. gauge) and Martin Evans' Super Simplex design could probably be used as it stands. The distance between tube plates is a little less than on the LT&S 0-6-2T, but that is an advantage, as the smokebox on the latter is very shallow indeed and, of course, the full size locomotive was unsuperheated. The firebox could be extended further back into the cab, which is quite a decent length, to make driving a little easier and would also increase the already generous grate area. Camouflaging a removable piece of cab for driving purposes should not be too difficult, as the roof of the full size engine is equipped with a rectangular ventilator.

The one thing most likely to give you sleepless nights if you decide to build a miniature London Tilbury and Southend engine is not the actual construction, but the painting of it afterwards. The colour scheme on the initial batch of 0-6-2Ts built in 1903 was even more complex, which is the main reason why fig. 1 shows one of the later engines! The basic green colour was a slightly darker version of that of the Great Northern Railway, and was applied to boiler, side tanks, cab, bunker and the combined splasher and sandbox over the leading coupled wheels, but probably not below the footplate, though there is some doubt about the colour of the wheel centres. Boiler bands were chocolate brown with a hint of purple, approximately 2in. wide, edged each side with a fine vermilion line, while the tanks, cab, cab-doors, bunker and leading splashers were edged with the same chocolate brown with a fine vermilion line between brown and green. The footplate valance was chocolate brown, edged all the way round in black, with a vermilion line next to the edging, and inside that, a fine yellow line. When you consider that the total depth of the said valance comes out at a shade under 5/8in. in 5in. gauge, that alone is enough to make any normal person reach for the anti-stress pills, but at least it is all straight lines. The same scheme, however, was also applied to those curvaceous footsteps and the mini splashers over the radial wheels - if you are of a strong disposition and steady hand, take another look at fig. 1 (not too closely, please) and I think you will agree this is not a task to be undertaken while under the 'alfluence of incahol'.

Wheel tyres and axle ends were black, fine lined in white, and wheel centres were chocolate brown, according to George Dow (see

references), who is normally meticulous in his researches. However, in two colour reproductions of 4-4-2Ts in my own collection, the wheel centres are green, and although one of them depicts No.80 specially decorated for the coronation of King George V, (and may therefore be a one-off job), the other shows No.81 in normal service. Another dubious item is the coupling rods, the webs of which the late Kenneth Leech claimed were chocolate brown, and fully lined out like the footplate valance(!) only on the 0-6-2Ts - not the 4-4-2Ts. As he became an apprentice at the LT&S Plaistow works in 1910 and was blessed with a photographic memory, his statement cannot be dismissed lightly, but I have not seen any photographs of the engines in service that are clear enough to settle the matter, while the NBL works photographs show them unpainted.

The buffer beams were vermilion, with a black edging, fine lined in yellow, but the buffer sockets were chocolate brown edged with black, vermilion and yellow. Digressing for a moment, older readers may remember a very fine 5in. gauge version of the LB&SCR 0-6-0T *Barcelona* built several years ago by Phil Haines of the Harrow & Wembley Society. Not the least of the engine's many attractive qualities was the superb rendering of the Stroudley colour scheme, even more complex than that of the London Tilbury & Southend, and including on the buffer casings surely the most elaborate lining ever invented - about eight separate lines if I remember correctly. Like everything else on Phil's engine, those on *Barcelona* were perfectly executed and I asked him how he did it. *"Oh, that was the easy bit"*, he said, *"I just put the buffer sockets in the 3-jaw chuck and mounted a draughtsman's pen in the tool post."* Somehow I don't think it was really quite as easy as Phil said it was, but it seems to me a brilliant idea, and I have never seen it in print.

To return to our LT&S 0-6-2T, the guard irons, which were fixed directly to the buffer beams, were also vermilion, unlined would you believe! The locomotive number was as shown in fig. 2, in gold serif letters, shaded black to the right and below, on both front and rear buffer beams, but did not appear on the side of the engine, which seems slightly odd - perhaps the staff preferred to use the names. These consisted of hand-painted gold leaf serif letters 4 1/2in. high, shaded black, which described a graceful curve across the side tanks above the company's armorial device - another little combination of tasks on a miniature version that should sort out the men from the boys. The main feature on the heraldic device, **(fig. 5)**, was a representation of the gateway to Tilbury fort, (built by Henry VIII), while the three shields represented London to the left, Essex to the right and Kent below. In case anybody should wonder why on earth the London, Tilbury and Southend Railway device included the white horse of Kent, the answer is that the company ran a frequent, and very lucrative, service of ferries across the Thames from Tilbury to Gravesend.

The fact that its only access to Gravesend was by water did not deter the railway from using destination boards bearing the name of that Kentish town on the front of trains that actually terminated at Tilbury - in fact I'm not sure whether the LT&S possessed such a thing as a 'Tilbury board'. As a matter of interest, the board for the main London terminus was just 'Fenchurch', omitting 'Street' and one hopes that the same economy of words was not practiced for the occasional LT&S working into Liverpool Street, as it could have caused serious confusion to old ladies! The destination boards were 5ft. 8in. long by 8in. deep, painted black with 6in. high white sans serif lettering, although in earlier days, the initial letter had been slightly larger than the rest.

The LT&S 0-6-2Ts put in over half a century of service under five owners: the London Tilbury & Southend, the Midland, the LMS and the nationalised British Railways, initially as part of the London Midland Region, then as part of the Eastern Region when the Tilbury section was transferred in 1949. Thus did the Great Eastern finally have its revenge for the 1912 Midland takeover, but this time there were no shareholders to reap any financial rewards. On 3 April 1954, one of the original 1903 batch of locomotives, formerly No.73 *Hadleigh*, worked a special train from Fenchurch Street on a five hour tour of the LT&S system, to celebrate the centenary of the opening of the first section of line to Tilbury. Now numbered 41983 and of course nameless, the engine had been beautifully cleaned for its starring role, as was usual at the time. I'm sorry to say, however, that the funereal garb of BR unlined black, relieved only by the tasteless 'constipated lion' emblem on the tank sides, did not have quite the same visual impact as the flamboyant colour scheme the locomotive carried in the days of its youth - but at least it would be easier to reproduce on a model!

London, Tilbury and Southend Railway 0-6-2Ts ('69' class) 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 3 1/2in. and 5in, gauge have been calculated to the nearest 1/64in., using 3/4in. and 1 1/16in. to the foot respectively.

For gauge 1, halve the 3 1/2in. gauge figures, for 2 1/2in. gauge, halve the 5in, gauge figures, for 7 1/4in. gauge, double the 3 1/2in. gauge figures. Dimensions prefixed by = are approximate only, dimensions in brackets are probably impractical for a live steam model.

Description	Full size	3/4in. scale (3 1/2in. gauge)	1 1/16in. scale (5in. gauge)
Length over buffers	37ft. 2 1/4in.	27 57/64in.	39 25/64in.
Length of main frame	33ft. 4in.	25in.	36 27/64in.
Height to top of chimney	= 12ft. 9 1/2in.	9 19/32in.	13 19/32in.
Width over footplate (maximum width)	9ft.	6 3/4in.	9 9/16in.
Height to top of footplate	4ft. 4 1/2in.	3 9/32in.	4 21/32in.
Width over cab, bunker and side tanks	8ft. 5in.	6 5/16in.	8 15/16in.
Length of cab roof	8ft. 0 1/2in.	6 1/32in.	8 35/64in.
Distance between frames, front of engine	4ft. 1 1/2in.	(3 3/32in.)	(4 25/64in.)
Distance between frames, rear of engine	3ft. 10 1/2in.	(2 29/32in.)	(4 7/64in.)
Thickness of frames	1in.	(1/16in.)	(3/32in.)
Locomotive wheelbase, total	24ft. 10in.	18 5/8in.	26 3/8in.
Divided into: front coupled to driving	7ft. 7in.	5 11/16in.	8 1/16in.
driving to rear coupled	9ft. 3in.	6 15/16in.	9 53/64in.
rear coupled to trailing	8ft.	6in.	8 1/2in.
Diameter of coupled wheels (18 spokes)	5ft. 3in.	3 15/16in.	5 29/64in.
Throw of crankpins	12in.	3/4in.	1 1/16in.
Diameter of trailing wheels (10 spokes)	3ft. 6in.	2 5/8in.	3 23/32in.
Pitch of boiler above rail level	= 7ft. 7 1/2in.	5 23/32in.	8 7/64in.
External diameter of smokebox	= 5ft. 4in.	4in.	5 43/64in.
External diameter of boiler over cladding	4ft. 10 1/2in.	3 21/32in.	5 11/64in.
Visible length of smokebox	= 2ft. 6 1/2in.	1 29/32in.	2 45/64in.
Diameter of smokebox door	= 4ft. 1 1/2in.	3 3/32in.	4 25/64in.
Height of chimney above cladding	= 2ft. 6in.	1 7/8in.	2 21/32in.
Cylinder bore	1ft. 6in.	1 1/8in.	1 19/32in.
Piston stroke	2ft. 2in.	1 5/8in.	2 19/64in.
Length of connecting rod	= 6ft.	4 1/2in.	6 3/8in.
Length of eccentric rods	= 4ft. 1 1/2in.	3 3/32in.	4 25/64in.
C/L cylinders to driving axle	= 10ft. 1in.*	7 1/2in.	10 23/32in.

*Cylinders inclined at approximately 1 in 10 and this dimension calculated at this inclination. Centre line of motion inclined approximately 1 in 8.

References

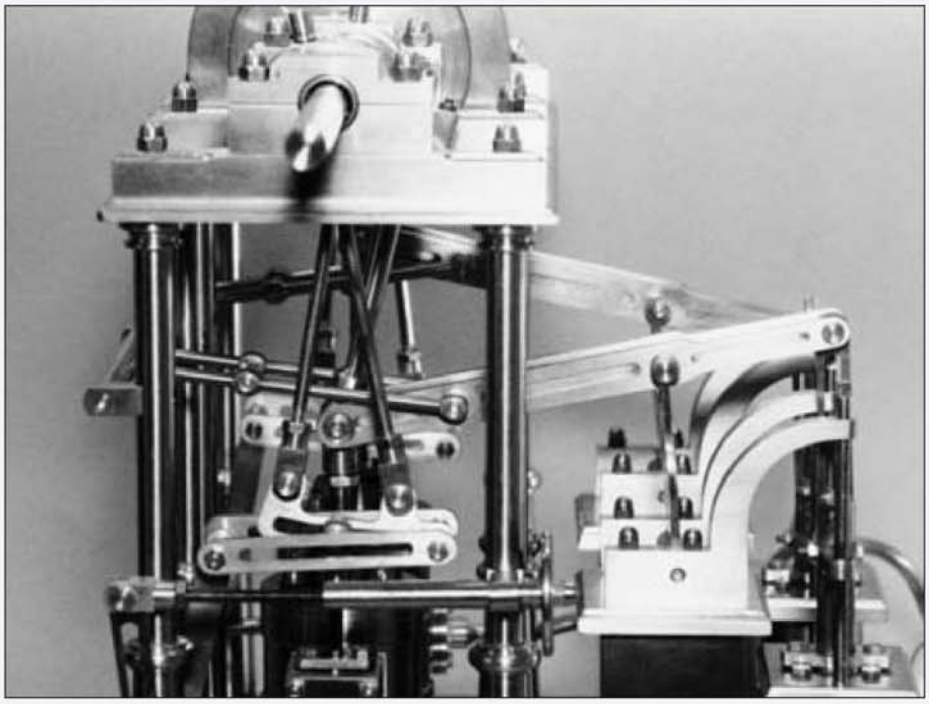
1: *North British Locomotive. Co. drawing No. 1/18504 (LT&S dwg. No.1849)*: GA side elevation, plan, cross section and rear of 1908 batch. Obtainable from the National Railway Museum, York, their ref. 4/GW/11673. The problems with this micro-film produced drawing have been mentioned in the main text.

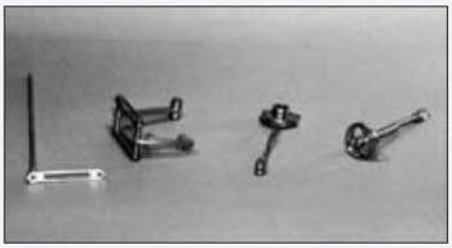
2: *North British Steam Locomotives built 1833-1948 for railways in Britain* by John H. Court, pub. Bradford Barton, undated. A superb collection of official photographs, including a double-page spread of LT&S No.75 *Canvey Island*.

3: *London, Tilbury & Southend Album* by George Dow, pub. Ian Allan 1981. Good collection of photographs, including four of the 0-6-2Ts, and very good brief history of the line.

4: *Midland Style* by George Dow, pub. Historical Model Railway Society, 1975. Very full details of LT&S colour scheme before the Midland takeover.

THE GORGON STEAM SHIP ENGINE





Valve Gear components.

Guenter Kallies in Germany continues construction of his replica engine with the valve gear system.

●*Part III continued from page 205 (M.E. 4267, 17 February 2006)*

The valve gear system used on the original engine was a complicated lever system which was standard at that time on stationary engines. To copy this on a small scale model means that you have to deal with a lot of very small elements. This was the reason that a more simple valve gear system was selected for the model version.

The Eccentric sheaves (3.1) should be made as a pair. Starting with a piece of brass 20mm dia. and 25mm long, turn both ends to 19mm dia. over a length of a little bit more than 5 millmetres. At the same setting, the groove should be introduced. Now, cut it in two pieces and clamp it into the chuck again, but with an offset of 3.5 millmetres. This is not really a problem if you have an independent 4-jaw chuck and a dial gauge. Please have in mind that you must read 7mm on the dial gauge for one full turn.

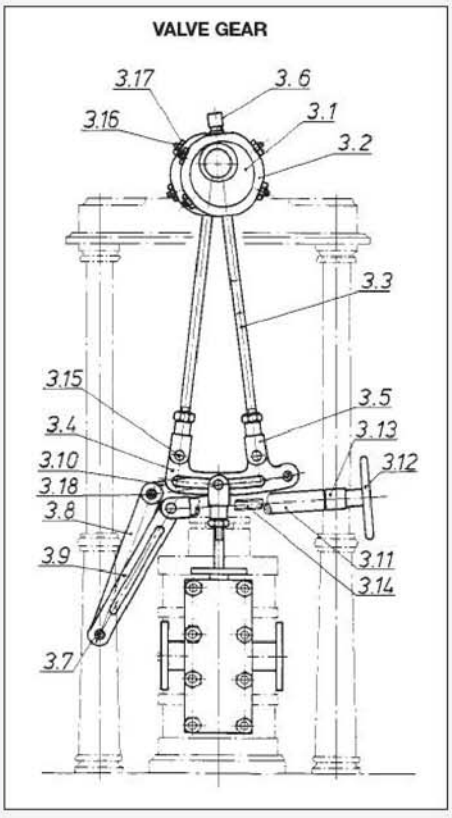
If you have only a 3-jaw chuck, don't worry. A packing of scrap material between one jaw and the work piece will give you the required offset. Check it out with the dial gauge.

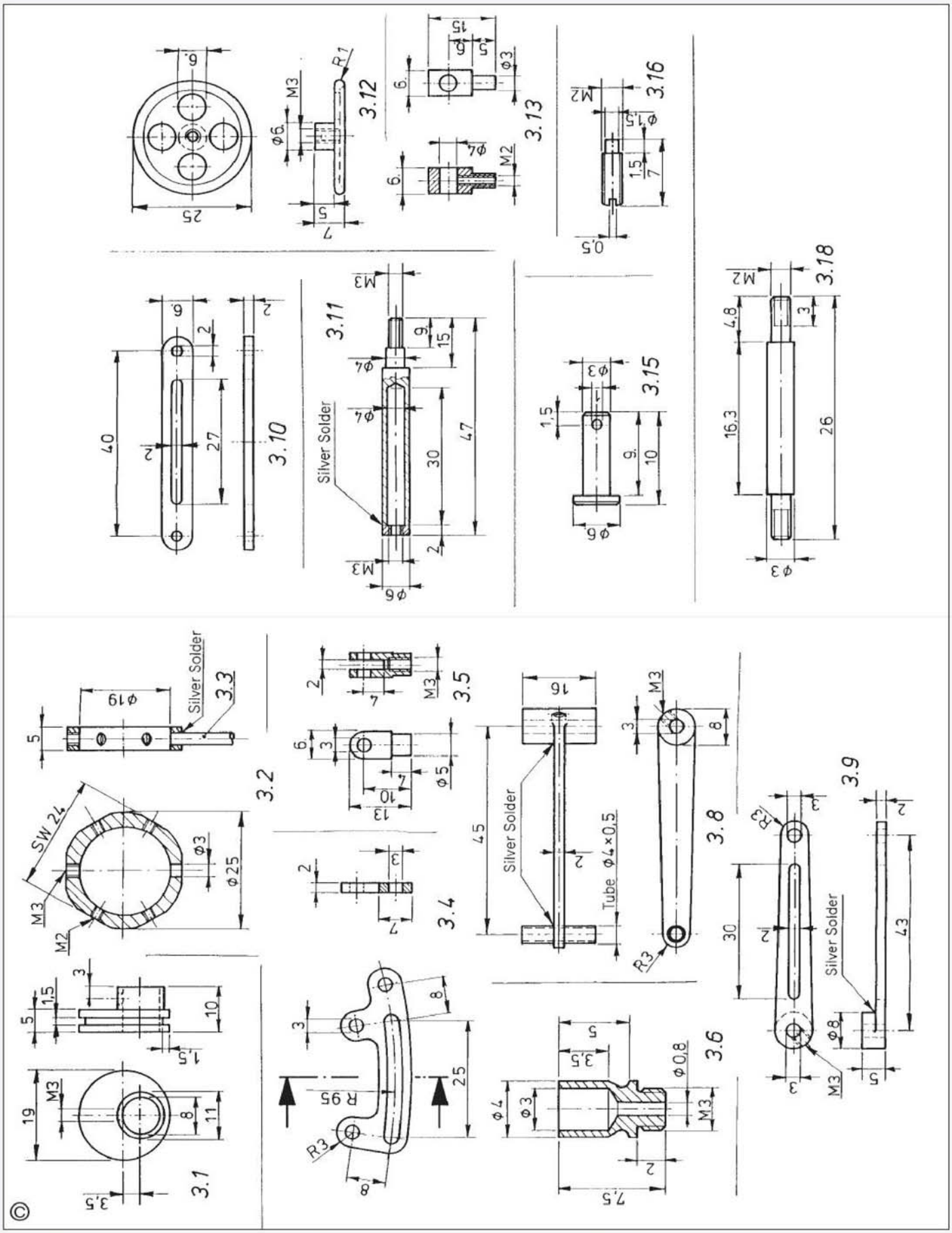
The Eccentric strap (3.2) is made either from round bar or, if you have it available, from hexagon brass material. An 80mm length of 3mm dia. brass has to be silver-soldered into the lower hole. The exact length of this rod must be determined on the assembled engine.

The Reversing link (3.4) can be filed to shape with the skill and confidence to do it, but most builders will prefer to use mechanical assistance at least in forming the slot. Cut the slot with a small slot drill either in the milling machine or in the lathe. The material for the link is soldered or clamped to a bar pivoted on a bolt which is fixed to the milling machine table

Group No. 3: The Valve Gear
Parts list:

Item	Quantity	Name	Material	Dimension
3.1	4	Eccentric sheave	brass	Ø20 x 15
3.2	4	Eccentric strap	brass	24a/f x 10
3.3	4	Rod	brass	Ø3 x 80
3.4	2	Reversing link	brass	40 x 20 x 2
3.5	7	Fork end	brass	15 x 6 x 6
3.6	4	Oilcup	brass	Ø4 x 10
3.7	1	Axle	brass	Ø3 x 190
3.8	2	Lever	brass	see drawing
3.9	1	Operating lever	brass	see drawing
3.10	4	Wing	brass	50 x 6 x 2
3.11	1	Screwed rod	brass	Ø6 x 50
3.12	1	Hand wheel	brass	Ø25 x 10
3.13	1	Bearing	brass	15 x 6 x 6
3.14	1	Screwed rod	brass	M3 x 40
3.15	7	Bolt	brass	Ø6 x 10
3.16	16	Pivot screw	brass	M2 x 10
3.17	24	Nut	brass	M2
3.18	4	Axle	brass	Ø3 x 30
3.19	4	Spacer	brass	Ø4 x 0,5 x 7
3.20	8	Nut	brass	M3
3.21	7	Socket grub screw	stainless steel	M3
3.22	7	Washer	brass	Ø3,3
3.23	7	Split pin	stainless steel	Ø0,8





or to an angle plate bolted to the lathe cross slide. Simply using the bar as a hand lever, it is not difficult to control the required movement. Stops on both ends of the movement give more accuracy.

A lot of other small items are needed in this group. Not shown in the drawings is the Axle (3.7) which is simply cut to length from round material. All the other components are so simple that they do not need any explanation in detail. Some items are silver-soldered together from more than one part. A fixture made from scrap material will be helpful to hold the elements in position during the soldering process.

●*To be continued.*

I/C TOPICS

Nemett
looks at material choices for miniature engines and describes an interesting 6-cylinder engine.
●*Number 10*

This time we look at materials used for miniature engines, one of the topics which readers have asked to be covered in this column. We will consider each of the major engine componenents in turn, and examine the options available

Crankcases

This is the major part of any engine and has to provide a rigid structure to hold the crankshaft and cylinder assembly in the correct relationship. In a two-stroke engine it also provides a gas tight chamber for the pumping action of the piston when charging the cylinder.

There are two options here; the first is to use a casting which in the majority of model engines will be aluminium, typically an LM4 sand casting. Occasionally cast iron will be used but usually only for larger engines.

The second option is to machine the crankcase from solid and in this case a free machining grade of aluminium alloy such as 2011 or 6082 (HE30) is suitable. Also in this case it is common to make the crankcase/cylinder assembly in several separate parts bolted together to ease the machining task and also to reduce the amount of swarf produced which is a disadvantage with this method. The big advantage is cost since it is cheap and easy to obtain suitable off cuts from our usual suppliers.

Machining from solid may also be chosen because it often enables the use of smaller machines than with castings particularly when compared with a one-piece crankcase/cylinder casting as is often used on single cylinder engines.

The single cylinder engine (**photo 1**) was machined from the solid and has the crankcase split vertically in order to be able to fit the individual pieces in a small lathe. It was in fact all machined using a Hobbymat lathe and milling machine.


1

Cylinder heads and cylinder blocks

The cylinder block may well be incorporated into the crankcase, particularly in multi-cylinder engines (such as the Westbury *Seal*), but is often a separate item in single-cylinder engines. Two-stroke singles sometimes have a separate cylinder block because it can make cutting the transfer port passages easier.

The materials used are usually the same as the crankcase but sometimes four-stroke cylinder heads are cast iron allowing the valves to seat directly in the head. Having said that, I have examples of engines where the valves seat directly into an aluminium alloy head which in this case is probably best made from the 2014 (HE15) high tensile grade. **Photograph 2** shows a crankcase, crankcase front, cylinder block and cylinder head for a 15cc four-stroke engine.

Crankshafts

There are again two basic options with crankshafts; built up or machined from the solid. If machining the shaft from solid then a medium tensile steel such as EN8 is probably best but I have in fact used EN1A free cutting steel with no problems. Built up cranks can be made from the same materials but avoid free cutting mild steel if the shaft is to be silver-soldered together.

I have built two single-cylinder 15cc four-stroke engines with built up shafts assembled with Loctite and pins for added security. In both those cases I used silver steel for the main shaft and crank pin with a mild steel web (**photo 3**). One engine has had many hours use over about 10 years with no sign of distress.

Cylinders

If the cylinder block of the engine is cast iron then the bores can but cut directly with no separate liners. Aluminium alloy blocks obviously need an inserted liner and I must admit preference for cast iron in this case. It is easy (although dirty) to machine and wears well with cast iron or aluminium alloy ringed pistons.

One problem with cast iron occurs with some high performance two-stroke engines if there are large ports cut into the cylinder walls which reduce the strength of the liner and can lead to distortion in use.

If the cylinder is structural, as on many rotary and radial engines, then steel may have to be used, either a grade that can be oil hardened such as EN30B (or EN24) or as Edgar Westbury suggested for one of his designs, mild steel with the bore case hardened. The danger with any heat treatment process is, of course, distortion resulting in the need to hone the cylinder afterwards.

Valves, valve seats and valve guides

Edgar Westbury specified a combined pressed in guide and valve seat for many of his designs and I have used both cast iron and phosphor bronze for these in the past. The Schillings engine has pressed in bronze guides with the valves seating directly into the head and I have specified a similar arrangement for the new 15cc single to be featured in this column shortly. The advantage of the one-piece arrangement is that the seat and guide can be machined at one setting in the lathe thus ensuring correct alignment and valve seating.

In miniature engines which generally run much cooler than full size ones and where the


2

Left: Crankcase and cylinder parts of a single cylinder engine machined from the solid.

Above: A 15cc single-cylinder four-stroke with crankcase and cylinder block machined from the solid, cast iron liner and a built up camshaft assembled with Loctite.


3

Built up crankshaft for a 15cc single-cylinder four-stroke.

Above: Built up camshaft, valves and tappets for the 15cc single-cylinder.

Right: Eldon 60cc straight six water-cooled two-stroke engine.

conditions inside the cylinder are somewhat less onerous I think the only sensible option for valves these days is free cutting stainless steel. It is easy to machine and suffers no distress from prolonged running. As it happens I have just had a conversation with our Technical Editor, Neil Read, about Nimonics (often used for exhaust valves and also things like gas turbine blades), but we don't need to go to such extremes for our engines.

Cams and tappets

I will be covering cam design and manufacture shortly but, unless you want to build a cam grinding/cutting machine, the easy ways these days are to use the type of jig described by Edgar Westbury for several of his engines or to use the rotary table in the mill with a computer generated set of offsets (look at Ron Chernich's excellent site at http://modelenginenews.org/index.html for this) to make the cams and then to Loctite them to a silver steel camshaft. I use EN1 or EN3 mild steel and case harden the cams to provide a hardwearing surface.

To answer all those out there who are thinking *"I would not use Loctite for that"*, I have never had camshafts made on that basis show any signs of giving way in about 15 years on a variety of engines. The trick is to ensure that the parts are thoroughly cleaned and degreased before assembly and also to make the cams with extensions to the bore on the side to make the bonding area larger.

The use of Loctite also avoids any possibility of a complete camshaft suffering from distortion during the heat treatment process. The same material can be used for tappets with the wearing surfaces case hardened. **Photograph 4** shows a camshaft, tappets and valves produced as described above.

Connecting rods, pistons and gudgeon pins

Connecting rods have been made of steel, aluminium alloy or bronze but for a typical miniature modern engine 2014 (HE15) aluminium is best and does not need separate bearing bushes since it has good bearing qualities when run on steel journals. Pistons can be made from the same material or even HE30 and are generally fitted with cast iron rings. Smaller engines (below 15mm bore) are often fitted with cast iron pistons particularly compression ignition engines which need a good piston/liner fit for easy starting. I have always made gudgeon pins from unhardened silver steel, again with no problems although some sources suggest hardening such pins right out.

Conclusion

I hope the foregoing has provided some useful guidance and I am keen to hear from other readers with comments on their own experience. I must point out that the above comments are my personal views based on experience with several engines; others may have different opinions, if so let us hear from you.

Because the of the effects of scale, the stresses involved in miniature engines are much less than those in full size engines (assuming a similar rpm range) and the use of exotic materials is generally not needed unless the engine is intended for really high performance operation. All the above materials can be obtained from our normal suppliers without any trouble.

A 60cc 6-cylinder in-line two-stroke engine

There are two reasons for featuring this engine in the column, the first is that it is an unusual and interesting engine; the second is that I am trying to find out some more about it and hope that one of our knowledgeable readers may be able to help. This is one of the perks of this job; you get to sneak such things past the Editor when he is not looking.

As you will have realised from the heading, the engine is a 60cc capacity 6-cylinder in-line two stroke (**photo 5**). It is in fact water-cooled with glow plug ignition and is obviously designed for model boat (large!) use as it is fitted with a flywheel (small) and collet type shaft coupling.

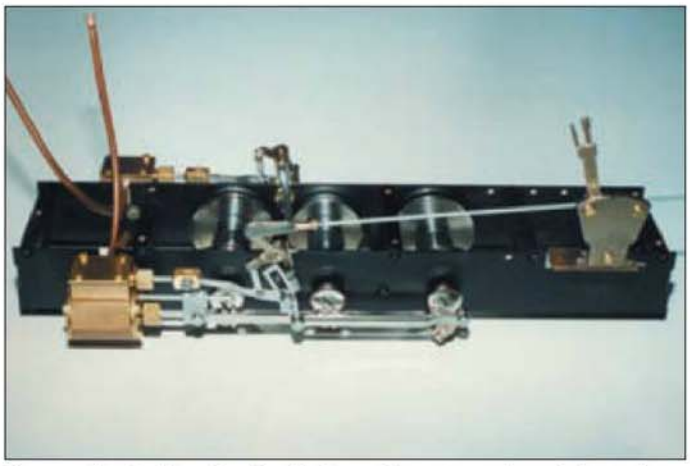
It is built from castings and I have dismantled it far enough to discover it has flat-topped pistons with a deflector and the visible cylinder head is a false one because there are individual heads in each cylinder which are clamped in position by the visible head.

The crankcase and cylinder are in one piece with the crankcase split horizontally along the crankshaft bearing line.

The engine is marked *'ELDON I 2636'* and is fitted with three Perry carburettors and I believe it was made in the United States but have not confirmed this.

I have run it on several occasions but only for very short durations because with the six un-silenced exhaust stubs it makes what can only be described as *"a horrendous din"*. Because of the small flywheel has an almost instant response to the throttle and I suspect would run quite happily without the flywheel, after all there are six bangs per revolution! Being a two-stroke it also produces some pretty obnoxious exhaust fumes (**photo 6**).

Eldon engine being run on the bench with a total loss water-cooling set-up.



The completed rolling chassis with the motion set up and ready for testing on air.

Initial tests on the chassis were made with a footpump. The foot pump used originated from a 1930s Sunbeam car.

BUILDING LADY ANNE FROM THE KIT THE DIARY OF A BEGINNER

Dick Mundy

from France, continues his account starting with the valve setting.

●*Part II continued from page 207 (M.E. 4267, 17 February 2006)*

So, it was on to valve timing and I found that, having removed the valve chest covers, the two screws replaced did not hold the valve chests securely so I packed out under the screw heads with spacers roughly equivalent to the thickness of the valve chest covers.

Actually three washers did the trick. But as all was revealed I found the steam inlet ports were both covered and I thought that no adjustment would be necessary - not so. I moved the reach rod forward and found the left hand steam inlet fully uncovered but only something over half the right hand inlet was revealed. I disconnected the radius rod and wound the valve spindle forward two full turns and after re-assembly the full hole was revealed and it matched the other side. But it did not work out when I rotated the wheels and some adjustments to the cranks were called for and I thought that I had better start that afresh when my brain was properly in gear, and it was not late into the evening. When I sat down later I decide to do a little planning ahead as to how I could test it all on compressed air.

So it was back to the valve timing and I returned to square one, set the mid-point position in the expansion link left-hand side and locked the lifting arm in place. I then checked the right-hand side and found it was all wrong, my adjustments the previous night had really messed things up so I reset the slide valve to suit the rules (I was probably putting it back to where it was set in the factory). The stages of setting up the timing are undoubtedly easily understood by those in the know but I found them thoroughly confusing and it was clearly going to take me some time. But I thought I could be getting on with that whilst delivery of the boiler kit was made if I ordered it the following day. In any case the next stage of testing requires the superheater and this comes with the boiler kit anyway. I had to go for it and whilst I was on the phone with my questions and credit card number I remembered to ask for a replacement right-hand side cross-head - the white metal one I had fitted which, as delivered, had a crack right through the bottom. This troubled me somewhat, I really did not want it failing at full throttle - if the locomotive ever should achieve that happy state.

I was trying to get the valve timing right and found I was a bit heavy handed when moving the return cranks on their pins. I had just moved the left-hand side much too far and put the whole works out of synchronisation so it was back to square one again. I found the most difficult thing was to move the return cranks very slightly and then re-tighten the screw on the crank pins without moving the wheels. I was also fed up with repeatedly having to remove and replace the cramp, which held the reversing rod in position. I made a small brass bracket to mount the reversing lever in place and the tension on this was sufficient to hold things steadily while adjustments were made.

It took me a good four hours setting, resetting and starting all over again to get the valve gear timing to something approaching what the 'book of words' says. I doubt if Oliver Clay had these problems or his build time could not possibly have been two weeks! I was still not happy that my dead centres were the same as those at Roundhouse. I could get them within a few degrees and they were the same on both sides in both forward and reverse, but I was suspicious that this was still not good enough as the valve slides travel less in reverse motion than forward. This had, however, been a useful exercise as I now had a somewhat better understanding of 'the works'. I had gone ahead and ordered the boiler kit. Apparently there was now no more I could do until I had the superheater tube.

In the meantime I decided to get out a compressor I had bought a long time ago to go with a Badger airbrush set. Despite a number of tries I had never had any success with the airbrush and it had been languishing under my bench for a good 12 years! If I could now make use of the compressor I would be delighted.

But I really could not wait, could I just try my work out on the car foot pump? I wondered if I could jury rig some sort of connection from the foot pump to a T-junction on the steam inlet. But I did not yet know what had to fit on the steam inlets and was wary of damaging the pipe ends irretrievably. At the risk of being accused of impatience I just had to try it. I found a length of plastic tube, which was a nice, firm fit over a steam inlet pipe, cut it into two equal lengths and pushed a length onto each pipe as far as it would go. I really had no conception of the pressures involved. Would they just blow themselves off? Then a T-fitting was needed to suit the bore of the plastic tube that conveniently suited a bit of brass tube I had by me.

Brass will take solder and so will copper. I had a length of larger bore copper tube so I took two short lengths of the brass tube (about 2in.long) and pushed them up into the larger copper tube to about half their length. The outside of the copper tube was then squeezed with pliers to flatten it across the brass inserts, and then a dent was made in the centre with a hammer. This formed a nice mechanical joint with the two brass pieces sticking out and nicely separated.

The outside of the joint was then cleaned up and then soldered using my big soldering iron. I flooded the joint with solder and this left an untidy but secure joint. When cool I checked by blowing through it that I had not blocked the thing with solder. Out came the foot pump and luckily the tyre adaptor just fitted over the end of my copper tube. The plastic tubes from the steam inlet pipes were pushed onto the brass extensions and I then had to put the chassis onto the floor, as the pump inflation tube is quite short. The reversing lever was placed in full forward, foot down steadily, *et voila*! The wheels went round! Tried the reverse direction and amazingly the same thing happened but in the other direction! I

paused here for self-congratulations and to take a photo. It did look a bit of a mess and I feel sure Heath Robinson would have been proud of me, but now I really had to get that compressor working and provide a continuous airflow to give the chassis a good run. This also allowed me to try the effect of different positions of the reversing lever. Remembering my very approximate dead centres, there could well be some tuning required but nevertheless I felt well pleased with myself.

I got the compressor running and, with various lengths of rubber tube, I managed to get the chassis running until suddenly there was a change in compressor sound followed by a pop and hissing. It looked as though the compressor was running below full strength when I first switched it on and now the blockage had cleared itself and blown my temporary air connections asunder. Clearly some sort of bleed or pressure regulator was needed and I manage to adapt a brass radiator drain cock. The compressor was switched on again and, with a gentle turn on the drain cock screw, I got sufficient pressure to get the motion moving again. I left it running for an hour or two to see if there was any improvement on the present jerky starting and stopping. I was also trying to achieve a nice smooth transition from stop to full forward and ditto to reverse. The compressor was very noisy and therefore I had to move the whole lot into my workshop so that I could get on with a few things in peace and quiet. Things were easier without that noise!

It was now just about an hour since I first switched on the compressor and when I went to check on its performance I found the motion very jerky, even in full forward, to such an extent that it frequently came to a halt. I stopped the compressor and put plenty of oil all round the motion and, on switching the air supply back on, it started up without a hiccup. I went and fetched the book of words to 'mug up' on the so-called 'fine tuning'. After half an hour or so the motion was very slow and jumpy again, a bit more oil was put on the bearings and I increased the pressure slightly. I had absolutely no idea what the air pressure was. Could I measure it with the tyre pressure gauge? I tried it and it showed 24psi as I had it set at that moment and this may well have been right as the specification for the safety valve says that is set for 40 pounds per square inch. It would not therefore have been blowing off in real life. I could have increased the compressor output if need be with my little screw adjuster but at the risk of blowing apart my push fit intermediate connections. I would have dearly liked to have spoken to the Roundhouse people but I knew they would have by now packed up for their Christmas break so I was on my own until the New Year.

The chassis had now been running for some two and a half hours and I realised, a bit late perhaps, that I really should keep a log. I was still not happy that I had got the timing right so I brought everything back into my little office and had another go at it. I find a powerful torch light very useful in seeing the crack of an opening steam port. Yes, some adjustment was necessary on the right-hand side cranks. Perhaps they were all now a bit more like the Roundhouse dead centres. I was feeling a bit more confident so screwed back the valve chest covers and put it back on to the compressed air. Oh yes, it started up faultlessly in forward. Tried in reverse and it still started up. It was now almost 11.30am and I had another oil round, started the compressor and left it running in reverse. The noise of the compressor was annoying, to say the least, so I went indoors for lunch and left it all running. I wondered how many hours I needed to run in the thing like this?

There was still no sign of the boiler kit - Santa Claus had let me down. I forgot to ask Roundhouse if the kit contained some steam oil. I checked on the running every hour or so during that afternoon and on the last occasion, at 5.11pm, I found the motion very jerky and almost at a stop.

I oiled around and found again that the drop of oil on the left-hand piston rod was all that was needed to get it running smoothly again. This had happened before and I felt obliged to check that there was no distortion there. It was now 5.32pm and I switched off the compressor.

The boiler kit arrived! Everything was there according to the packing list including a bottle of steam oil and the replacement cross-head I had asked for. I had been oiling around the motion with the light 3-in-1 oil and this seems to disperse very quickly so I changed to a heavier grade of engine oil, SAE 20-50. I found it was most important to keep the piston rods well oiled whilst running under compressed air. I was about to fit the replacement cross-head when I noticed this also has a crack just below the fixing screw hole so I decided to return it. Perhaps Roundhouse had a faulty batch in from a subcontractor. In the meantime I continued with the original part.

Fitting the superheater tube was not too difficult but getting the bend right to fit nicely in the smoke box and through the centre of the flue in the boiler was taking a bit of time. However, eventually it seemed all right. I gently bent the exhaust pipes to come vertically up the smokestack but, in the position they are it, it was difficult to tighten the exhaust union nuts should that be needed in the future. It was not possible to get a spanner onto the nuts from underneath because the exhaust pipes were in the way. Again, I deviated from the script and carefully, with a pair of small pliers, reshaped the exhaust pipes to bring them forward in a gentle curve to clear the two nuts. I then bent them back so that they aligned again with the smoke stack. In between times I went off to the 'spray booth' and painted the boiler cover and the smokebox. I could not do anything until the smokebox was painted as it is the main support for the boiler at the front end. Painting takes a good 24 hours even with quick re-coats and at that moment I was only at the primer stage.

I eventually put the last coat of black on the smoke box and could therefore fit that to the chassis. However, the boiler wrapper, which is needed for the next stage, had only got one coat of its green so it was back and forwards to the 'spray booth' at one hour intervals. It seemed to me that this stage of the assembly procedure is all wrong. Surely the boiler wrapper should be one of the last things to fit? I cannot see any way round this as it is a sliding fit but as time (and assembly) went on I hoped I might see a solution.

I asked myself why a boiler wrapper is needed at all. There is no lagging between that and the boiler itself and maybe it is an unnecessary luxury. I felt at the time that experience of running the locomotive would be the final test.

I am not too sure about the shade of green I have chosen for the bodywork. When wet it was very vivid and not a bit like that on the aerosol's cover. I hope it tones down a bit with time.

Just as I was about to fit the smoke box, and quite by chance, I noticed the tube was not parallel to the fitted base plate. If I left it like that surely the boiler would not align properly or the whole superstructure would run off at an angle. Loosening the two screws underneath I could twist the base plate into the right position and when I looked down from the top I could see the edges lined up perfectly. However, it did mean I had to touch up the paint work around the fixing supports where bare metal had been exposed. The moral here is to check before painting. In fact, I suppose it is to double check at every stage before going on to the next!

The painted smoke box was now fitted to the chassis. Oh, how I disliked those slotted cheese head screws in inaccessible places where the screwdriver would not reach. I do not like them aesthetically either although they are not be so noticeable now they have been painted. I slid the boiler over the superheater tube and engaged it into the smoke box. Everything seemed okay now my project stated looking a bit more like a locomotive. But I was still confused concerning the boiler bands. The handbook said: *"One of the boiler bands should be fitted around the rear of the boiler"*. However, there was only 'quantity one' listed in the kit, and the catalogue picture of Lady Anne definitely shows one at the front as well. Perhaps the front one would come with the body kit.

I then realised I had forgotten something again! I needed to fit the door handle and handrail onto the smokebox before fixing the smoke box to the chassis - there is no way one can get the nut onto the threaded stud of the door handle behind the exhaust pipes! I put the brass cap on the chimney at the same time and found that no adhesive was required. In fact I had to resort to a few light taps with a hammer, with a block of wood interposed, to get the cap over the chimney and seated down.

Looking at the boiler sleeve now the green paint was dry and on the locomotive I was horrified. It is a green with a kind of silvery speckled look quite unlike the sample colour on the lid. Even my daughter was unimpressed and so I stripped it off completely including the primer. Because I did not want a gloss finish and it is difficult if not impossible to get aerosols in semi-matt finish here in France, it was now to be an all black locomotive and that meant two or three days further delay for the repaint. But after reading the instructions again I now understood that the back boiler band (in fact the only one I have) fitted directly over the boiler and not over the boiler wrapper, so there was something I could get on with between the paint spray sessions. Yes, everything fitted together but now I must wait for the boiler wrapper again. But things were going well, weren't they?

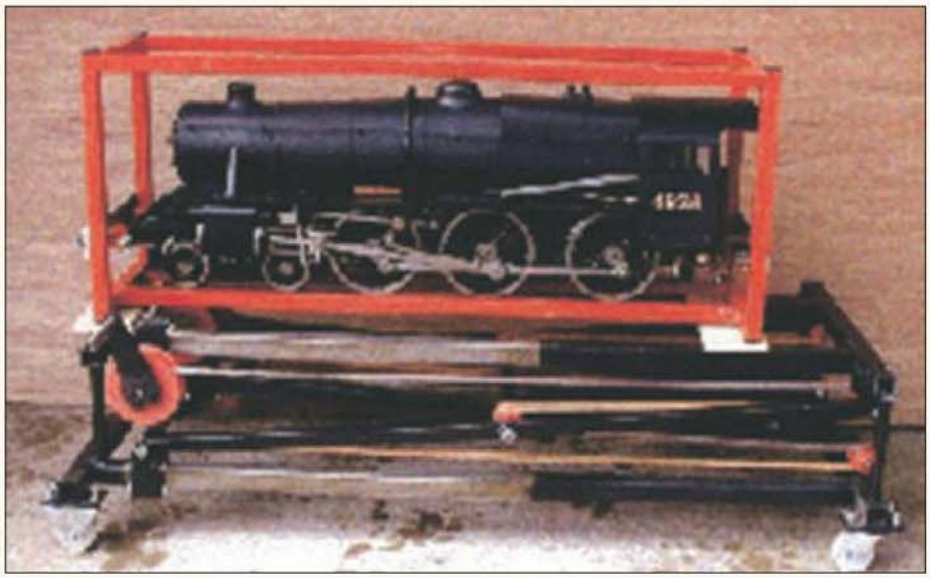
●*To be continued.*

A LIGHTWEIGHT LIFTING TROLLEY

Ivan Turner

continues his description of a trolley designed to lift an engine weighing more than 70lb.

●*Part II continued from page 156 (M.E.4266, 3 February 2006)*



Trolley in lowered position and loaded with a 3½in. gauge 'Black Five'.

The disposition of the pivot pins and plates can be seen in **fig 6**. Note that there is both a left and right-handed version for all four units. Assemble the units on the pivot pins. Use pieces of 10mm rod as temporary pivots on the upper sliding pivots at this point in the proceedings. The outer leg fixed pivot is fixed to the top frame, and its sliding pivot fits on the base slide bar. The arrangement of the inner leg is the same but inverted. The plastic components, which have been included to aid assembly, must be removed before any welding is done.

Top and base frames (fig 7)

Locate the outer leg pivot plates centrally on the long end piece of the upper frame and tack weld in position. Repeat the process for the inner leg pivot plates but using an end piece from the base frame. The slide bars are assembled next, ensure that they on the same centres as the fixed pivots and that both top and bottom are parallel to each other. Avoid damage to the plastic components during welding. Attach the support legs to the top and bottom frames, these are to stabilise the trolley in the lower position.

Initial assembly

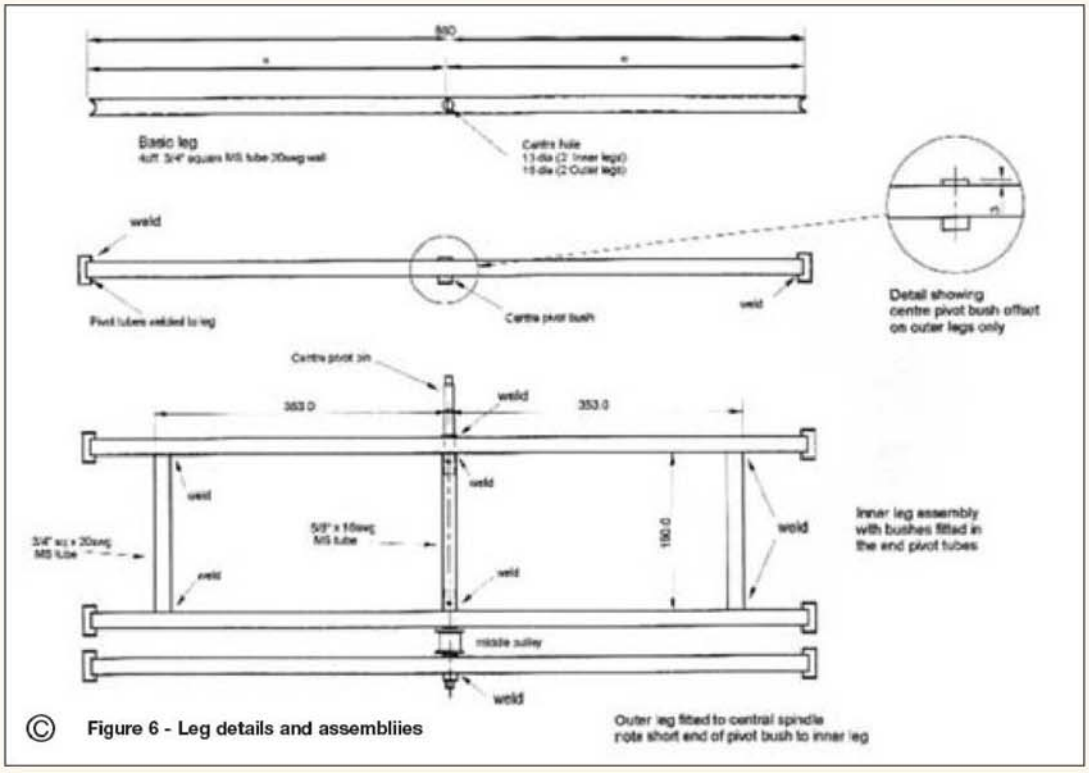
On completion of the top and bottom frames it is now possible to assemble the legs to the frames to check the operation of the sliding mechanism, but remember to fit the middle pulleys on centre pivots. A rod or bolts may replace the winding spindle at this stage. In operation the top frame should remain parallel to the base when it is moved up and down and any undue stiffness or play in the assembly should be eased or adjusted.

Ratchet and flanges (fig 8)

Drill the flanges in pairs, M4 tapping size, to ensure alignment and open up the clearance holes as required. The keyways may be cut with a hardened silver steel tool, mounted on the lathe toolpost by traversing the saddle, or in the chuck of a drilling or vertical milling machine and moving the quill, but the spindle must be locked in this case.

The ratchet is robust for the duty and need not be hardened, the teeth were cut using a dovetail slideway cutter but this is not the only method. The important detail is the pawl latching face, which must hold the pawl engaged under load, and this is the reason for the face being shown 2mm below the horizontal centreline.

The pawl may be fabricated although the prototype was cut from solid just for the fun of it. Finish the shape to suit the housing in the brake spool to ensure clearance for free and easy movement on the pivots. Drill the pocket for the return spring after marking on a practice assembly.



© **Figure 6 - Leg details and assembliies**

Ratchet and brake assembly (fig 9)

This assembly is a fiddly job. Start with the spindle at the right-hand side of the diagram. Have the ratchet keyway towards the left end of the spindle.

Put the spindle through the outer bush on the sliding pivot, next through the bushes of an inner leg, and the inner bush of the sliding pivot.

Arrange the ratchet components in a practice assembly, (refer to **fig 10**) and ensure that the ratchet is set to hold the load. The prototype handle turns anti-clockwise to raise the load, and the pawl should engage if the handle moves clockwise.

Fit the ratchet flange with the clearance holes on the spindle, then the brake spool, next the ratchet and finally the flange ▶

Figure 7 - Top and base frames

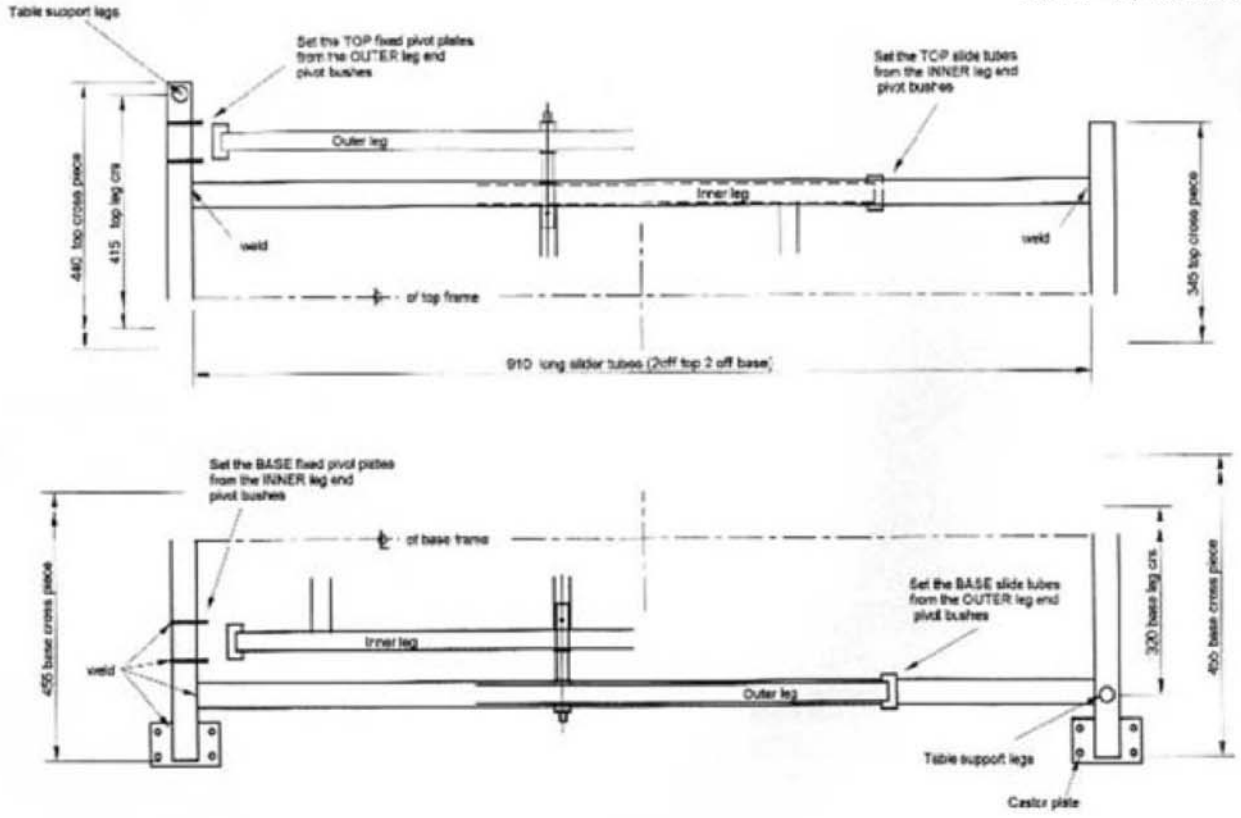
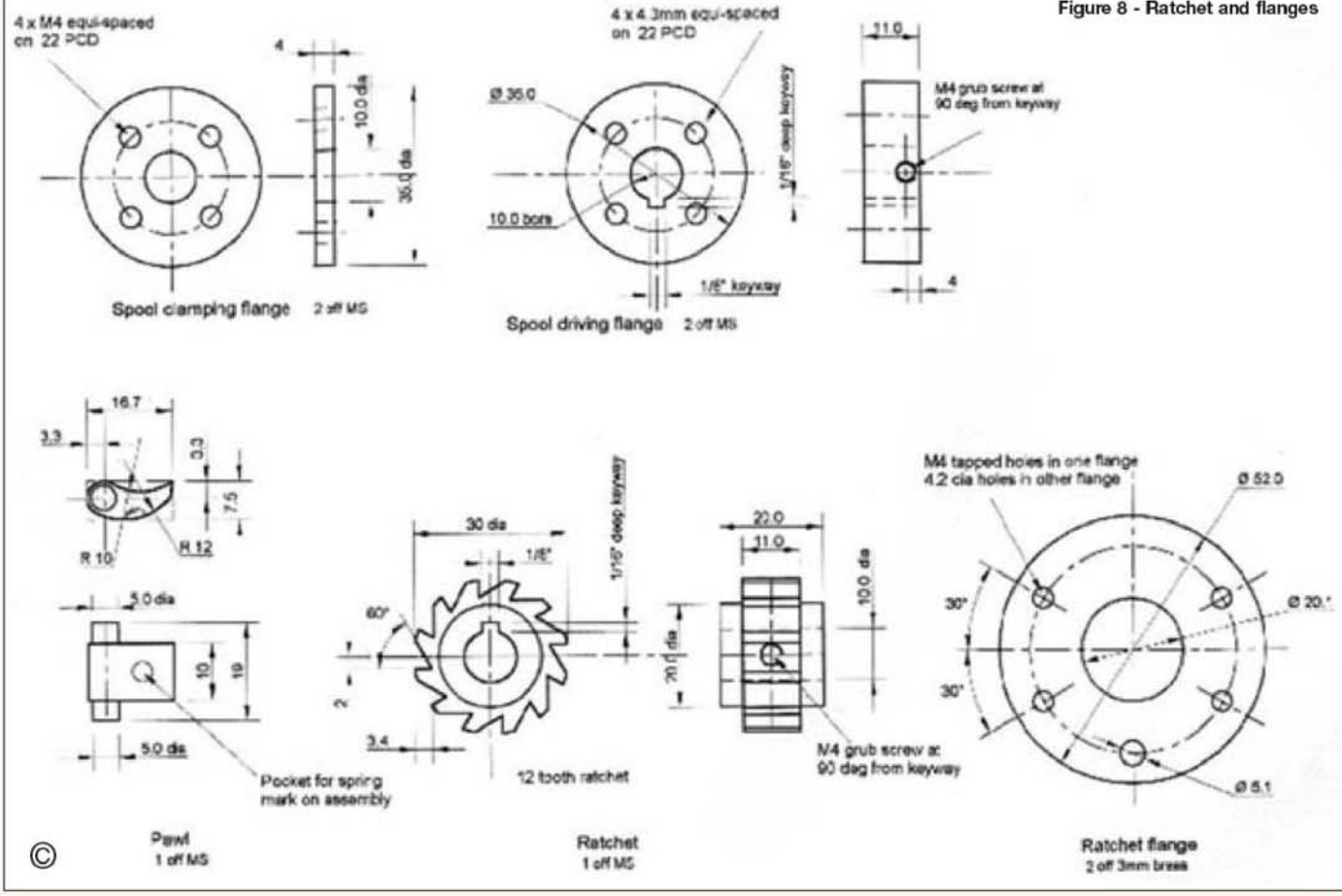
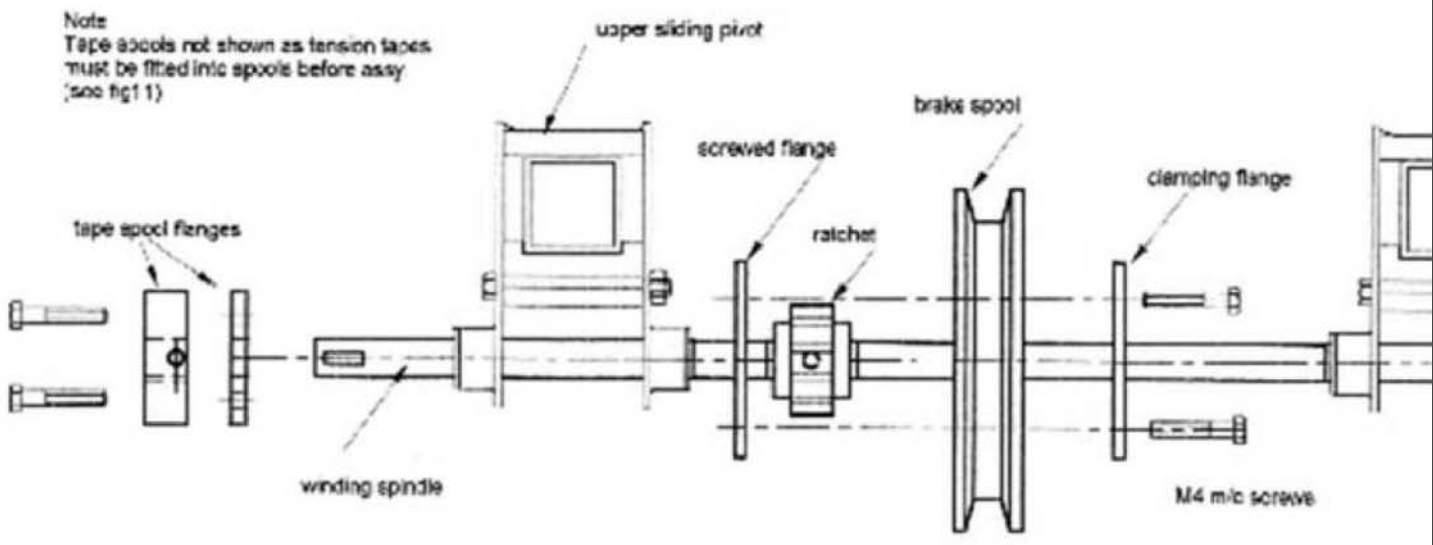


Figure 8 - Ratchet and flanges





© Figure 9 - Ratchet and brake assembly

with the screwed holes. Have another check that all is okay.

Complete the fitting of the spindle into its correct place through the other leg bushes and sliding pivot. Fit the key and the ratchet to the spindle and lock in place with the grub screw. Put the spool on the left-hand side flange, fit the pawl, then the other flange. Bolt up, fit the return spring and the grub screw, making sure it does not intrude into the belt groove, turn the spool to make a satisfying clack, clack, clack!

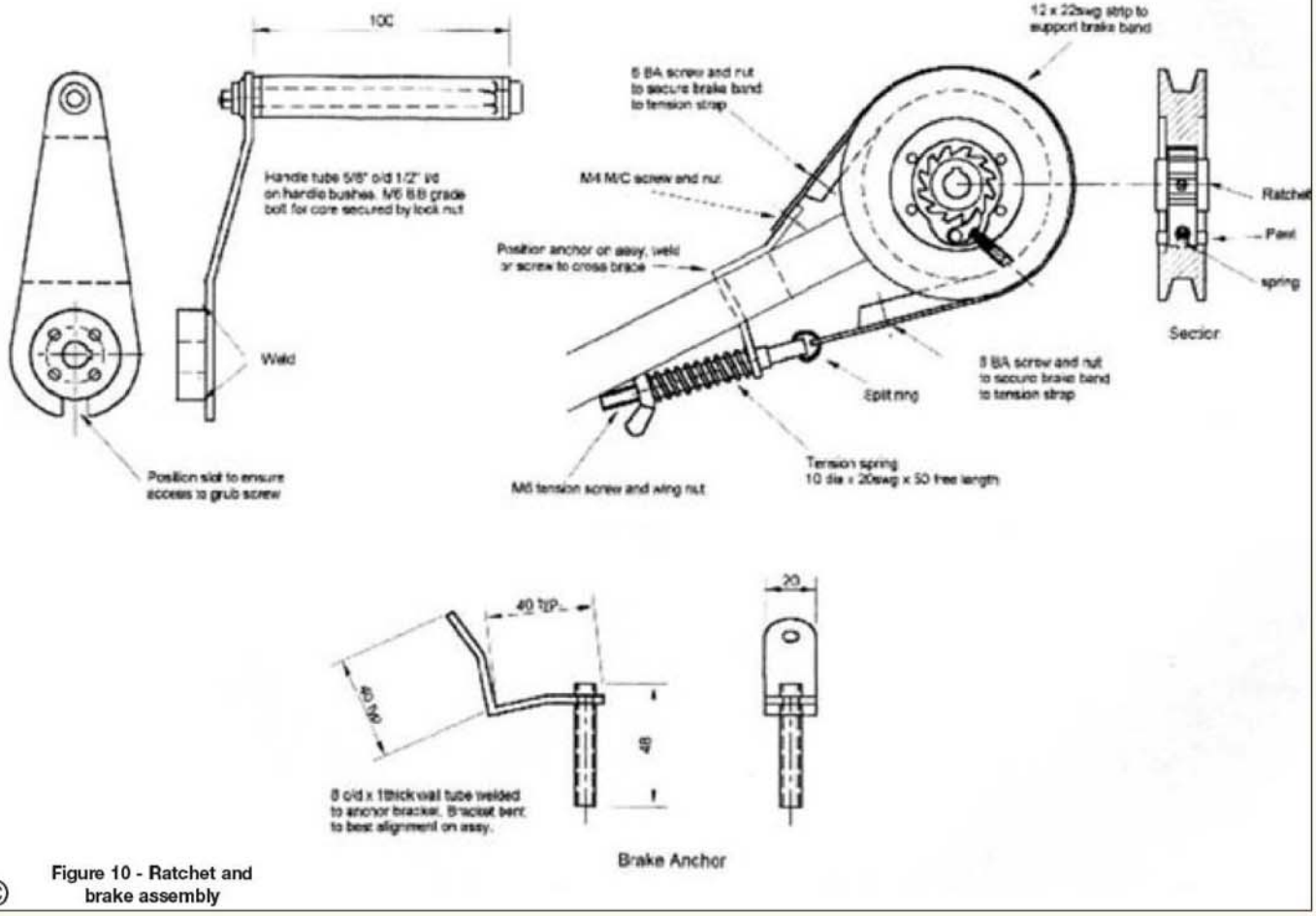
Ratchet and brake assembly (fig 10)

Weld the handle onto a spool driving flange but keep clear of the grub screw hole.

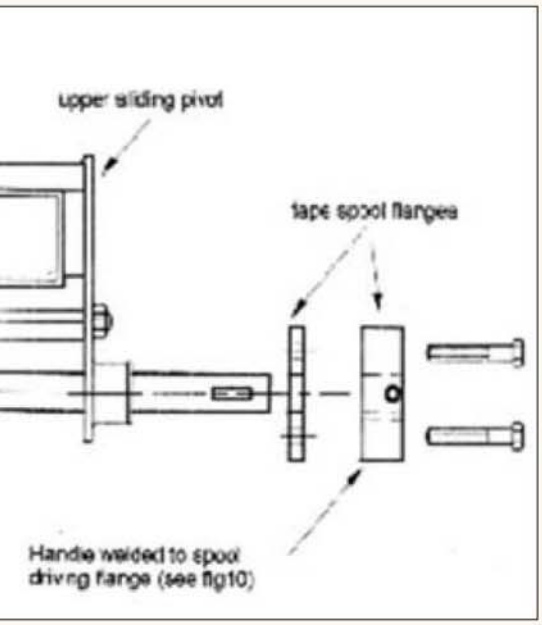
The anchor for the brake band is fitted, or made to fit with the best alignment. The friction band is from the same V-belt section as used to size the brake pulley that is mounted on a thin flexible metal strip for extra strength. The brake force is provided by a compression spring to be adjusted during testing.

Tension tape arrangement (fig 11)

Form a loop in the end of the tape (don't sew it) and push it through the slot in the spool, next push a 10mm pin through loop in the tape. Start winding the tape onto the spool, not much, just sufficient to determine the length of the sewn joint. See the diagram. Remove the tape and sew the loop, either by hand or machine, by spouse or shoe repairer. Use a round ended needle for best results, apparently it pushes the fibres aside rather than cutting them.



© Figure 10 - Ratchet and brake assembly



Main materials required

Item	Description	Quantity
1	ERW 25.4 x 25.4 x 1.22	6 metres
2	ERW 19 x 19 x 0.91	6 metres
3	ERW 15.88 dia x 1.5	1 metre
4	ERW 19.0 dia x 16SWG	1 metre
5	$^{5}/_{8}$in. dia. mild steel	1 metre
6	95mm dia x 32mm thick Polyacetal	3 pieces
7	40mm dia x 30mm thick Polyacetal	6 pieces
8	45 x 35 x 10mm thick Polyacetal	8 pieces
9	Climbers webbing $^{3}/_{4}$ x $^{1}/_{8}$ 100Kg b/strain	7 metres
10	Castors fixed and swivel	

To find the length of the tapes start with the trolley in the lowest position. Fit the loop, as already practised, and wind two full turns on the spool. Pass the tape over the top fixed pivot pulley, down and back round the middle pulley, down and round the lower fixed pivot pulley and on to the lower sliding pivot. Add 60mm, to provide at least one turn around the 20mm dia. compensating tube, and then more for the loop and sewing allowance. Make the second tape the same length but sew the loop opposite hand.

The winding spools, complete with tapes, can be fitted to the winding spindle and secured with the grubscrew. The flange on the bronze bush for the compensating socket is too big and must be reduced before fitting.

The tape loop is placed on the pivot pin, and the compensating socket pushed over it with the tape passing through the slot, and the bush engaging the pivot pin. Fit the tension socket connector, into the sockets before assembling the second tape on the other side.

Centralise the connector and wind one to two turns of tape onto the sockets, one side clockwise the other anti-clockwise. Drill through the connector and the socket walls and fit the cross pins.

The trolley should now be operational and ready for testing. Fit a suitable platform and an unimportant load of, say, 40lbs.

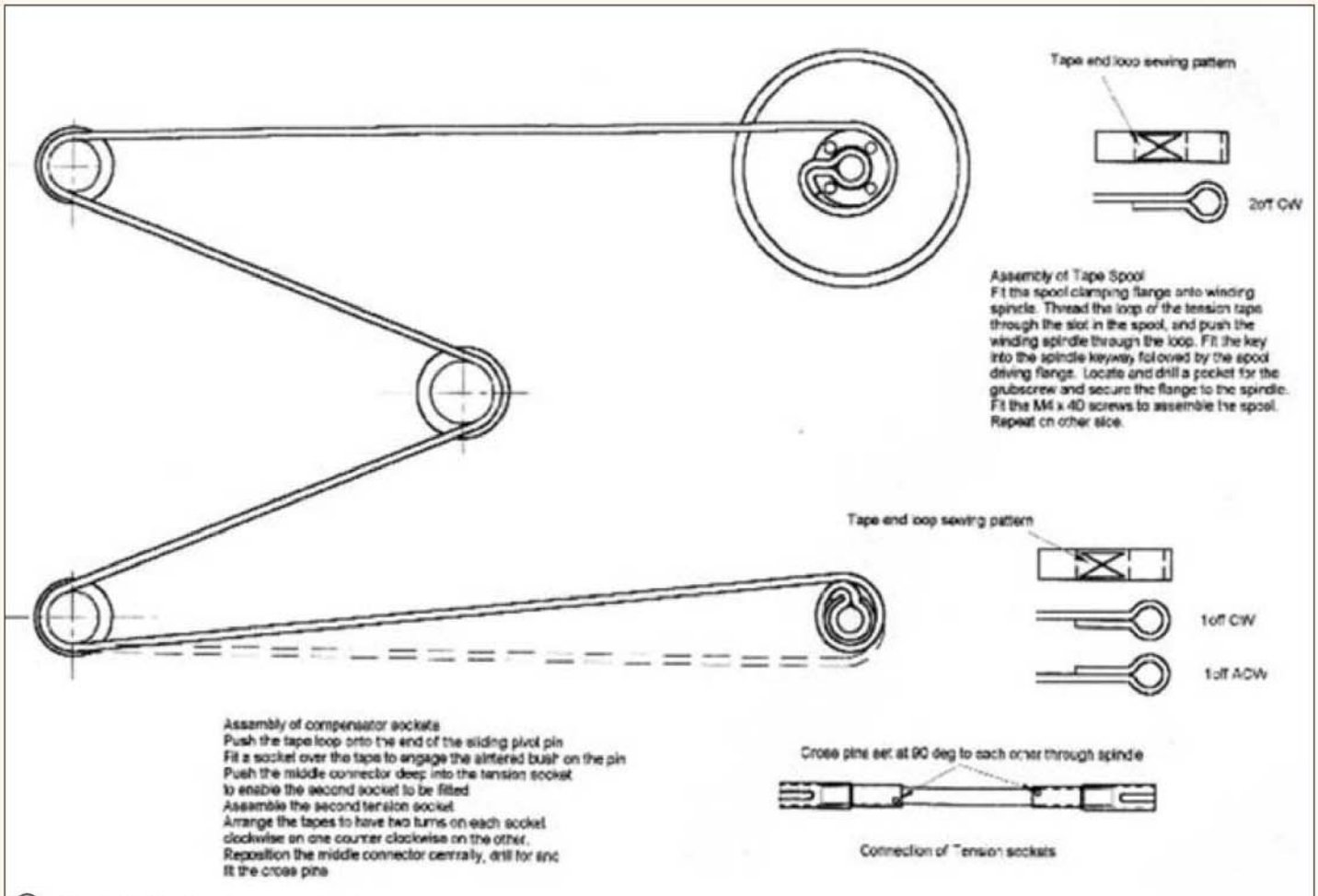
The winding handle is at the right-hand side, when looking from the sliding pivot end. To raise the load the handle is turned anti-clockwise, or top coming towards the operator.

The base is steadied with the left foot, and the left hand provides the extra force needed to start the lift. As the platform rises it becomes easier to lift and self-sustaining.

To lower, turn the handle back and cause the ratchet drum to slip within the brake band, check the fall as it lowers otherwise it will bump onto the legs.

Adjust the brake tension as required and practise with heavier loads until confident that your prize model will not come to grief on the trolley.

However, always use the rig as carefully as if it was the first time.



© **Figure 11 - Tension tape arrangement**

George Meldon's 5in. gauge B1. After WWI the LNER placed large orders for locomotives with NBL, Vulcan Foundry and R. Stephenson & Hawthorne.

The North British Locomotive Co. nameplate was inherited from one of its constituents, Dübs. NBL supplied 290 B1s from 1946 to 1952.

BRITAIN'S PRIVATE LOCOMOTIVE BUILDERS

Dave Roberts
concludes this series with a look at the Scottish builders.

●*Part III continued from page 200 (M.E. 4267, 17 February 2006)*

The key firm in Glasgow's locomotive history was **Neilson & Co**. Founded as Mitchell & Neilson in 1837, Walter Montgomery Neilson belonged to a family of Clyde engineers; his father James had invented the hot blast iron furnace.

The firm at first concentrated on stationary engines but by 1843 had become involved in locomotive building. By then it had become Kerr, Mitchell & Neilson and, by 1855, Neilson & Co. The works was situated in Hydepark Street, Finnieston, to the west of Glasgow.

In 1858 a German, Henry Dübs, was appointed Works Manager. Dübs had previously worked at Sharps in Manchester, been Works Manager at Vulcan Foundry and spent a few months at Beyer, Peacock. Soon after Dübs' appointment, the decision was made to transfer the works to new premises in Springburn, where there was room for expansion and better connection with the railway system.

Dübs was given the job of designing the new works and organising the move, the new Hyde Park Works being in operation in 1862. Springburn already had a strong railway engineering connection, with the North British Railway's Cowlairs Works and the Caledonian's St. Rollox Works in the vicinity. Henry Dübs did not stay long with Neilsons, however, resigning in 1863 to set up his own locomotive building business. Walter Neilson then appointed James Reid as Managing Partner.

A dramatic change to the company occurred in 1876 when Walter Neilson left the business he had founded. There was evidently a dispute between Neilson and James Reid, the details of which are unclear, but resulted in Reid acquiring Neilson's share. Reid then had sole control of the company until 1893 when his four sons joined. The name was changed to Neilson, Reid & Co. in 1898.

Neilson's became one of the largest of Britain's private locomotive builders, at first selling engines to Scottish railways and, later, railways south of the border, including many for the Midland including the 800 class and 980 class 2-4-0s, and a large number of 0-6-0 goods engines, all of Kirtley design. A feature of Neilson's engines was the firebox casing being flush with the barrel at a time when most builders used raised fireboxes. Their most famous locomotive was a one-off, Caledonian Railway's legendary No.123, a 4-2-2. Designed by Neilson but incorporating Drummond features, the engine was exhibited at the Edinburgh Exhibition of 1886 and is now preserved in Glasgow.

Meanwhile Walter Neilson, having left his old firm in 1876 and spent eight years away from engineering, made a new start at locomotive building by establishing the Clyde Locomotive Company. He built a new works in Springburn, near the Hyde Park Works. This new concern was not successful however, only a few orders being obtained. After being in existence for only four years Neilson sold the works to **Sharp, Stewart & Co.**, who transferred their business from Manchester. The new owners renamed the premises Atlas Works, perpetuating the name of their Manchester factory.

Sharp, Stewart's success was continued after the move to Glasgow with locomotives built for railways both at home and abroad. Among these were the Highland Railway's 'Big Goods' engines to Jones' design, in 1894 the first 4-6-0s to run in Britain, and, two years later, the first 0-8-2 tank locomotives, built for the Barry Railway. At the small end of the scale, Sharp Stewart designed the 'Class B' 0-4-0 tanks for the Darjeeling Himalayan line, of which a later example by North British is still running. Their first order for South African Railways in 1895 was for 4-8-0s and in 1912, 4-8-2s were supplied.

J. W. Lowe comments that it would be easier to list places where Sharp Stewart locomotives could not be found, and this remark might also be applied to both Neilson and Dübs.

We must now return to the career of Henry Dübs, who having departed from Neilson's, set up his loco-building facility in 'southside' Polmadie. The new works, called the Glasgow Locomotive Works, produced its first engines in 1865 for the Caledonian Railway.

Dübs & Co. was successful from the start and within ten years had become the second-largest locomotive builder in Britain. In 1864 William Lorimer joined the firm, becoming a partner in 1875. Henry Dübs died the following year, Lorimer then becoming Managing Partner.

Among the many locomotives supplied to Britain's railways were the Highland Railway's 'Duke', 'Loch', 'Small Ben' and 'Castle' classes, and many 0-6-0s and 4-4-0s of Johnson design for the Midland. They built some of the elegant 4-4-2 tank engines of Adams' design for the LSWR, and others for the London Tilbury & Southend. A Dübs innovation was the crane engine, having a jib attached to the centre of the boiler barrel, which found use in ironworks.

Abroad, the best customers were India, South America, South Africa, Australia, New Zealand, and several European countries.

The Glasgow-based firms gained a first-class reputation for engineering excellence and the longevity of their products. The British locomotive manufacturers relied to a large extent on orders from the widespread British Empire and other countries with British commercial interests. But towards the end of the 19th Century the British builders were no longer having it all their own way, and were facing increasing competition from German and American builders. Baldwin in the USA in particular had become a major threat and was able to undercut Britain's prices and offer quicker delivery.

It was with a view to combating the competition from abroad, and avoiding competition from each other, that the three Glasgow builders, Neilson Reid, Dübs, and Sharp Stewart, combined in 1903 to form the **North British Locomotive Company**.

The new concern became the largest locomotive manufacturer outside the USA. It employed nearly 8,000 people, and its shops occupied 60 acres. The Chief Managing Director became Hugh Reid of Neilson's and the Chairman William Lorimer of Dübs. The former Dübs works was renamed Queen's Park Works. Despite the confusing name, the new concern

had nothing to do with the North British Railway.

At first 'The Combine' as it was called, carried on much as before, with orders being spread between the three works. In 1909 a new administration building was opened near Hyde Park Works, accommodating the commercial and technical departments with a drawing office on the top floor. For the first twenty years NBL was very successful, winning valuable orders from railways around the world. Exported locomotives accounted for about three-quarters of the total built.

In 1921, though, the number of orders received dropped to only four, the recession years of the twenties and thirties nearly brought the company to closure. The company's Atlas Works was closed, building its last loco in 1923. North British never again reached the boom time seen before World War I.

Out of the 11,400 locomotives built by NBL, only a few types may be mentioned. For the railways in Britain, 14 of the Reid Atlantics for the North British Railway were built in 1906, and five years later 20 Class Z engines for the North Eastern, also of Atlantic type (4-4-2). The year 1912 saw the building of 50 superheated 2-8-0s for the Great Central, to Robinson's design. During the First World War this design of loco was chosen by the Railway Operating Department (ROD) for service in France. Out of a total of 521 of these engines built in 1917-18, 369 came from North British.

Mention of Gresley's A1 Pacifics implies built in Doncaster, but 20 of these famous engines were built at NBL's Hyde Park Works. Scarcely less famous was the LMS's 'Royal Scot' class 4-6-0s. Designed by NBL, the 50 urgently required engines appeared in 1927. The same railway, then under Stanier, ordered 50 of the 'Jubilee' 5XP class locomotives, delivered in 1934-35, and 73 two-cylinder 2-6-4 tanks, built in 1936.

With the outbreak of war in 1939, the Stanier 8F 2-8-0 was chosen for large-scale production for the war effort, a total of 849 being built, of which NBL contributed 175. To these were added, from 1942, 545 of the simplified 'Austerity' versions of the 2-8-0 and in the following year, all 150 of the 2-10-0 version. The wartime production of locomotives was in addition to munitions work, including a large quantity of bombs, shells and mines being made, and also 619 'Matilda' tanks to the design by Vulcan Foundry.

After the war the LNER placed large orders with North British. These included 290 of the B1 class mixed-traffic 4-6-0s, all 70 of the K1 class 2-6-0s and 35 L1 tanks, all 2-cylinder engines of Thompson design. The last batch of 40 B1s were actually ordered by the newly-nationalised British Railways in 1948. They cost £16,190 each. It was the only order for steam locomotives ever given to a private builder by BR.

Rather than attempt to mention any of the locomotives sent overseas by NBL, the author offers the numbers sent to the following places: India: 2,748; Africa (mostly South): 2,207; the Americas (mostly South): 1,603; the Far East: 597; Europe: 525; Australia and New Zealand: 515. Over the years, thousands of Springburn locomotives have been hauled through the streets of Glasgow to Finnieston Quay on the Clyde for shipment to the countries of the world.

The Neilson plate. This one was taken from a 0-6-2 tank engine.

For the ten years following World War II, a modest prosperity returned, but NBL had not anticipated the speed of change to Diesel locomotion. A start was made with a few Diesel-mechanical shunters in 1947-48, followed by a large number of Diesel-hydraulic locomotives. Most were of the 0-4-0 or 0-6-0 type, though a number of much larger Diesels were built, including the 'Warship' class for the Western Region. North British invested heavily in Diesel locomotive building facilities, including the building of hydraulic transmissions under license from Voith of Germany, and by 1955 they were building MAN Diesel engines, also under license from Germany.

Among the last steam locomotives built by NBL were 20 GMAM class 4-8-2 + 2-8-4 Garratts for South Africa, sub-contracted from Beyer Peacock and completed in 1958.

Such was the speed at which steam was abandoned on the world's railways in favour of Diesel and electric traction, the company soon ran into financial difficulties. The commitment to the hydraulic transmissions further contributed to the company's downfall when British Railways adopted the Diesel-electric system as standard for its locomotives, a disastrous decision for NBL, which applied also to Beyer Peacock. The company went into liquidation in April 1962, though the Voith transmissions continued to be built until 1970.

The goodwill, drawings and patterns were purchased by Andrew Barclay. All that remains of the North British Locomotive Company today is the 1909 administration building, now Springburn College.

The history of **William Beardmore & Co**'s locomotive building activities has similarities to those of Armstrong Whitworth described earlier. The company specialised in warships and ordnance, but in the peacetime following the Great War turned to locomotive work. The Dalmiur, Glasgow, works took up mostly new construction while the Parkhead shop was used for repairs and rebuilding. A range of Diesel locomotives was introduced about 1930.

Among engines produced in Beardmore's brief locomotive building career might be mentioned six 0-6-6-0 Mallet type superheated compound locomotives for Burma Railways, and 90 'Prince of Wales' class 4-6-0s for the London & North Western. Around 400 locomotives were built in the period 1920-1931.

In Kilmarnock the firm of **Andrew Barclay, Sons & Co.** originated in 1840. Andrew Barclay started as a tin and coppersmith but became a general engineer, at first in partnership with Thomas McCulloch. The firm served textile mills, ironworks and built colliery, winding engines. The Caledonia Works' first locomotive order came in 1859. The firm produced large numbers of mostly 0-4-0 and 0-6-0 tank engines of rather basic design for use by collieries, ironworks, contractors and the like both in Britain and abroad.

The firm developed the 'fireless' locomotive suitable for use in locations where there was a risk of fire, the 'boiler' being merely a pressure vessel filled with steam from a stationary boiler; 112 of these were built between 1912 and 1962. Among the later locomotives constructed were some Class 4 0-6-0s for the LMS in 1928, and ten 2ft 6in gauge 4-8-0s for the Sierra Leone Government Railways. The last steam locomotive was a narrow-gauge 0-6-2 for Indonesia, subcontracted from Bagnalls, in 1962.

Barclays successfully made the changeover to I/C engined locomotives, building its first in 1916. Most of the Diesels were of the shunting type for industrial use.

Although a moderately sized company, Barclays outlived the huge North British Locomotive Company, acquiring the goodwill, manufacturing rights, etc. after that company's closure in 1962. This proved to be a profitable acquisition, Barclay providing a spares service to former North British customers. Five years later Barclays took over the goodwill of John Fowler of Leeds. But things were reversed when, in 1972, Andrew Barclay, Sons & Co. became part of the Hunslet Group, and from 1989, Hunslet-Barclay. It remained the sole survivor of British locomotive builders.

Further reading

The locomotive building companies mentioned in this article include all the largest concerns, plus a few smaller ones of interest. There are many others that space does not permit including. J. W. Lowe's encyclopaedic British Steam Locomotive Builders lists over 500 firms, including the railway companies' own shops. Some of the company names mentioned in this article are still in existence, though mostly no longer trading.

In preparing this article the author has had to rely on what historians call 'secondary sources', though this incurs the risk of perpetuating errors, and minor inconsistencies are to be found between sources.

The author thanks his friends who have kindly loaned books for reference, and provided other useful items of information

1: Atkins: *The Golden Age of Steam Loco Building* (1997)

2: Cantrell & Cookson: *Henry Maudslay and the Pioneers of the Machine Age* (2002)

3: Warren: *A Century of Locomotive Building by Robert Stephenson & Co.* (1925)

4: Rolt: *A Hunslet Hundred* (1964)

5: Redman: *The Railway Foundry, Leeds* (1972)

6: Townsley: *The Hunslet Engine Works* (1998)

7: Hills & Patrick: *Beyer, Peacock, Locomotive Builders to the World* (1982)

8: Bradley: *Giants of Steam, the full story of The North British Locomotive Co.* (1995)

LETTERS TO A GRANDSON

M. J. H. Ellis

continues his investigation into how the length of the metre was standardised.

●*Number 86*

Dear Adrian, I ended my last letter with an account of the successful first attempt to relate the length of the metre to what, if one were disposed to grandiloquence, might be called the 'eternal verities'. In this instance they were the invariable wavelength of the red light emitted by the cadmium atom, and by implication, the constancy of the velocity of light. Incidentally, cadmium can also radiate on at least two other wavelengths in the visible spectrum; the green and blue. These were also tried, but subsequently dropped. My supposition is, that they offered no advantage over the red; but rather, because of their shorter wavelength, gave rise to closer fringes that were more difficult to count. A new ball had now started to roll, and in the light of these experiments, when the International Conference of the BIPM met in 1923 it considered that a wavelength definition of the standard metre would not only be desirable, it would probably be practicable.

In 1927 the General Conference gave qualified approval to the use of the cadmium red wavelength as an alternative to metallic bars as subsidiary standards, but did not venture so far as to dispose the International Prototype metre from its position of pre-eminence.

Enter the NPL

In Great Britain, the National Physical Laboratory had been founded in 1900, and housed in Bushy House, Teddington. It entered the scene in 1933 with a more sophisticated re-enactment of Michelson and Benoit's procedure. The first step was to produce an accurate end-bar, calibrated against the (line-bar) British replica of the International Prototype Metre. In cross-section, the bar had the shape of a cross. Its end-faces were not only flat and parallel they were also highly polished. As before, étalons were used, but in the form of Invar tubes. Like those of the bar, their ends were meticulously finished, and chromium plated. They incorporated an interesting refinement, in that they were machined with a flange close to either end, through which passed four straining-rods. Fine threaded nuts screwed onto these rods allowed the etalon to be compressed to a small extent lengthways, so permitting fine adjustment to its length and to the parallelism of its end faces. Just the kind of thing that brings I. K. Brunel to mind!

My interpretation

What I am going to tell you now is my interpretation, after careful reflection, of other peoples' accounts; and these, at times, are somewhat ambiguous, although I don't suppose they were meant to be. I believe that what I say is probably correct, but...

"I wouldn't want to swear to it on oath"

The reflecting surfaces that formed part of the étalons were those of 'semi-aluminized' quartz discs, which were so accurately plane that they could be wrung onto the ends of the étalon. I believe that these quartz plates were aluminized on one flat face only, that these acted as efficient mirrors, and when wrung in position, they faced one another, so that a ray of light would be reflected to-and-fro between them. My reason for thinking this is that the diameter of the discs was less than that of the flanges on the étalon, so that (1) light could not pass from one to the other outside the étalon, and (2) I can see no reason for the discs to be used with the reflecting surface to the outside, since that would imply that one étalon was always used in conjunction with another, and I don't think that that could have been the case.

Besides, we are told that the procedure was similar to that followed by Michelson and Benoit; but there was one important departure. The experimenters, Sears and Barrell, worked by stages up from the shortest étalon to the longest, but then came the clever bit. This time, the longest étalon was a little longer than the standard bar; by a matter of 6.5mm or so. While this étalon was calibrated, the bar was actually threaded through it. And now comes further evidence in support of my interpretation. Light *did* pass from end-to-end of the étalon, and it was able to do so, because it shone along the channels between the arms of the cross-section. When this had been accomplished, it was possible to remove the quartz discs from the ends of the étalon, and, by means of established interference techniques, to measure accurately the distance at either end between the plane end of the étalon, and that of the bar. The arithmetic needed to arrive at the length of the bar in wavelength terms was then so simple that I really do believe that, with a bit of coaching, even your Dad could be made to understand it.

The same procedure was used to determine the length of the standard yard in terms of the cadmium-red wavelength. Further work of the same kind was carried out in several different countries, until it was brought to an end by the outbreak of war in 1939. The average of nine independent results was;

One metre equals 1,553,164.12 Cadmium-red wavelengths.

This differed from Michelson and Benoit's original figure by only 0.13 of a wavelength, i.e., by less than a ten-millionth of a metre.

In 1948 the General Conference confirmed that in principle the metre could be defined in wavelength terms, but considered that it might be possible to improve on the use of the cadmium-red light. Finally, in 1960 the 11th General Conference defined the metre as:

1,650,763.73 wavelengths of the orange radiation of the Krypton-86 isotope in vacuo.

It was estimated that if the need ever arose, this standard could be reproduced to an accuracy of one part in a thousand million. At the same time the yard, which now found itself rather the poor relation, was defined as 0.91444 of the metre. By a happy compromise, this value was about half way between the previous British and US equivalents. In Britain, this figure was established legally by the Weights and Measures Act of 1963. So far as I know, nothing has been done about it in the US; but as the proverb goes...

"Half a loaf is better than no bread"

Postscript

In 1958 the laser was invented. Because laser light is coherent, (i.e., all the atoms emit light in phase with one another), it is capable of being used in interferometry over much greater distances than was possible previously. If such a thing were required, it is not impossible that it could be used to define a standard kilometre.

Finally, here is the most recent information which I can find from the National Physical Laboratory.

The Metre is the length of the path travelled by light in vacuum during a time interval of 1/299,792,458 of a second.

The second is the duration of 9,192,631,770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the Caesium 133 atom.

We have come quite a long way from Edward I's Iron Ulna. Phew!

The figure I have just quoted for the length of the metre comes from the fact that it is now possible to measure the velocity of light in vacuo as 299,792,458 metres per second. What a pity, that in 1791 no such degree of accuracy was achievable. Had it been, nothing would have been more reasonable than to define the metre as the distance travelled by light in 1/300,000,000th of a second. How neat! I'm sure the Legislative Assembly would have danced for joy.

"The road to Hell is paved with good intentions"

...so says the old proverb. I think it could just as well be said that it is paved with lost opportunities. I have just thought of an anecdote with which it would be appropriate to end this letter, but I don't think I would be able to finish it in the space which I customarily allow myself. But I won't count that as a lost opportunity, for I have every intention of using it to start my next one. There is a Spanish proverb which says...

"Tomorrow is also a day"

Your affectionate Grandpa.

WILFRID – THE TALE OF A LOCOMOTIVE

R. E. Furlong

describes his first experiences with steam in 7¼in. gauge courtesy of a Maxitrak locomotive kit.

I am new to the model engineering and railway world, and rather to my surprise I think that the tale of my journey so far might be of interest to others as a typical example of one of the many routes people travel. As a young man, amongst other things, I was entranced by model steam engineering and I spent much time poring over Bassett-Lowke and other such model makers catalogues and fantasising over an Emco Unimat lathe set up. However, thank heavens I had no facilities, and eventually reality triumphed and I put away all such thoughts in the interests of obtaining a secure and gainful livelihood.

After many years as I was approaching retirement, my younger daughter, an engineer, moved to Brussels after a spell at Westlands where she met the man she has recently married. In the meantime I met his father, who is 'potty' about 7¼in. gauge railways and went to a few events with him including Great Cockcrow and other similar layouts and a couple of exhibitions. As my interest was plain to see he one day said, *"You know, you want to go and have a look at Maxitrak, they are just down the road from you"*. So one day, out of curiosity I stopped off there, and I was hooked.

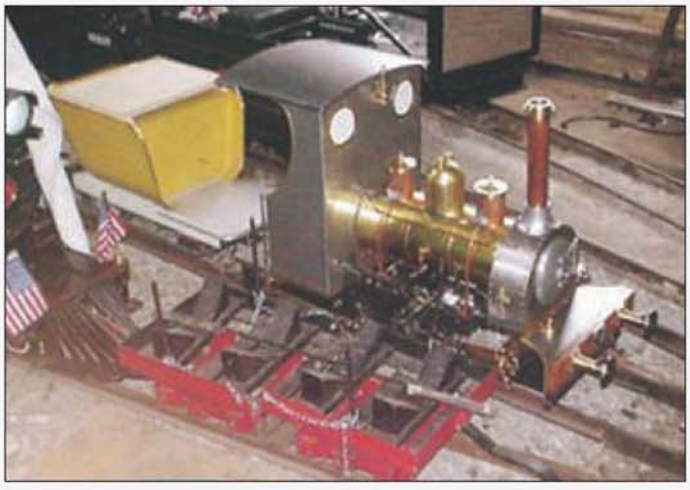
I decided that I wanted a proper, well-engineered steam locomotive and I was very impressed with their *Pearl, Opal, Dixie,* and *Sapphire* models. However, as soon as I saw pictures of their latest 1898 Hunslet narrow-gauge *Jack* I realised that it was in a different league from the others and it was love at first sight. Although I had already decided that 7¼in. gauge ground level was the layout I really wanted to join, the quality of this 5in. gauge locomotive was such that I nevertheless signed up for one, consoling myself with the conviction that I would have no difficulty in locating suitable 5in. gauge layouts, and I obtained an advance copy of the instruction manual which I studied carefully.

I knew of a local enthusiast with his own garden layout, and called on him, leaving a card in order to make contact. Out of the blue just before Christmas my wife and I were invited to one of his 'steam-ups'. I was so charmed with the whole thing that day that I came away determined that my engine had to be 7¼in. gauge. I sat up in bed all that night studying the instruction manual to see if my engine could possibly be stretched, and went down to Andy Probyn at Maxitrak first thing next morning to ask if this was possible. After some thought he said yes it was (which explains why it is now being offered as an option).

I have no previous engineering experience although I am reasonably intelligent in a workshop and fairly good with my hands. I have not hurried and was determined that the finish would be as near to perfect as my limited experience and facilities would permit. I took pains to clean up each part with files and emery paper before fitting.

I gave considerable thought to how everything would look and there were minor aspects of the kit which I decided to improve upon, which led me to acquire a second-hand Boxford lathe and take up metalwork. Consequently I started by turning up some brass collars for the braking linkage. I also thought that the water system and cab layout could be improved, and I wanted vacuum brakes. I gave the matter considerable thought and ended up with a through water 'main' from the well tank, by way of a stop-cock, to a solid brass water manifold with a stepped top face under the footplate to take the three stop cocks controlling the feeds to the hand pump, axle pump, and injector, with a rear connection to the stop-cock controlled tender tank. I must say that compressed air running at the intermediate stage acted as a considerable spur and convinced me that I could well end up with a viable steam locomotive.

I decided upon an improvement to the steam controls and ended up with a steam manifold of my own design. I found the basic appearance of the ▶



front end of the engine, although authentic, untidy and unsatisfactory. I therefore curved the side edges of the front apron and added brass trims, and designed my own buffers and buffer beams.

I have designed my own ride-on tender, which incorporates a stopcock controlled 4 1/2 gallon water tank, with overflow pipe for the axle pump return. The body was intended to be a derivative of a quarry-truck and was shaped from 3mm aluminium over a wood former for the curved bottom edges and rear corners by cutting out darts with a jig-saw. A local engineering shop welded the resulting shape for me, which I cleaned up with a file and which required remarkably little filling. The tender incorporates the actuating cylinder and reservoir for the vacuum brakes.

I have not rushed things and have other interests (notably the accordion) and construction has taken of the order of 12 months. When I started out I hoped for a project which would be interesting, enjoyable and somewhat of a challenge to my abilities, which would produce a locomotive of which I could be proud and whose appearance would always be a pleasure, and which would enable me to enjoy many years of 7 1/4in. gauge railways. It has lived up to my hopes so far and has enabled me to take the first tentative steps in model engineering with some confidence and purpose. I have found Andy and the others at Maxitrak unceasingly helpful, and one of the reasons for my being attracted to this hobby has been the friendliness and the helpful people you meet.

I steamed up for the first time, had my completion hydraulic and steam testing of the boiler carried out by Maxitrak, and made my first venture onto a track. I had difficulty in getting and maintaining adequate water in the boiler but nevertheless got in some running before having to pack up, but warts and all it was a most exciting experience. Naturally I was diffident as to how my efforts would be received by the experienced, mainly standard gauge railwaymen, however I have received many very kind remarks, perhaps the best of which *was "By 'eck but that's a cracking bit o' tackle"*.

I had accidentally punctured the hand pump feed pipe with a drill but found that my soldered repair leaked, so I replaced the offending pipe. When I mentioned to Andy that the axle pump was not working, he said *"Bring it in, I think we may know what is wrong"*. Too small a ball was fitted to the N/R valve, which had stuck in the nozzle, and a larger ball worked fine. A combination of no longer having air entrained in the water from the leaking hand pump feed pipe, and fitting a 90deg. turn-off stopcock with a 1/4in. feed right up to the injector, have produced an injector which now appears to work. Additionally, I fell for the little steam pump advertised by Bruce Engineering, and one is now neatly mounted on the right-hand frame behind the smoke box. I do not yet know how well it works, but what the hell, it looks a treat. Incidentally, I learned that mechanical lubricators have to be carefully set up if they are to work.

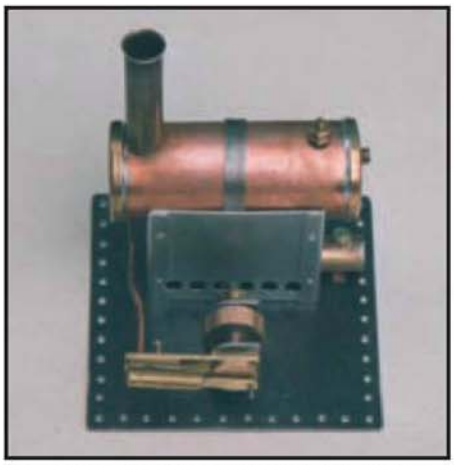
Essentially I now have more than one reliable means of replenishing the boiler when required, but so far it appears that Andy's advice (that if you set the axle pump by-pass valve appropriately this aspect would take care of itself) appears to be about right and my previous anxieties have now somewhat receded. I know that there are other ways of filling the boiler at firing-up but I would prefer to use the hand pump if possible, however this is a somewhat lengthy business. If all else fails when running I should wish for more rapid results from the hand pump and for these two reasons I am tempted to produce a more effective pump than that provided. This concern is no doubt beginner's nerves which I will doubtless overcome, to become laid-back about the problem like most that I meet.

I scanned a suitable photograph of a lamp identical to that which appears on the *Jack* maker's photo of 1898, reproduced it to scale and designed and made a pair of brass lamps of a similar character using spinning brass and super glue, and these have turned out as I hoped they would. In the near future I shall devise an appropriate alteration to the cab roof to improve visibility of the pressure gauge in particular, and the controls in general.

It appears to me that super glue and similar are dissolved by paraffin and I have found that the steamcock drain pipes are always coming adrift from the cock bodies. Also, the dummy sand pipes, which are stuck to the sand hoppers with such adhesives, are continuously falling off and I am looking at alternative means of fixing. I have removed the dummy lubricators which were either side of the smoke box as I did not favour the easily damaged pipework required to complete authenticity. Although the above comments might appear to resemble a list of complaints this is certainly not my intention, on the contrary, having reached the completion of the locomotive I am much impressed with the quality of the kit.

At an early stage I took the path of opting to finish and debug the engine before totally dismantling for painting, although I now think on reflection this was the wrong choice. However, I think it looks really classy as it is and for the present I do not propose to paint it.

I will admit that I now have thoughts floating around my head of tackling a plans and castings project at some time in the future.



The completed engine. British makers were not known for their bright paint work so the engine has been left unpainted. The flywheel could be picked out in colour if you wish.

BOWMAN

Marcus Rooks

introduces a delightful little steam engine based on a between wars toy design.

●*Part I*

After the Great War, British, especially English steam toy makers had a purple patch, existing firms flourished and many new ones were established. This was due mainly to an intense anti-German sentiment; which was understandable after the events of the previous decade. Prior to the Great War, German toy makers had a virtual monopoly of the steam toy industry in Britain. After the war there was need for ex-servicemen to be employed, so rather than import foreign toys the British public bought British toys made by British workers.

The term British and English are often incorrectly used. In the case of steam toys nearly all the toy makers were English (apart from Bar-Knight that was based in Glasgow) so English and British steam toys can be regarded as synonymous.

The most well known of these firms were Bowman/Hobbies and Wormar, based in Dereham, Norfolk, all made by Bowman; Mamod Models in Birmingham and, possibly the other most well known, was Mersey Models, based in Liverpool. They were characterised by solid construction and the use of British labour. Apart from their lack of realistic appearance they were far superior in construction than any of the available German steam toys.

Although christened Bowman our toy is an amalgamation of all that was good from these steam toys. The boiler is solid drawn brass or copper tube; the simple oscillating engine is supported on a steel and brass frame. It would not be difficult to make an exact replica of one of these engines.

Although a workshop and lathe will be needed to make Bowman, it is designed for the novice constructor to get their teeth into something. It can be a little daunting to tackle some of the designs that appear within these pages; we have Stan Bray to thank for producing some more modest designs!

Base

The base is an obvious place to start, being made from 1/16in or 16 gauge steel sheet, the overall size is 6in. x 6in.; the corners being nicely rounded. As this is a flat bed base some of you may wish to add some feet to the corners to raise the engine off the table. Sheet metal is a pain to cut to size, supporting it can be a nightmare. I used a workmate type of bench, which supported the sheet nicely and the hacksaw went very nicely into the central gap; better still find a supplier who will cut to size, much easier.

As far as marking out is concerned, mark the outline and then cut to shape. In this way the rows of holes can be quickly and accurately marked with oddleg calipers held against the edge. I find centre popping a series of holes quite daunting; in the end I do it by touch rather than sight. The centre punch is first given a good going over to make a really sharp point. It is then placed on the long scribed line at an angle of about 45 degrees and gently dragged along; you should be able to feel when it comes to the cross mark. Upright the punch and tap lightly, when satisfied the *coup de grace* can be administered. I would suggest using a very fine Swiss file to remove the raised edge around the centre pop as I find that the drill is often deflected from its true position by this rim. At this stage drill only one of the boiler fixing holes. The holes are 5/32in. at 1/2in. spacing. These dimensions were not pulled out of the hat but correspond to Meccano standards, in this way the engine can be built into Meccano based models. Nearly all the British makers made their bases like this, even today Mamod have their bases drilled accordingly, although Meccano (in Britain that is) has been long since defunct. Lightly countersink all the holes with a larger, hand held drill and you should end up with a very nicely finished base.

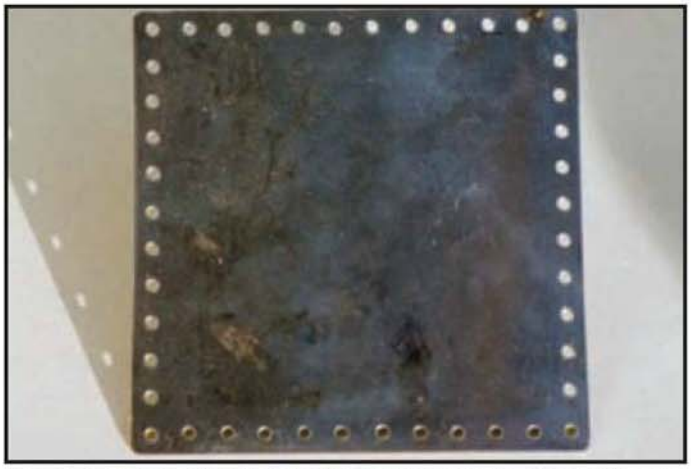
Geoffrey Malins, of Mamod fame started the manufacture of Mamod engines in his back garden shed. The bases were drilled in exactly the same way as we are doing now, except that he would clamp half a dozen or so together to save time. It is amazing what big trees from small acorns grow.

Firebox corner joint showing the neat pop rivets and brushed aluminium effect.

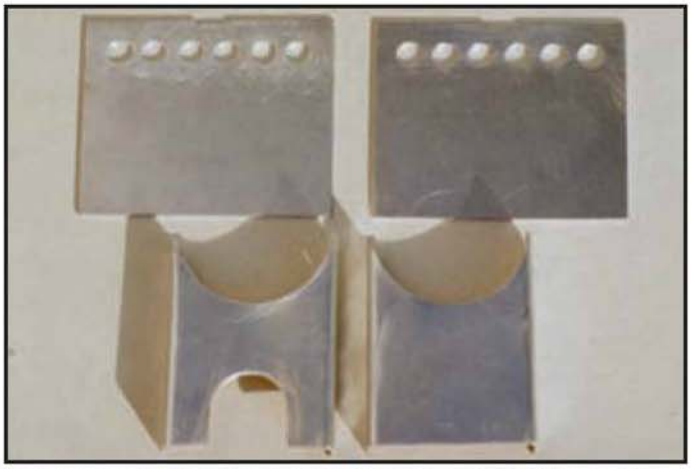
Firebox

The firebox is made from 18 gauge aluminium alloy sheet. "*Aluminium alloy*?" I can hear you mutter. Yes indeed and why not; although not in common use before the war, it became commonplace afterwards, I believe due to the perfection of the electric aluminium smelting process. Cyldon/ Rees engines were made with aluminium fireboxes and base-plates, so we will follow suit.

The aluminium will probably come with a protective plastic coat. At first sight this seems an excellent idea but after a while the drawbacks will become apparent, it gets tangled up with everything, so I think it better to remove from it



The first stage in making the base plate. The hole spacing is to the Meccano standard, which was used by the majority of makers.



The components for the firebox were made form aluminium alloy and have been cut, drilled and bent prior to rivetting together.

The Mersey Model design of safety valve. Note the soldered end cap to barrel joint level plug.

The SEL (Signalling and Equipment Ltd.) safety valve and level plug.

The Bowman safety valve and level plug.

the outset.

Mark out the shapes in the usual manner and cut to size noting that the opening for the burner is at one end only. When you assemble Bowman you will be able to arrange the opening as you wish, but there seems to be a convention that the burner is inserted from the right as you look at the toy. Being aluminium alloy it is very easy to drill and the 3/8in. dia. air holes are easily tackled; the smaller holes are for 3/32in or 1/8in. pop rivets. Once cut, deburr the edges and round off all edges with fine emery cloth and we are ready to bend. Protect the vice jaws with a suitable covering and line up the bending marks. On no account bash with a hammer, the material is far too soft so be warned. I used a piece of plywood between the metal and hammer. In this way a nice sharp bend was produced without marking the metal. The pieces should fit snugly together, make any adjustments now before rivetting. Once the firebox has been rivetted together place it on a flat piece of metal and adjust so that it stands without any rock. Aluminium is very soft so gentle hand pressure should do the trick, no need to get out the sledge -hammer!

Pop rivetting is a process that was not around between the wars; or was it? Modern steam toys have adopted the system and it works very well. You can pick up a complete pop rivetting set for under a fiver, really good value. What to do next? The boiler or engine, take your pick, I will first describe the boiler, which is a very simple brass or copper pot boiler with a safety valve/ filler.

Boiler

Obtain a 4 1/2in. length of 2in. brass tube, making sure that the ends are square. I trued them with a file but the traditional method is to place a bung in one end and chuck the tube with the bung supported in the tailstock.

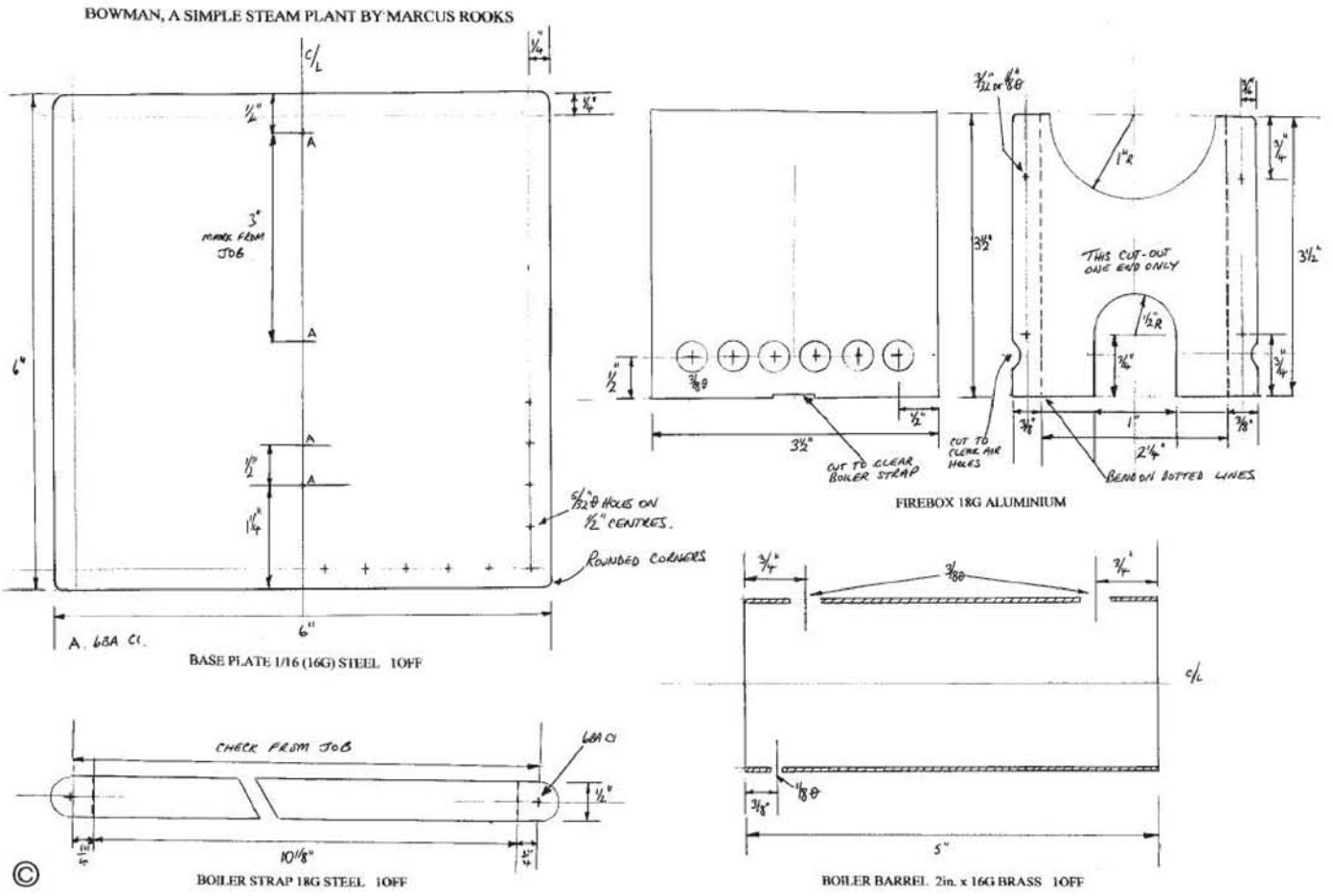
The holes for the dome and safety valve are popped and drilled 3/8in dia.; the 1/8in. dia. hole at the bottom is for the main steam line. The boiler ends are commercial brass stampings that fit a treat over the ends. One of these end caps has the water level plug and, as it is only about 18 gauge thick, an extra thickening piece of 16 gauge brass is soldered to the inside. The whole lot can then be drilled and tapped 2BA.

Before we progress any further, safety valves are an important feature of these steam toys, not so much because of their action, but their design is almost a fingerprint when identifying a model. All British valves were turned from solid brass and left polished; they were never plated like their German counterparts.

I have given the dimensions of a typical safety valve from Mersey Models, I rather like the Mersey Model design so I have used this on Bowman; you can use whichever takes your fancy. English valves rarely used a washer to seal the face but relied on careful fitting to achieve steam tightness. I have included some photographs of Bowman and SEL safety valves for comparison; you may wish simply to fit a Mamod safety valve.

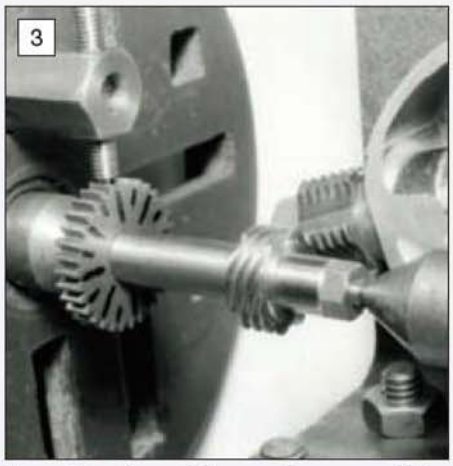
There will be more on this topic next time.

●*To be continued*



The finished gears made by the methods outlined in this article.

The special 40DP hob used to cut the gears - an item made for a previous project.



The cutting of one of the gears in progress. Note the method of indexing the eight starts.

CUTTING SPIRAL GEARS IN THE LATHE

Rex Swensen
from Australia explains his methods.

Some time back a start was made on the design and construction of a single cylinder, open crank 'gas engine'. While it was loosely based on the *Centaur* designed by the late Edgar T. Westbury, it was to be somewhat smaller with fabricated construction. Two essential requirements were identified. Firstly it had to have a 'side shaft' operating both inlet and exhaust valves similar to *Centaur* and secondly, twin flywheels with forward facing curved spokes. This configuration required a pair of spiral gears in a 2:1 ratio proportioned in size so that they would fit comfortably in between the engine frame and one of the flywheels.

Being a dedicated 'do-it-your-selfer' it was decided to have a go at producing these in the home workshop. The geometry of gears has always fascinated me and I anticipated an absorbing challenge. This is where the story really starts!

Spiral, or skew gears as they are frequently called, are really helical gears mating at right angles as shown in **fig 1**. The ratio between the two, as with all gears, depends upon the number of teeth in each. Strangely however, as we will see, the relative diameters bear little relationship to the ratio. The 'small' gear in the pair can in fact be the larger! The relative helix angles really dictate the relative diameters. The spiral gear pair may be thought of as a worm with, say, eight teeth mating with a helical gear of 16 teeth.

It was felt that the gears could be produced on the lathe by a thread milling process. Indeed a suitable hob was already available and this influenced the decision to have a go. A trial run was performed on an aluminium alloy blank and the results looked encouraging.

Hobbing process

At this stage we will make a small digression to look at a simple hobbing process. No, not the self-driving tap process which has frequently been described for making worm and wheel pairs, but a different technique for making spur gears. This technique had already been used to make a pair of 40DP camshaft spur gears for an earlier engine. In fact the hob was made for that purpose. The hob has a tooth form similar to a section of rack. The tooth sides are straight and inclined at an angle equal to the pressure angle of the desired gear. This is the same shape as a tool used for screw cutting a worm. The hob in my case has 6 rows of parallel teeth. Note that the teeth are not in a spiral but are separate parallel rows. It is perhaps technically wrong to call it a hob, which I think does have spiral teeth, but since it is used for cutting gears I will continue to refer to it as a hob. **Fig 2** shows the essential geometry. The cutting teeth were backed off by eccentric turning.

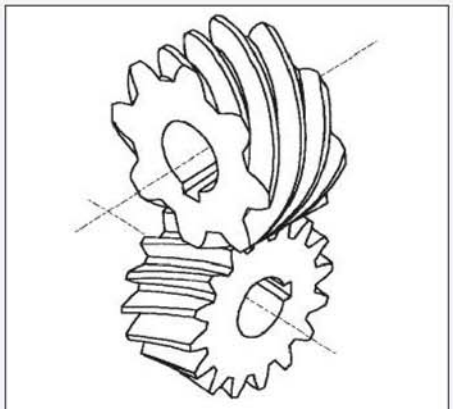


Fig. 1 Typical spiral gears

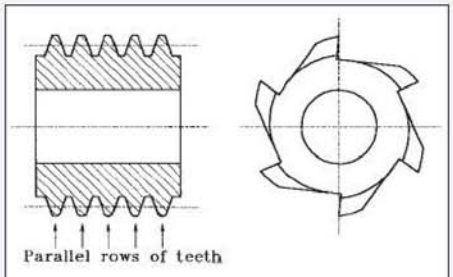


Fig. 2 Details of the hob

For generating spur gears the hob is passed across the face of the blank, the blank is then indexed one tooth and the process repeated. Consequently the tooth space is formed by several adjacent hob teeth in successive passes. The resultant tooth form has faceted flanks as shown in **fig 3**. Each facet is tangential to the true involute curve but it is faceted none-the-less and not a smooth involute curve as it should be. However the height of these 'peaks' are quite small. On a 40DP gear of 20 teeth they are only 0.001in. as shown in **fig 4**. Of course in gears with less teeth, it will be somewhat larger. Incidentally, the 0.001in. dimension was arrived at by laying out the geometry on a CAD system which makes a precise measurement possible without doing any sums. In practice, the bumps can be lapped off by running the gears together with some lapping compound. Of course, careful cleaning is necessary before the gears are put into final service.

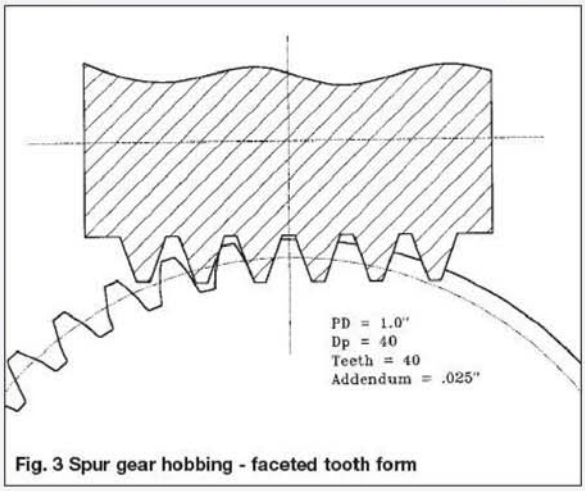
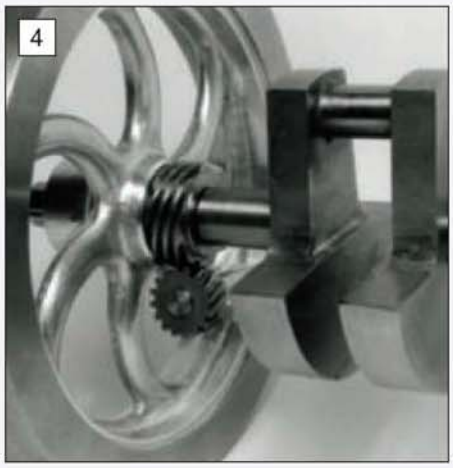


Fig. 3 Spur gear hobbing - faceted tooth form

In considering the spiral gear pair, it was felt that the hob could be used in a thread milling fashion to produce the teeth. While the teeth would probably be faceted to some degree, the lapping process has less to remove in this instance since the gears do not mesh across their entire tooth width. The product of this endeavour is shown in the **photo 1** along with the hob in **photo 2**.

The thread milling technique requires the hob to be mounted on a suitable spindle, which is orientated at the appropriate helix angle and driven by a supplementary electric motor. This rig is mounted on the cross slide, which is traversed along the lathe bed by the leadscrew as the mandrel turns. The drive is not applied to the mandrel but to the leadscrew, which is provided with a suitable handle. For the helix angles involved the leadscrew makes many turns for each turn of the mandrel so it is out of the question to drive it from the mandrel. Driving from the leadscrew means a sizeable reduction ratio. Because of the multi-start nature of the 'threads' being milled, some means of indexing the 'starts' must be provided. The actual thread milling was performed in several passes for each tooth. The clasp nut must not be released so the carriage must be wound back each time with the leadscrew handle. Also the backlash in the gear train must be taken up with an applied torque to the mandrel by the usual cord and weight technique. A four-stage reduction was used for one of the gear trains, so backlash elimination is of the greatest importance.

Now we come to the complication in this story. Yes, you have guessed it already - how to arrive at the optimum gear train of change wheels to achieve the required helix leads



The gear set fitted to the author's part built, free-lance internal combustion engine.

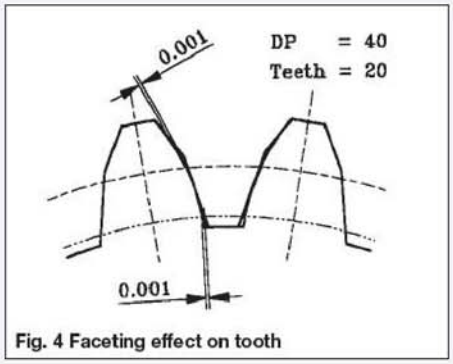


Fig. 4 Faceting effect on tooth

Leadscrew ratios

The requirement was for a pair of gears with a 2:1 ratio, shafts at right angles, and diameters in the vicinity of 0.6in. for each gear. The 40DP tooth size appeared to fit this quite well. So a worm of eight teeth (eight starts) and a wheel of 16 teeth appeared to be about right.

However I did explore the possibility of a 10:20 pair as well. As it happens, the diameter of the 'worm' can be of any size and only the helix angle will change. Any given helix angle requires the carriage to move a specific lead distance which in turn dictates the gear ratio required between the lathe mandrel and the leadscrew. Remember that the input motion is achieved from a crank handle on the leadscrew with a reduction ratio to the lathe mandrel via change wheel gears. My lathe has an 8 threads per inch leadscrew so that meant gear ratios ranging from 5:1 to 30:1 or so.

To arrive at the ratios required, a complex set of calculations must be performed. These involved helical gear geometry, helix angle, and helical lead, which finally yield the lathe leadscrew ratio required. The equations used were extracted from my reference library, and are shown in the box along with a worked example.

Of course there is only a finite combination of gears available so there is some juggling of numbers involved. The procedure goes something like this: -

1: Choose a suitable diameter for the 'worm' - say about 0.60 inch. This is the pitch diameter.
2: Calculate the helix angle and the helix lead.
3: Calculate the required leadscrew ratio.
4: Evaluate possible gear trains.
5: Choose a suitable ratio with minimum error.
6: Using this ratio recalculate the gear diameter and the helix angle.

Now this procedure is not too difficult given a scientific hand calculator which has sine and cosine functions, etc. However the evaluation of the many possible gear trains is very tedious. But here is where the real difficulty arises.

Helical Gear Equations
(ref: Design of Machine Elements by V.M. Faires)

Pd = Diametral pitch in plane of diameter
Pdn = Diametral pitch normal to helix e.g. 40
Nt = Number of teeth e.g. 8
Dp = Gear diameter at pitch circle e.g. 0.635in.
Lh = Lead of helix
Ha = Helix angle

Equations and worked example:
Dp = Nt/Pd = Nt/(Pdn*cos(Ha))

Ha = Arcos(Nt/ (Pdn*Dp)) Ha = Arcos(8/ (40*0.635)) = 71.641deg

Lh = Nt*π/ (Pdn*sin(Ha)) Lh = 8*π/ (40*sin(71.641)) = 0.6620in.

Leadscrew ratio = 8*Lh Leadscrew ratio = 8*0.662 = 5.2961

We must repeat the procedure for the driven gear, and this time we have no flexibility with any of the variables. The helix angle is given to us by virtue of the helix angle of the worm and the fact that the gears must mesh at right angles so the required leadscrew ratio pops out at the end of the calculation. It is unlikely that there will be a set of change wheels that yield the exact ratio required, so it is even more tedious trying out the various combinations until a set is found with an acceptably small error. If this is not achievable, it is back to square one and choose a different starting diameter for the worm.

Computer

Having worked through this process once to establish the procedure, a computer program was written to do the sums, which greatly speeded up the process. The main problem of course was to evaluate all possible combinations of gears in the change gear train. Since it was anticipated that the overall reduction required could be in the order of 30:1 it was necessary to use four stages of reduction. I have 11 change gears available in my set including two 20-tooth wheels. Since any one gear could occupy a place in any one of 8 positions, on the surface it would appear that there would be 11^8 possible combinations. This comes to 214 million.

Of course any one gear can only be in one place at one time, and there was no point in examining 'step up' ratios so a more refined approach was developed. In its final form the program evaluates 37,500 combinations of which 6,384 are in fact unique possibilities. It is highly unlikely that a perfect match will be found so the program selects all combinations that are within 3% of the desired ratio and sorts them into sequence. It is quite amazing how many are found. For instance in the area of 5:1 there are usually about a dozen combinations within the tolerance range. The situation is quite different in the 30:1 area where there are usually only one or two possibilities for a given analysis. If the error is considered too great, then the whole process should be repeated from a slightly different starting point by choosing a different nominal diameter for the worm. In hindsight it would have been better to design the driven gear first, which requires the larger reduction ratio for the leadscrew. The error would then be set to zero and the worm designed to match.

A variety of possible, spiral gear sets were designed although this is by no means an exhaustive list since there are probably infinite possibilities. The results from this analysis are shown in **table 1**.

Combination 5 in table 1 is at the limit of the gear ratio available with my change gears so it

Table 1: Possible gear solutions 8:16 teeth

Set	Worm dia.	Wheel dia.	Centre dist.	Error (%)
1	0.464	0.443	0.454	0.01
2	0.547	0.430	0.489	0.24
3	0.635	0.421	0.528	0.79
4	0.711	0.417	0.564	0.02
5	0.781	0.414	0.598	9.80

Spiral gear design for cam shaft drive	
Basic gear details:	
Diametral pitch	40
Tooth depth	0.054
Worm gear details:	
Number of teeth	8
New pitch diameter	0.635
Original pitch diameter	0.635
Outside diameter	0.685
Minor diameter	0.577
Helix angle	71.645
Helix lead	0.662
Lathe leadscrew turns	5.296
Lathe leadscrew gears: (65/20) x (40/30) x (55/45) x (1/1)	
Driven gear details:	
Number of teeth	16
Pitch diameter	0.421
Outside diameter	0.471
Minor diameter	0.364
Helix angle	18.355
Helix lead	3.991
Lathe leadscrew turns	31.924
Lathe leadscrew gears: (65/20) x (60/20) x (55/25) x (45/30) Error = -0.79%	
Gear centre distance = 0.528	

Fig. 5 Output from computer program

was out of consideration. The final solution chosen was set 3 even though the error of 0.79% was a bit on the high side. The diameter of the worm fitted nicely against the side of the flywheel. The printout for this computation is shown in **fig 5**.

Both trains must produce rotation in the same direction so an idler gear was inserted in the train for cutting the worm. The final gear trains were set up as shown in **fig 6**.

A photograph of the thread, milling-rig is shown in **photo 3** and the pair of gears so produced is shown earlier in Photo 1. The worm is in steel and the driven gear in bronze. The two gears mesh quite well, and after the frame of the engine is completed they will be run in *in situ*. I expect that they will have a long life in their rather docile role rotating, at a leisurely speed of about 1500 revolutions per minute. **Photo 4** shows the gears mounted on the crankshaft adjacent to the flywheel of the engine. It is also worth noting that this technique could also be used for making regular helical gears although it is doubtful if their performance would be better than equivalent spur gears, which are much easier to make.

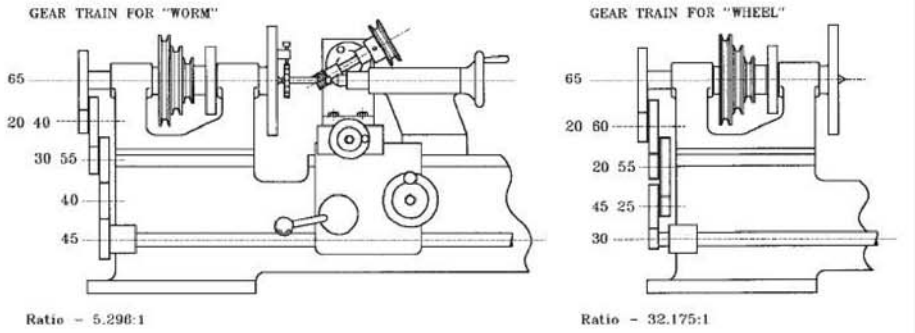


Fig. 6 Gear train set up for machining the two gears

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- **Engineer's Day Out**
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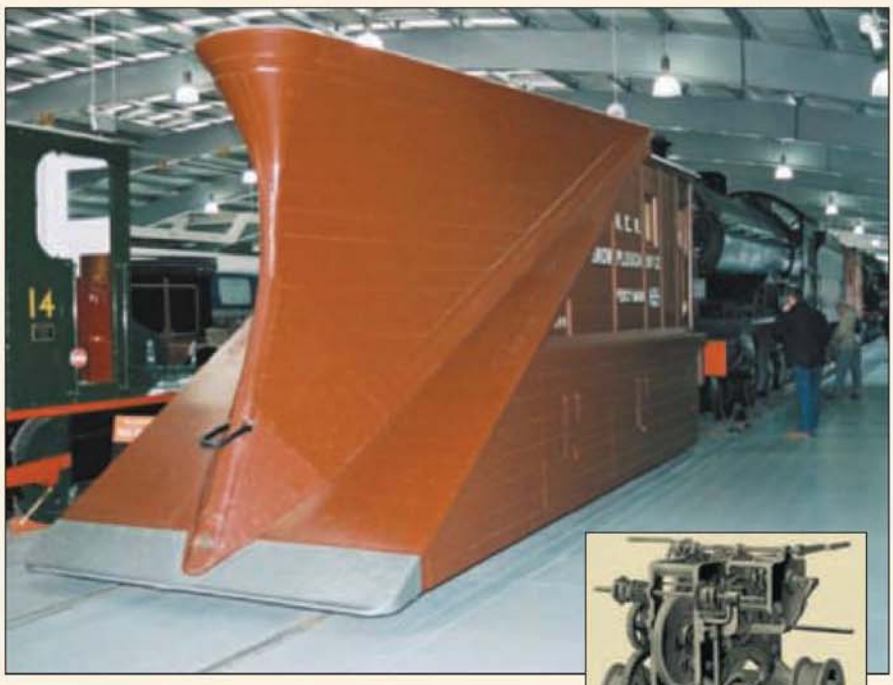

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KEITH'S COLUMN

LILLIAN
A NARROW GAUGE LOCOMOTIVE
for 7 1/4in. gauge

Keith Wilson

offers more observations on the theory of numbers before pressing on with the machining of the cylinders for *Lillian*.

●*Part XVIII continued from page 103 (M.E. 4265, 20 January 2006)*

In my recent notes on the fascinating subject of the theory of numbers, I inadvertently put irrational and transcendental numbers into the one group. I also missed out the 'imaginary' number. For there is much help in noting that only one of these is needed.

Imaginary numbers are things like square roots of negative quantities, which obviously do not (appear to) exist; for (-1) x (-1) obviously equals (+1).

But it came to pass that square roots of negatives had to be dealt with. If memory is correct, this came about from the mathematical study of alternating current electric motors. The square root of -1 had to be 'invented', P.D.Q. So it was decided that i (representing root -1) was defined as i squared equals -1. Some time later it was realised that i meant rotation through 90 degrees! It gets quite complicated, but only one imaginary number is needed; for root -25 for example is easier written as 5i. Also, easier to understand.

A missed keystroke, now corrected, reminds me that j is used sometimes instead of i. Also, if i becomes i squared, then the problem vanishes.

I do not propose to discuss 'magic squares', to any great extent; but numbers theory is one of the few (I only know of two anyway) where the 'ordinary' member of the public can help out, and sometimes beat, the big professional scientists. The other discipline is astronomy, looking for comets, etc.

But there is an intriguing problem, though it has probably been solved by now computer-wise.

There are no magic squares of the first or second order, (1 and 4 digits), and only 1 of the third order (9 digits). Just 640 of the fourth order (16 digits), and unknown numbers of 5th order (25 digits), and so on. How many of, say, the 8th order (64 digits)? I cannot even guess.

There is also the case of the Greco-Latin squares, these are squares of 16 or above (with the square root of the '16' number of different letters. No two identical letters may be in the same line, horizontal, vertical, or long diagonals.

Easy with 16(4) but gets much harder as the numbers get higher; in fact I read somewhere that it needed a computer to get beyond about 36(6). Don't know if it was true, but 'try 'em and see'.

Machining of cylinders (cont.)

It is easier to machine important exterior surfaces after the boring operation is finished, for you will then have something definite to work to/from. It is mainly counter-productive to try and locate something accurately from a rough, cast surface, for there is nothing to measure truly from. But with the bore finished, a perfect location point is created. It is quite simple to line-up surfaces from the bore, especially if you have a mandrel of the fit size. But it is easy to clamp a piece of smaller stock to the bore and measure from that. For example, if you want to get the frame mounting face exactly to the right distance from the bore (not fantastically important, within 1/32in. is adequate) then the cutter for the face can be precisely located from the bore using the feed screw dials, or with gauge blocks. These blocks are rather costly, but a close substitute is ordinary bright drawn mild steel.

So, for getting the mounting face 2.91in. from the bore centre, you want blocks to a total of 1.66in. (2.91-2.5/2). So a piece of 1in. plus one of 5/8in. plus a bit of 20 s.w.g. brass or steel will give you enough accuracy. It is of course more important that the bore and mounting face are parallel. Other surfaces may be located in similar ways.

Just discovered two intriguing problems regarding this machining. The cutting of the access ports at each end of the bores is one, and the drilling of the steam passages themselves are obviously closely connected, albeit needing somewhat different set-ups. It would seem at first that the two are identical, but nowt doin'.

The set-up for the access ports requires that the axis of movement is at right-angles to the centre of the cutter (3/8in. slot drill) whereas set-up for steam passages requires movement along the centre line of drill. Mutually incompatible, unless your vertical milling head has a 'quill' feed so that drill can be fed in along its axis. However, a bit of ingenuity solves matters neatly. Using some angle plates the matter can be solved, but one of the angle plates at least must be adjustable. Trouble is an adjustable angle plate can be set at any angle between 0 and 90deg., but not beyond these limits. However, in this case we need an angle of 104 degrees. Tricky. (Sigh) But with two angle plates, the matter can be solved. The adjustable one is set to 14deg., (not far off parallel). Then with the 90deg. one bolted to it, the 104deg. is then easily set. A combination square is most desirable.

For the access ports, the cylinder is mounted on a 90deg. angle plate. To get the angle between the centre line of the cylinders and the 'vertical' angle of the access port, the part of the mill that holds the slot drill is set to as near 45deg. to the milling table as possible. (I mention this because the swivelling part of my milling machine is graduated to plus or minus 50deg. but will not reach beyond 40 in one direction. However, it

Milling the steam access ports at one end of the cylinder. A universal vertical head is a valuable accessory.

Drilling the steam ports on the drilling machine using an adjustable angle plate in conjunction with a fixed angle plate.

Using a piece of bar to help ensure the cylinder bore is parallel to the top surface of the milling machine table.

The portable erection stand. On the top is the left-hand frame member with its cylinder and other parts.

Wilson's Words of Wisdom:
UFOs tell us nothing about intelligence elsewhere, but demonstrate how rare it is on Earth.
Arthur C.Clarke.

Left to right: The cylinder block including the floating gland cover, dummy piston rod and guide bar. A G-cramp holds the motion bracket in place and the cross-head on the dummy rod. A 3/4in.dia. pin is placed through the motion bracket to locate it on the frame. An O-ring on the end prevents the pin dropping through.

doesn't matter overmuch.) For this position it was necessary to use a long-series slot drill, but of course much depends on what machinery you have available.

When it comes to drilling the passages, the adjustable angle plate is set to 14deg. and the 'fixed' angle is mounted on top. With the aid of the combination set, the cylinder bore is set to 45 degrees. This brings the steam passage centre line vertical; so on the normal drilling machine all is well.

For those lucky enough to have a quill feed on the vertical head, the same setting can be used for both milling the access and drilling the passages.

Care must be taken to start the drills correctly - a deep centre pop is recommended. Take the drill (3/16in. dia.) in gently checking for depth, for if for some reason the drill misses the steam port and breaks through into the exhaust port you've got a problem, albeit not an insoluble one.

So keep a close check on the hole depth, if it exceeds about 2.25in. then be very careful. It might be necessary to re-set the cylinder and drill holes in the bottom of the steam port to meet up.

I am not well enough up on solid geometry to know just how much one angle will fare with another in the above set-ups, but sitting very much on the edge of my seat I took the first hole through gently; to the delight of both of us it broke through with a few 'thou' of where it should. The other two were drilled at the same setting - just shifting the whole system along about 1/4in. each time and holes came out without trouble. (Phew!! Long sigh of relief). Of course, due to the 'compound angle' matter, each of the three holes should be drilled at a slightly different angle. In practice however, as long as each one does break through (more or less, in the right place!) this tiny difference of angle is not important.

All went perfectly well for the first cylinder. But Nemesis struck! The first hole of the second block missed the steam port by a small amount, and ran into the exhaust port. When you consider the size of the target position for the drill to break through into, not perhaps too surprising. The cure is quite simple, part off a piece of metal (I don't think it matters what metal) about 1/4in. long and of a diameter to fit the passage. Push it down the passage until it clears the steam port but just shows in the exhaust port, and then put a few drops of Loctite 601 into the joint; this should cure matters.

After the above incident (oh dear, tut tut!) I reset the block onto the milling table, and took the steam ports about 1/4in. deeper. To avoid possible trouble with the port size, I used a 3/16in. dia. slot drill - adequate enough. Note that the 'other' angle i.e. between the centre line of cylinder to ditto of the valve rod is 14 degrees.

To fix the cylinders to the frames, it is easiest to locate cylinders by using a piece of steel - turned down in lathe if necessary - to go in the exhaust passage in the frames and cylinder. A couple of clamps (fairly hefty) will hold things in place for holes to be 'spotted through' and, as soon as the first hole is through, shove in a bolt and nut it up tight, same for second hole. Clamps *can* slip! (Do not ignore Murphy's Law!).

By now cylinder and frame make up a heavy and rather unwieldy assembly (understatement) so a portable trolley has its uses. The assembly can be rested on the top (where else?) and wheeled under the drilling machine. Etc. Etc. The top of this trolley is two strong steel rails (say 1.5 x 0.5) just 7 1/4in. apart, length about 5 feet.

Note that the exact location for the cylinders is not savagely important; it is sufficient for the bore to be dead horizontal - distance along is not quite so important for 'us'. A few 'gnat's whats-its' above or below centre line of motion is not utterly vital, for of course with a tank locomotive has a slightly variable centre line anyway.

Fore-and-aft misplacement can be allowed for in the exact length of the piston rod and exact length of the guide bar. Note that there has to be a lug welded to the motion bracket to support the rear end of the guide bar. I couldn't see a good way of doing this on the 'drawing board' (computer) but will see how it works out in the metal.

This reminds me of the time the chief draughtsman was a dishonest fool. Thus:-

"Keith. Ignore what the shop floor chaps say; just tell them what they've got to do."

This still strikes me of silly fooldom, for the shop floor chaps have the advantage of seeing it in 3D. This was before the days of computers of course. Another sin came up when the General Manager and I designed a particular invention. A patent was applied for, by crook rather than hook my name was omitted and the chief draughtsman got his in - although he hadn't a clue about this (or virtually anything else) and did nothing whatsoever for the design. But as can be seen in politics, a sufficiently dishonest fool can go a long way.

I left that firm a few weeks later. Surprised?

●*To be continued.*

CLUB CHAT
With Malcolm Stride

Before I get down to the real business this time can I ask contributors to check the address they use to submit items for this column and also please send all such items to the Editor. The reason for this is that information from newsletters is extracted for this column and also for *Club Diary* which is produced elsewhere so if items come straight to me then the information for the diary has to be sorted out and sent on thus causing delays.

Now I have got that out of the way, I would like to express my thanks to all those who regularly submit items for this column, without you all there would be no column.

UK News

Ashcombe Miniature Railway has had a successful term's activity with well-attended running nights and routine maintenance proceeding smoothly. Two members have left the society but have been replaced by two new members. This is a regular occurrence at this school-based society as members leave the school and new pupils get involved.

One society that features regularly in these pages is **Bournemouth DSME** and the latest newsletter contains a report on the 'Funlec' efficiency competition which was won this year by Peter Watson and John Ingram. Editor Richard Harvey reports that *"now number one son is fast approaching nine"* he decided to make the attic into a play room complete with Scalextric and a resurrected train set to which he has fitted modern digital controls. I wonder who spends most time up in the attic, Richard or number one son?

One of the benefits of being a member of **Crawley Model Engineers** is that the society premises are close to the route taken by the annual London to Brighton run for veteran cars meaning that members can watch the run and be within easy reach of coffee, tea and biscuits. The day seems to have been one for lots of reminiscing about working lives. The following Sunday John Wilks showed a connecting rod from his latest I/C engine project which is described as a twin-cylinder two-stroke in which one cylinder is used to charge the other with mixture. I think these are '*Clerk-cycle' engines*. Perhaps *Nemett* could have some information on this project?

In a note on the club insurances at **Guildford MES**, Tony Hills points out something that will apply to many societies. We all know that we are covered by insurance for public running days but what of the driver asked to give a ride to non members on a non public day, the answer is that the society is probably not covered for this and any claim may well be refused. Something for everyone to check, I am sure there are many who have given rides with the comment *"Ok but it is at your own risk"* assuming that protects them against any claims.

Harlington Locomotive Society has got rid of the builders and thanks to a grant from the local community trust now has an extension to the clubhouse which houses a new kitchen, toilet facilities and a baby changing facilities. I am not sure I should comment but in my own club the majority of the members are well past any need for baby changing facilities! The society also has a 200ft. twin track Gauge 1 layout and has already staged a rally for the gauge. This layout also proves popular on summer evenings. Other local funds have provided grants resulting in a new gazebo for use at birthday parties and a concrete workshop. The society is holding a visiting clubs day on Saturday 17 June 2006 and further information can be obtained from Peter Tarrant at 35 Warwick Road, West Drayton, Middx. UB7 9BZ or tel: 01895-851168.

This year marks the 70th year of existence of **Harrow and Wembley SME** and a few special attractions are being planned to mark the occasion. The society has organised a visit to the Ironbridge Gorge Museum and Severn Valley Railway at the end of March. The society carried over 9,500 passengers during 2005 and Mathew Byatt has produced some detailed statistics analysing the various running sessions.

Another society that had a very successful running season in 2005 is **High Wycombe MEC** who report that numbers were 20% up on the previous year. Alan Cooper has come to the end of his long-running series on building a *Sweet Pea* locomotive. This has attracted so much interest that consideration is being given to publishing it as a single booklet to be made available to other builders.

Chairman of the **North London SME**, Ian Johnston, has temporarily stood down following a successful hospital operation. His devotion to duty is such that he wrote his *"Chairman's Notes"* from his hospital bed. Ian is now back home and I am sure we all wish him a complete and speedy recovery. The November meeting was a 'Work in Progress' evening and one interesting exhibit was the partially completed Hawthorn Leslie steam railway crane shown by Ian Clifft. This is being built using spare parts from some 0 gauge locomotive kits.

Another society reporting a successful (record in this case) year is **Rugby MES** who provided 5,649 rides and 12 birthday parties in 2005. The locomotives doing all this work have benefited from the use of well water pumped into the tank on top of the container and gravity fed to the steaming bays and running tracks. Work is now taking place to fit two rolled steel joists to take the weight of the full water tank. I wonder who noticed that the roof was sagging. The society hosted the 7¼in. gauge invitation day in September with eight locomotives on the 7¼in. track and two on the raised track making for a busy and enjoyable day.

Saffron Walden DSME members were entertained with a talk on the history of canals and the part they played in the industrial revolution. At the same meeting Jack Setterfield demonstrated the use of a dead weight tester to calibrate pressure gauges.

A group of members from the **Society of Model and Experimental Engineers** had a trip

CLUB DIARY

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

MARCH

17 **Canvey R&MEC.** *Seen on the Table 1.* Contact Brian Baker: 01702-512752.
17 **North London SME.** *Gordon Massey: Steam in China.* Contact David Harris: 01707-326518.
17 **Rochdale SMEE.** *Annual Models Competition.* Contact Mike Foster: 01706-360849.
18 **Canvey R&MEC.** *Members' Running Day.* Contact Brian Baker: 01702-512752.
18 **York City & DSME.** *D.A.G. Brown: Loco Design using CAD.* Contact Pat Martindale: 01262-676291.
19 **Bedford MES.** *Boiler Testing.* Contact Ted Jolliffe: 01234-327791.
19 **Frimley & Ascot LC.** *Club Running.* Contact Bob Dowman: 01252-835042.
19 **Hornsby ME.** *Train Operations Day.* Contact Ted Gray: 9484-7583.
19 **Saffron Walden DSME.** *Public Running.* Contact Jack Setterfield: 01843-596822.
20 **Peterborough SME.** *Stan Bray: Photographing Models.* Contact Ted Smith: 01775-640719.
21 **Chesterfield MES.** *AGM.* Contact Mike Rhodes: 01623-648676.
21 **Nottingham SMEE.** *AGM.* Contact Graham Davenport: 0115-8496703.
21 **West Wiltshire SME.** *Dennis Chedgey: Early Mining in Radstock.* Contact R. Nev. Boulton: 01380-828101.
22 **Fylde SME.** *AGM.* Contact Alan Reid: 01253-882872.
23 **Cardiff MES.** *Boiler Testing.* Contact Don Norman: 01656-784530.
23 **Sutton MEC.** *Chat Night.* Contact Bob Wood: 0208-641-6258.
23 **Worthing DSME.** *David Tate: The Delights of Sussex.* Contact Bob Phillips: 01903-243018.
24 **Brighton & Hove SMLE.** *Mick Funnell: Archive Cine Films.* Contact Mick Funnell: 01323-892042.
25 **Brighton & Hove SMLE.** *First Trackday of the Season.* Contact Mick Funnell: 01323-892042.
25 **Cardiff MES.** *Steam-Up and Family Day.* Contact Don Norman: 01656-784530.
25 **Chesterfield MES.** *Public Running Day.* Contact Mike Rhodes: 01623-648676.
25 **Dublin SMEE Ltd.** *AGM.* Contact Colm de Br'n: (01) 868 2549.
25 **Hornsby ME.** *Family Day & Boiler Inspection.* Contact Ted Gray: 9484-7583.
25 **Tyneside SMEE.** *Track Work Day.* Contact Ian Spencer, 0191-2843438.
26 **Bristol SMEE.** *Public Running.* Contact Trevor Chambers: 0145-441-5085.
26 **Canvey R&MEC.** *Members' Training.* Contact Brian Baker: 01702-512752.
26 **Leighton Buzzard NG Rly.** *Mothering Sunday.* Enquiries: 01525-373888.
26 **Maidstone MES (UK).** *Public Running.* Contact Martin Parham: 01622-630298.
26 **MELSA.** *Sunday in the Park.* Contact Graham Chadbone: 07-4121-4341.
26 **Romney, Hythe & Dymchurch Railway.** *Mother's Day.* Information: 01797-362353.
26 **Steam LS of Victoria.** *Working Bee & Barbecue.* Contact Graham Plaskett: (03) 9750-5022.
27 **Bedford MES.** *Signalling Summerfield.* Contact Ted Jolliffe: 01234-327791.
27 **Hornsby ME.** *Meeting.* Contact Ted Gray: 9484-7583.
29 **Guildford MES.** *AGM.* Contact Dave Longhurst: 01428-605424.
29 **Hull DSME.** *Alan Dixon: Image Manipulation by Software.* Contact Tony Finn: 01482-898434.

round St. Paul's Cathedral last year and gained a lot of interesting information about the history of this famous London landmark first built on the site in 604 AD. A succession of disasters and rebuilds followed until the completion of the present building by Wren in 1710 following the destruction of the existing building in the great fire of London in 1666. In order to complete the painting at that time various fund raising ideas were put into place including a tax on all sea coal brought from Newcastle into the city of London. The boundary markers put up at the time still stand around the perimeter of the city. Another method to raise funds was to redirect funds from Westminster Abbey which process led to the phrase *"to rob Peter to pay Paul"*. History may not be taught much in schools but you can still learn it from this column! The society also had a talk on the design and construction of lifeboats by David Cox, curator of the lifeboat museum at Chatham.

St. Albans DMES boating members are happy that the small lake used for their operations is now starting to fill with water and is now at a level where boating activities can start again following the refurbishment. Further refurbishment of the Verulamium Park is also likely in the future.

"Well it's all over. Tables and chairs put away, food all eaten, empty barrels returned to the brewery. All that remains is a list of names in the visitors book and many happy memories of Model Engineers enjoying themselves driving their own or other peoples engines and commenting on everybody else's driving abilities". So starts the **Swansea SME** report on the 'Last of the Summer Wine Rally' which the society ran for the second time last year. The name came from the nickname of a group of three members who visited many events around the country and the rally was set up following a suggestion from one of the group who sadly passed away while attending an event. The report states that an organising team was selected by *"twisting various appendages until they said yes"*. I suspect that approach will be familiar to many readers. The event was very successful and finished with a barbecue in the evening which had so many takers that Chairman Colin Burrow had to resort to eating his meal using the Bridgeport mill as a table. The visitor tally was 21 steam, two electric and one I/C powered locomotives and more than 60 visitors signing in. The next event will be over the weekend of 30 September/1 October 2006 and further information can be obtained from Secretary D. Richards, 229 Dunvant Road, Swansea SA2 7SS.

World News

New Zealand

The highlight of the November meeting of the **Hutt Valley MES** was the demonstration of a home built CNC mill by Murray (sorry no surname in the report). A lot of the machine has been built from redundant photocopier and printer parts and as a result the stepper motors all have different parameters which complicated the design somewhat because the different responses had to be incorporated into the computer program that drives the machine.

Omitted from the last Club Chat due to space, Richard Niven on the way to winning the Edinburgh SME efficiency competition with his 3½in. gauge South African locomotive.

Successful seasons seem to be the norm these days; **Maidstone MES** is another society reporting that its 2005 operations have been conspicuously more successful than any year from the past 15 or 20. At the November general meeting, member Trevor Watt was elected a life member in appreciation of his long association with the society and his *"consistent, practical and invariably successful participation in club activities"*. May we tender our congratulations to Trevor on this award?

United States

The Latest edition of the *Whistle Blast* from the **New Jersey Live Steamers** contained the following from Gary Madinger under the heading *"A dozen things I've learned about live steam"*

"As an 8-year member of the NJLS, I guess I'd still be considered a newcomer to live steam. But, in my short time in the hobby, there are a few things I've learned. Here's my top twelve:

You don't need to own an engine to have fun, but it sure does help.

Like the real world, the world of live steam runs on coffee.

It is generally better to listen to those you ask for advice than those who volunteer it.

People will travel long distances to put a locomotive on a steaming bay and clean it.

The more urgent the need to see it, the smaller the water glass appears.

What can go wrong will go wrong, but usually there's someone who's had the same thing happen and can help you correct it.

Live steamers do not often sit in lawn chairs, but when they do they usually fall asleep.

If you are in a hurry, live steam is not the hobby for you - try racquetball.

You can spend thousands of dollars to buy a 2-6-0 locomotive from Bert Johnson and everyone will still always refer to it as Bert Johnson's Mogul.

The smaller the gauge, the more physical labour involved in moving it.

A good live steam story is worth retelling - over and over and over again.

Having the right tool for the job - critical: Having friends who are willing to share their expertise AND the right tool - priceless!"

It all sounds very familiar to me and I suspect to most of our readers wherever they are in the world.

30	**Cardiff MES.** *Bits & Pieces.* Contact Don Norman: 01656-784530.
30	**Sutton MEC.** *Derrick Sleave: Bee Keeping.* Contact Bob Wood: 0208-641-6258.
APRIL	
1/2	**Taunton Model Engineers Exhibition.** Heathfield Community School, Monkton Heathfield
1	**Glasgow & S.W. Rly Ass'n.** *Modelling Matters.* Contact Bruce Steven: 0141-810-3871.
1	**New Jersey Live Steamers, Inc.** *Work Day.* Contact Karl Pickles: 718-494-7263.
1	**York City & DSME.** *Bits & Pieces.* Contact Pat Martindale: 01262-676291.
2	**Bedford MES.** *Boiler Testing.* Contact Ted Jolliffe: 01234-327791.
2	**Bristol SMEE.** *Public Running.* Contact Trevor Chambers: 0145-441-5085.
2	**Canvey R&MEC.** *Public Running.* Contact Brian Baker: 01702-512752.
2	**Cardiff MES.** *Open Day.* Contact Don Norman: 01656-784530.
2	**Frimley & Ascot LC.** *Public Running.* Contact Bob Dowman: 01252-835042.
2	**Guildford MES.** *Maintenance Weekend.* Contact Dave Longhurst: 01428-605424.
2	**Plymouth MSLS.** *Start of Running Season.* Contact John Brooker: 01752-671722.
2	**Steam LS of Victoria.** *Public Running.* Contact Graham Plaskett: (03) 9750-5022.
3	**Peterborough SME.** *Chris Donaldson: East Anglian Air Ambulance.* Contact Ted Smith: 01775-640719.
4	**North Cornwall MES.** *Meeting & Maintenance Evening.* Contact Ray Reed: 01237-424254.
4	**Romney Marsh MES.** *George Barlow: Miniature Railways.* Contact John Wimble: 01797-362295.
4	**West Wiltshire SME.** *AGM.* Contact R. Nev. Boulton: 01380-828101.
5	**Bradford MES.** *Derek Coates: Tramcars & Trolleybuses of Bradford City Transport.* Contact John Mills: 01943-467844.
5	**Bristol SMEE.** *George Eycott: Claverton Pumping Station.* Contact Trevor Chambers: 0145-441-5085.
5	**Guildford MES.** *Talk.* Contact Dave Longhurst: 01428-605424.
5	**Leeds SMEE.** *President's Night.* Contact Colin Abrey: 01132-649630.
6	**Cardiff MES.** *Chris Rayward: LSWR Beattie Tank.* Contact Don Norman: 01656-784530.
6	**National 2½in. Gauge Ass'n.** *Spring Get-Together.* Contact Clive Young: 01233-626455.
6	**South Lakeland MES.** *Meeting.* Contact Adrian Dixon: 01229-869915.
6	**Sutton MEC.** *Bits & Pieces.* Contact Bob Wood: 0208-641-6258.
6	**Westland & Yeovil DMES.** *AGM.* Contact Gerald Martyn: 01935-434126.
7	**Aylesbury (Vale of) MES.** *Photo Competition.* Contact A. Rapley: 01296-420750.
7	**Brighton & Hove SMLE.** *Clive Groome: My Life in Steam.* Contact Mick Funnell: 01323-892042.
7	**Canvey R&MEC.** *M. Leahy: The Boiler Regulations explained.* Contact Brian Baker: 01702-512752.
7	**Maidstone MES (UK).** *Bring & Buy and Crumpet Night.* Contact Martin Parham: 01622-630298.
7	**North London SME.** *Mike Foreman: A Holiday on the Footplate.* Contact David Harris: 01707-326518.
7	**North Norfolk MEC.** *Bits & Pieces.* Contact Gordon Ford: 01263-512350.
7	**Rochdale SMEE.** *Bits & Pieces.* Contact Mike Foster: 01706-360849.
8/9	**Guildford MES.** *Boiler Testing.* Contact Dave Longhurst: 01428-605424.
8	**National 2 ½in. Gauge Ass'n (Southern Region).** *Spring Get-Together.* Contact John Cook: 0208-397-3932.
8/9	**Worthing DSME.** *Biannual Exhibition.* Contact Bob Phillips: 01903-243018.
9	**Canterbury DMES (UK).** *Public Running.* Contact Mrs P. Barker: 01227-273357.
9	**Leeds SMEE.** *Running Day.* Contact Colin Abrey: 01132-649630.
9	**Sutton MEC.** *Track Day.* Contact Bob Wood: 0208-641-6258.
10	**Bedford MES.** *Mechanical Music.* Contact Ted Jolliffe: 01234-327791.
10	**North Staffordshire MES.** *David Bradbury: Steam in Staffordshire.* Contact Stuart J. Daw: 17 Bedford Crescent, Clayton, Newcastle-under-Lyme, Staffs ST5 3EH.
10	**Melton Mowbray DMES.** *Ladies Night.* Contact Phil Tansley: 0116-2673646.
10	**Saffron Walden DSME.** *Club Night.* Contact Jack Setterfield: 01843-596822.

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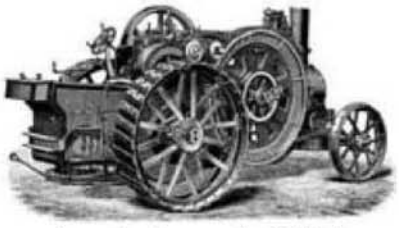

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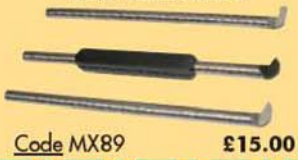

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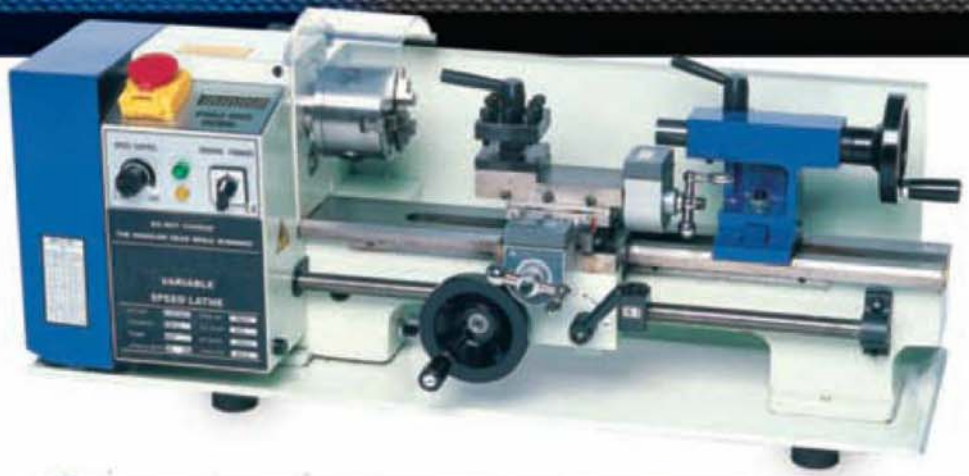

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