

MODEL ENGINEER

Vol. 201 No. 4335

26 Sept - 9 Oct 2008

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ON THE COVER...

A partially-assembled Aquilla 9-cylinder, sleeve valve aero engine was beautifully displayed at the Bristol Model Engineering Show. When Brian Perkins built one Aquilla, several years ago, he made some extra bits - enough for a second engine! This he displays in partially assembled form. (Photograph by Roger Bunce)

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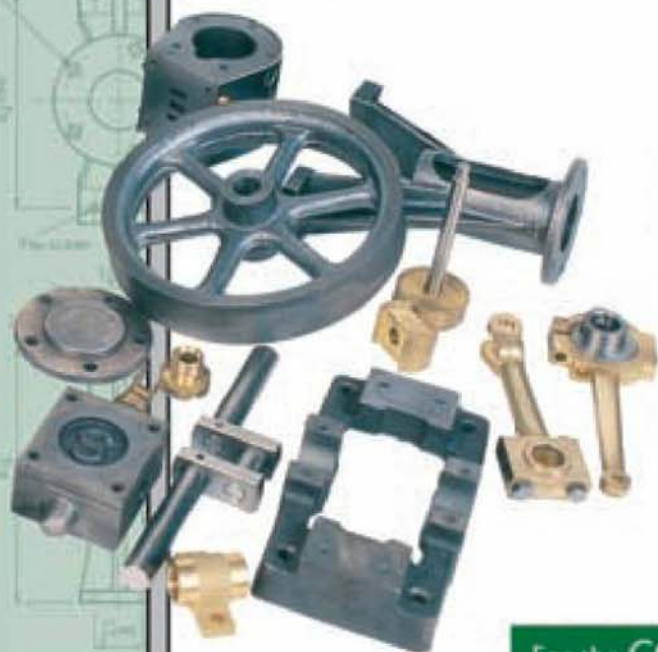
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The Miniature Locomotives of David Curwen

• Little & Holroyde • £11.40

Over a fifty-year period David Curwen has built almost 50 miniature locomotives, steam and diesel, designed three dozen more for other builders, as well as two miniature passenger liners. Not surprisingly he had little time left for record keeping, and his biography (below) is a tad short on details of all he had built, an omission which this book more than corrects. Here are details of every miniature (and one narrow gauge) locomotive David has had a hand in, plus details of the railways David's firm operated, and other additional material to David's autobiography. Together these books are an excellent record of the work of this most prolific of builders. 118 pages. 146 photos, many in colour. Paperback.

Rule of Thumb • Curwen • £13.95

David Curwen may be best known as a designer of miniature railway locomotives, but he served his apprenticeship in the garage trade in the 1930s, then maintained generating plant and steam cars. Along with the late Tom Rolt, he was the only other full-time employee of the Talylyn Railway when it first emerged in preserved form although, by then, he had already built some 10 1/4" gauge miniature railway locomotives and subsequently went on to design a whole range of steam or IC powered locomotives up to 15" gauge. This book of autobiographical reminiscences is written in an easy-to-read and humorous style, which reflects the man very well. 56 A4 format pages, full of B & W and colour illustrations. Paperback.

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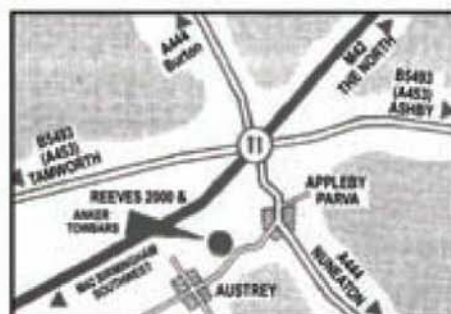


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- The image displays three magazine covers from the 'Model Engineer' series. The central cover is white and features a blue and orange motorcycle model. The left cover is red and features a steam engine. The right cover is purple and features a model of a person. All covers have the title 'MODEL ENGINEER' at the top.



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There is nothing more disheartening than taking a phone call from a model engineer who is looking for his stolen model. It doesn't matter that it might have been purloined a month or several years ago, people still keep looking, ever hopeful. While I was unable to help in this particular instance, it is worth reminding readers that there is a lost models directory which at least offers a central location to register these models and get some photos on the web. The Lost Models Directory W. www.modeleng.org/lost/lostmain.htm

Don't forget to take photos of your model from all angles. Note its distinguishing features (dare I say blemishes?) and photograph them, too. Also, find a way to mark your model indelibly (discretely) so that its ownership is not in doubt if recovered. Occasionally models are recovered, as a search of the website will show, but sadly not nearly often enough.

5th Cologne Live Steam Meeting

After the end of this year's outdoor traction engine rallying and railway running season with its numerous events (and excessive rain!), an indoor event sounds like a nice break. Model engineering is actually a very international activity and model engineers, steam enthusiasts and model train

1. Indoor running on the Sinsheim track will be a big attraction at the 5th Cologne Steam meet. Weather is never a problem inside.

2. Tinkering with an engine to get it to run a bit better. Although mainly steam focussed, the exhibition does have some unique I/C engines running, too.



fans might consider attending the 5th Cologne Live Steam Meeting at the Cologne Exhibition Centre from the 6 - 9 November 2008.

The biennial Köln Echtdampf-Treffen (it's official name in German) has four days of live steam activities. On several kilometres of indoor track (yes, the one from Sinsheim), steam locomotives and trains of all kinds will be creating an memorable, smokey-steamy-noisy atmosphere (**photo 1**). Driving through the exhibition aisles will be many traction engines, some offering rides. If you hear a whistle or siren, pay attention, you might be in the way!

Individuals and clubs add to the event's interest, too, with their numerous stationary engines working on real steam. Even some I/C engines are run, too (**photo 2**)!

On the boating pond dozens of steamboats and ships will be operating nearly all the time.

This event is also a good chance to discuss things with the numerous engine and boat builders, a surprising number of whom speak English - just ask.

The continental model engineering market is large and in the exhibition you'll find the smallest metric nut or bolt right up to complete, ready to go steam locomotive models.

Cologne can be reached by train from London by taking the Eurostar to Brussels and changing to a German 'Thalys' service. Special connecting fares to other cities in Britain

are available. The city's transport links are excellent and there are plenty of hotels in the city and near the exhibition centre.

Alternatively, you can drive to Cologne in a day from parts of southern Britain and flying to Cologne Bonn Airport is possible, too, from Edinburgh, Manchester, East Midlands, and various London airports.

Organised as a cooperative venture between the KoelnMesse and Messe Sinsheim GmbH (the well-known organiser of largest indoor steam meet) this event is held jointly with two other events: the International Cologne Railway Exhibition 'Modellbahn', and the creative exhibition 'Mein Steckenpferd' (roughly translated as 'my special craft/hobby': it's a crafts fair). The combination of these three events, plus our past experience visiting the Sinsheim Echtdampf-Hallentreffen, means a lot of families will attend, possibly introducing the next generation of model engineers to the hobby.

The Cologne Echtdampf-Treffen takes place at the Cologne Exhibition Centre (Koelnmesse) at the same time as the International Railway Exhibition (Modellbahn) and the creative crafts fair 'Mein Steckenpferd'. All three events are open daily from 9am to 6pm on just one admission ticket: Adults, €10; discounted tickets, €8. Children up to six, just €2 for all the events. **ME**

Where's Blue Star?

SIRS, - Back in October 1968 *Model Engineer* carried the first of three articles, by Neil Simkins, Richard Coleby and Bill Devitt, describing the construction of a 3½in. gauge Southern Merchant Navy class locomotive. The locomotive, named *Blue Star*, was uniquely built with the Bulleid's chain-driven valve gear and oil sump. The locomotive was finished in Malachite Green, and steamed occasionally at the Urmston track, Birmingham. However, a year or so later it was sold at auction in London to provide funds for the next project.

Now 40 years on, can any readers please shed light on where this locomotive is now, or any places on its journey over those years?

Rob Speare, by email.

Paternoster engineering

SIRS, - Does anybody have information about an old German engineering company called Paternoster? My father worked at a small printing firm early in the 20th century and spoke of a small press made by this company.

Paternoster is also mentioned in the screenplay of the early silent classic film *Metropolis* where it refers to the type of "never stop, step on and off" passenger lift used in continental buildings. I have seen one of these in an office block in Hamburg. This might make a good subject for an unusual model!

Richard Clifton, Isle of Wight.

I spent the first 15 years of my working life at Brush Electrical in Loughborough and recall that the technical college there had such a lift (in the 1970s I think). Students seeking excitement would apparently stay on past the top floor and be carried over the top to come back down. MLS

Cleaning a model

SIRS, - I am retired now but in the 1930s I collected and still treasure copies of *Model Engineer*.



Edward Steward's steam engine needs cleaning.

From those days I have a model steam engine that was part of a model crane.

As you can see in the attached photo, it is very grimy, and short of taking it to pieces and rubbing it down with emery paper I don't know how best to clean it: it resists turps and WD-40. I would be very grateful if any readers could advise me.

Edward Steward, London.

More Mickey Mice

SIRS, - With regards to Peter Rich's excellent article on *Mickey Mice at Newport (M.E. 4328, 20 June 2008)*, this reminds me of the gripping stories told many years ago from the Bury St. Edmunds engine shed. I had the privilege to know several ex-engine men at Barber Greene in Bury St. Edmunds and I knew many men from the Bury St Edmunds shed situated on the Cambridge to Ipswich line, with branch lines to Thetford and Marks Tey.

These were ancient Great Eastern tank engines (such as Claude Hamiltons). The most modern locomotive stored at Bury St. Edmund's, was the 2MT Tender locomotive, which was known as *The Moby Dick* by the Bury engine men. This engine could be seen hauling sugar beet trains from local stations into Bury sugar beet factory and replacing the J15 on the Melford Flyer. This engine was very popular with all the footplate men.

At Barber Greene, the men I knew had been made redundant from the railways

and worked as assembly fitters. Sadly many of them are no longer with us, although the man who told most of the historic stories is still alive and he is in his 70s. His name is Ron Barry and until being made redundant from the railways he became a full-time driver and drove the local expresses. The last and most impressive story of the standard BR2MT Tender engine was the Clacton Butlin special.

Every Sunday in the late 1950s, and engine was sent from Bury, via Melford, Mark's Tey, and Colchester, to Clacton. It would then take the Butlin special cross-country past Mark's Tey through Sudbury, Clare and Haverhill, through to Cambridge, where they would change engines. The engine used was a K3 and it was a very powerful engine compared to the BR2MT. On this particular Sunday the crew on the K3 were driver Frank Bailey and fireman Ron Barry. They arrived at Clacton and coupled on to 18 bogies (or coaches) to take it to Cambridge on the cross-country route, where the destination was Birmingham. The train was then split and the second half of the train went on to Manchester.

After an uneventful trip to Cambridge the train was uncoupled to take a local train from Cambridge to Ipswich. The 2MT was then reversed onto the Butlin special. Driver Bailey and Foreman Barry were most impressed when the 2MT

Write to us

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stormed out of Cambridge station with the Butlin special behind it. I have heard the story many times from driver Barry and I am never tired of hearing it.

Joseph Ollett, by email.

Steam velocity (1)

SIRS, - The following information may be of some help to Mr. R. F. Parson's queries about flow through nozzles in turbines (M.E. 4330, 18 July 2008).

1) The formula to calculate the adiabatic expansion of steam through a nozzle is:

$$V = [2 \cdot g \cdot (n/(n-1)) \cdot 144 \cdot P_1 \cdot V_1 \cdot (1 - (P_2/P_1)^{n/(n-1)})]^{1/2}$$

where:

- V = Velocity in ft/sec,
- P₁ = Inlet pressure pounds per square inch absolute (psia) = 215 psia,
- P₂ = Outlet pressure = 0.93 psia,
- V₁ = Specific volume in cu.ft/lb = 2.136 (ref. 1) at 215 psia,
- n = Ratio of specific heats C_p/C_v.

For steam where most of the process occurs in the wet region n=1.135 (ref. 2) and when the steam is dry n = 1.3. Substituting these values in the equation above gives:

For wet steam: V = 4,121 ft/sec = 2,817 miles/hour, which is near enough to the 2,814mph quoted by Mr. Ron Isted (M.E. 4323, 11 April, 2008) and for dry steam: V = 3,270 ft/sec = 2,230 miles/hour although these values will be reduced by friction in the nozzle by some 10%.

2) Using the website <http://www.twt.mpei.ac.ru/MAS/worksheets/wspWPT/mcd> to calculate the speed of sound in steam gave the following result:

At 215psi and 100deg.
C: 1,547.71 metres/sec
= 5,077.78 ft/sec
= 3,462.12mph.

Skeleton clock suspension

SIRS, - I have been following the John Parslow 15-day skeleton timepiece articles with great interest as I had bought his book last year, made the clock but could not get it to keep going. I have made a number of clocks successfully in the past using John Wilding's designs so have a good grounding in what makes a clock tick!

In John Parslow's concluding article he says that if the clock will not run, the most likely cause is the escapement adjustment. I have checked this as well as the pivots. All seems well. I then looked more closely at the picture of the finished clock on page 203 (M.E. 4332, 15 August 2008). The suspension spring is not the same as supplied by Cousins Material House under their part number 070 S5553, which was the part number quoted by John Parslow in his materials list (M.E. 4322, 28 March 2008).

The suspension spring as supplied has an exposed spring length of 3.00mm, the suspension spring in the picture appears to have a much greater exposed spring length. Could this be the reason that my clock will not keep going?

I would be most grateful if you could get to the bottom of this problem.

Beris Bowen, Norwich.

John Parslow responds:

Thank you for your e-mail regarding Mr. Bowen's problem with his clock. I have just spoken to him and he is quite right. I made two of these clocks one in 1998, the other a couple of years later, both fitted with suspension springs supplied by Cousins under the part number quoted in the manual. Looking at the Cousins catalogue for 2006 the correct spring is now specified as Clock Suspension No 6, part number S5516. The 070 bit in the original part number seems to have disappeared. I can only assume that Cousins have changed their numbering system. A similar problem occurred with M&P who supplied two different mainsprings under the same part number. I will phone Ian Cobb to ensure that he supplies the correct suspension spring.

John Parslow.

3) Flow through a nozzle can be supersonic and a very concise explanation of the flow up to and beyond the sonic velocity is given in the following website: <http://www.engapplets.vt.edu/fluids/CDnozzle/cdinfo.html>

References

1. *Mechanical World Year Book* 1960, p238, Emmot & Co. Ltd.
2. *Heat Engines* p292, Moorfield and Winstanley, Edward Arnold (Publishers).

David Lockley, Hampshire.

Steam velocity (2)

SIRS, - R. F. Parsons states in his letter (M.E. 4330, 18 July 2008) that a gas cannot move faster than the speed of sound. The muzzle velocity of a gun can be 1,800m/s, over five times the speed of sound. We have supersonic wind tunnels and

I presume the velocity of the gas coming out of the turbine nozzles of Concorde must have been well above the speed of sound, otherwise it would have left its exhaust behind. The exhaust gas velocity of even a model gas turbine is well over 1,000mph. I think the writer is getting confused with the speed of sound in air and shockwave propagation etc.

Colin Usher, Cheshire.

Profile cutting

SIRS, - I was interested to read of David Piddington's difficulties with moving from a pencil drawn profile to something that can be interpreted by the latest profiling machinery (M.E. 4331, 1 August 2008).

What I have done in this situation is dust off my old flat-bed scanner and import the

'picture' so made onto the face of the 'plate' in my 3D model. Then, I select the option of developing an open spline and trace the outline of the imported 'picture'. I find it useful to draw a succession of splines and particularly find it useful to end one and start another where a sharp corner is required. When I have a complete profile, I can extrude the cut so producing a solid model to the shape of the pencil drawing, warts, blended curves and all.

From the model, a drawing is produced and this I then 'save as' a DXF file (xxxx.dxf). This is all the machine needs as this format is the basic and universal code. My understanding is that DXF stands for Drawing Exchange Format, or something similar. I hope this helps.

James Buxton, Shropshire.

Titanic (1)

SIRS, - I'm sure you'll have had thousands of emails from other folk regarding the article about the *Titanic* (M.E. 4330, 18 July 2008). The Merseyside Maritime Museum has the original builder's model of this ship which is apparently around 20ft. long. It is currently on display in the museum at the Albert Dock in Liverpool. See the maritime website for further details.

One of my friends tells a funny story concerning this model. In the late 1970s, or early 1980s, he was asked to transport this model on the rear of his lorry from Liverpool to Belfast for an exhibition. Having boarded the ferry to Ireland, he then went down into the truck driver's canteen and started to chat with other drivers. As usual, they got round to discussing what each was transporting and when he said he had the *Titanic* on board, quite a few of the other driver wanted to disembark. They did not want to travel with such an ill-fated ship, even in model form!

Many thanks for a wonderful magazine, can we have a few more articles on railway signalling. One never knows, I might even get round to writing one.

Brian E. Eves, SINCS Engineer, LNE North East.



Die tolerances

SIRS, - Since reading the correspondence (M.E. 4327, 6 June 2008) on the subject I have been reluctant to comment since I am acutely aware that technicalities enshrined in British Standards 1127 and adopted by high-class manufacturers do not necessarily bear much relationship to what is actually lying on the bench. In this context my guess is that for many model engineers there will be a motley assortment of dies from a range of suppliers and of uncertain vintage. Furthermore, it is likely that dies of the same diameter will not all be of the same thickness. This immediately poses a problem in relation to the dimensions of the die holder. However, worse is to come, so let's get the shock over at this early stage. Precision split dies in their relaxed state are designed to cut the correct full diameter and are not intended to be expanded. Moreover they should be a sliding fit in the holder. The reason for this is that the relief on the cutting edge is very small and any slight expansion of the die results in rubbing. Another revelation is that the lines of the detents, whilst making a right angle between them do not meet at the centre of the die but slightly higher in respect of the split and on its centre line. BS 1127 is quite specific on this point and the reason is to minimise the shift of the centre when the die is compressed.

This leads to the question of die holders and how they should be used. Being cynical, most of them should be thrown away. A decision can be made on the following basis.

Remove all the adjusting screws, insert a high quality, precision die and examine the relationship between the threaded holes and the detents in the die. Assuming that the die is correct, throw away those holders where there is a mismatch. If you have any holders left, prepare two long setscrews with the appropriate threads and with ends tapered to a point and screw them into their adjusting holes. Hold your breath and see if any of them meet in the middle or thereabouts. Misalignment of adjusting holes with detents will inevitably affect the geometry of the die, usually skewing it out of plane, and this can have a major influence on the accuracy of the thread produced. The metal used for the die is not at all indicative of its quality. An older carbon steel die from a reputable manufacturer can often be better than a HSS die from abroad but the recent trend in quality dies is to make them from high chromium steel.

Thus far it would seem that the major faults lie with the holders but what of dies that are not classified as 'precision'? Whilst British Standards are specific about all outer diameters they are much more relaxed about thicknesses, slots and entries; leaving the manufacturer to decide. This is not good news when mating with a precision holder.

One further issue is the matter of the entry cone. Dormer tell me that it is desirable for the length of the cone (technically a frustum) to cover one and a half thread pitches and that because of the stepwise relationship between thread pitch and thread diameter the angles of the entry are slightly variable and only approximate to 45 degrees. This becomes significant when considering the angle of the work-piece to achieve maximum stability when starting the cut.

In conclusion, it must be said that threading with split dies can be as bad or as good as one cares to make it but there is a limit to perfection beyond which the use of die boxes and machine threading in the lathe has to be considered. To get the best from a split die, use a high quality die in a high quality holder and preferably constrain it to 'float' normal to the work-piece which should have a machined 45deg. taper. Despite appearances, split dies are single point cutters and the work-piece should be held as firmly as possible. A short tapered work-piece helps.

Martin Humphrey, Herts by email.

Titanic (2)

SIRS, - I have read of the giant new model of the *Titanic* (M.E. 4330, 18 July 2008) with great interest, but am intrigued by one detail; all her funnels are of the same height.

Close examination of any good photographs with the help of a ruler will show this not to be the case.

I was told by the late John H. Isherwood, a respected marine historian and lecturer at the School of Navigation that the vessel's two centre funnels were extended by about 5ft., solely to enhance her appearance.

Photographs of her sister ship, *Olympic* completed at Belfast some 10 months earlier show that her funnels were also raised.

If this alteration was not on any of the amended plans of either ship, then it was probably carried out unofficially. I suspect one of the draughtsmen must have had a classical education and was thinking about rectilinearity.

Curiously, the third of the sisters, the *Britannic*, had all her funnels the same height.

Mark Bedford, London.

Westbury road roller castings

SIRS, - I would like to build a working model of the I/C engine-driven road roller by Edgar Westbury as published in *Model Engineer* in 1938. I have copies of the drawings; can anyone possibly put me in touch with anybody who has castings or patterns for this project?

Keith Williamson, Kent.

Ratty email?

SIRS, - I think I may have some bad news for the **Model Engineers Society of Northern Ireland** about their water rat (M.E. 4331, 1 August 2008). Here in Birmingham and the Black Country we have one of the last remaining strongholds for the water vole, best known as Ratty the water rat in *The Wind in the Willows*. Now Water voles are fine, educated creatures with the good manners to dine on grass and willow leaves, not like the

scurrilous vermin that keep pirating our bantam eggs!

Now while I can see that Tom Reid enjoys messing about in boats as much as dear old Ratty, the bad news is that my understanding is that there are no water voles in Northern Ireland. In fact his photo highlights the cheeky culprit's big eyes and pointed nose - very much a rat rat, not a water rat!

Mind you, if they really are taking an interest in model engineering, perhaps the Irish have a better class of rat?

Neil Wyatt, by email.

Propane firing

SIRS, - Martin Ranson (M.E. 4331, 1 August 2008) finds some variation in the gas from mixed butane/propane cylinders, and wonders if the two liquefied gases settle out.

No, they don't: they are completely miscible and shaking the canister won't do any good from a mixing point of view. (Though it may raise the pressure in the can due to increasing the inward heat transfer from the can wall, which is being warmed by the hand). Variations from can to can are probably due to less-than-accurate blending at source.

The reason for the variation in gas quality, when fed to the burner, is the different volatility of the two components. Checking the internet showed a usual butane-propane mixture to be about 20% propane. I assume this is %w/w as liquefied gas is normally sold by weight. That being so, if Raoult's Law, relating the partial pressure of the vapour to the liquid phase concentration, applies (a not unreasonable assumption for straight chain hydrocarbons) then the mole fraction of the propane in the liquid would be about 0.248 (20%w/w), and in the vapour, about 0.56 (50%w/w), or more than twice as great. The pressure of a 20%w/w propane mixture in the tank at 20deg. C would be about 38psig.

The propane evaporates faster than the butane, so the liquefied gas in the tank gradually gets richer in butane

as the tank empties. Because butane has a lower vapour pressure than propane, the pressure in the tank also falls, but if the tank is heated, e.g., by a heat shunt, this will be less noticeable as it heats up. When about 20% of the fuel has burned, the propane content of the remainder will have fallen to about 11.5%: when 50% has burned, the propane content is only about 2%, and when 70% of the fuel has burned, less than 1%, so even without any cooling occurring, the pressure in the tank falls, unless steps are taken to restore it.

I calculate roughly that a tank of 20%w/w propane-butane mixture will have a pressure of about 30 psig at 14deg. C, but having burned off 20% this will need to be raised to 22deg. C to keep up the pressure, and after 50% burn-off, to 32deg. C, which if maintained thereafter will keep the remaining butane at about the same pressure until the tank is empty.

The only way to maintain a virtually constant composition from a propane-butane mixed fuel would be to take a liquid feed from the tank and vaporise it on the way to the burner,
Tony Finn, East Riding of Yorkshire.

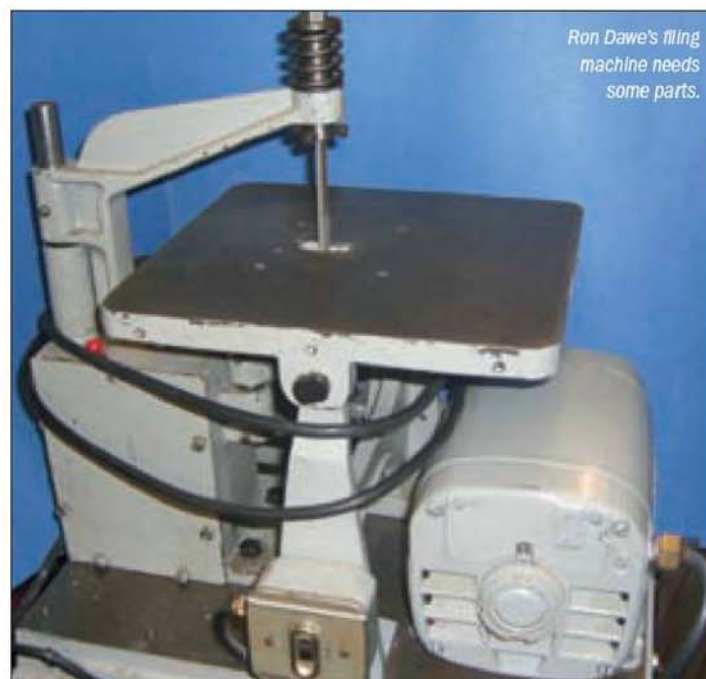
Ewins oil pumps

SIRS, - I thank Mr. Webster (M.E. 4326, 23 May 2008) and Mr. Hillman (M.E. 4328, 20 June 2008) for their response to the Ewins oil pump problem.

I would ask both these gentlemen to recall their earlier days in the science laboratory where they were taught that although a given quantity of liquid can move and change shape, its volume remains constant not matter what pressure is applied to it. It is this quality which makes oil the obvious choice of fluid in hydraulic systems.

Such remarks as "a depression is created when the piston rises" and "a near perfect vacuum" therefore do not apply as we are not dealing with air or a gas, both of which will change in volume when the pressure varies.

In the case of the Ewins pump, when the piston is at its lowest point in the cycle, the ball valve returns to its seat, thus trapping oil in the small cavity between piston and ball. This is the hydraulic lock situation. The piston cannot rise, not even a fraction of an inch, unless the oil is increased in volume by adding more oil to the cavity. This can only happen if extra oil is allowed in by some



Ron Dawe's filing machine needs some parts.

means, such as a leaky piston, oil seal or ball valve.

I trust this detailed explanation shows the Ewins pump problem in its true light.

Jack Shilling, Nottinghamshire.

Kelly & Son filing machine

SIRS, - Has any reader information on the Robert Kelly & Son Filing & Sawing machine as shown in the photograph. The firm operated as Machine Tool Makers at 55 Market Street, Manchester.

The machine I have has many unused tapped holes, but no fittings to fit in them, the parts which I think are missing could be the adjustable "Hold Down" support to prevent the work-piece from lifting on the upstroke of the file or saw blade.

I could design something to get over the problem, but would prefer to fit something akin to the manufacturer's original design.

All costs met for any information.

Ron Dawe, Kent.

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- **Engineering in wood**
- **McOnie's oscillating engine**
- **Steam injectors**
- **Edwardian Elegance**
- **Toulet Imperator Clock**

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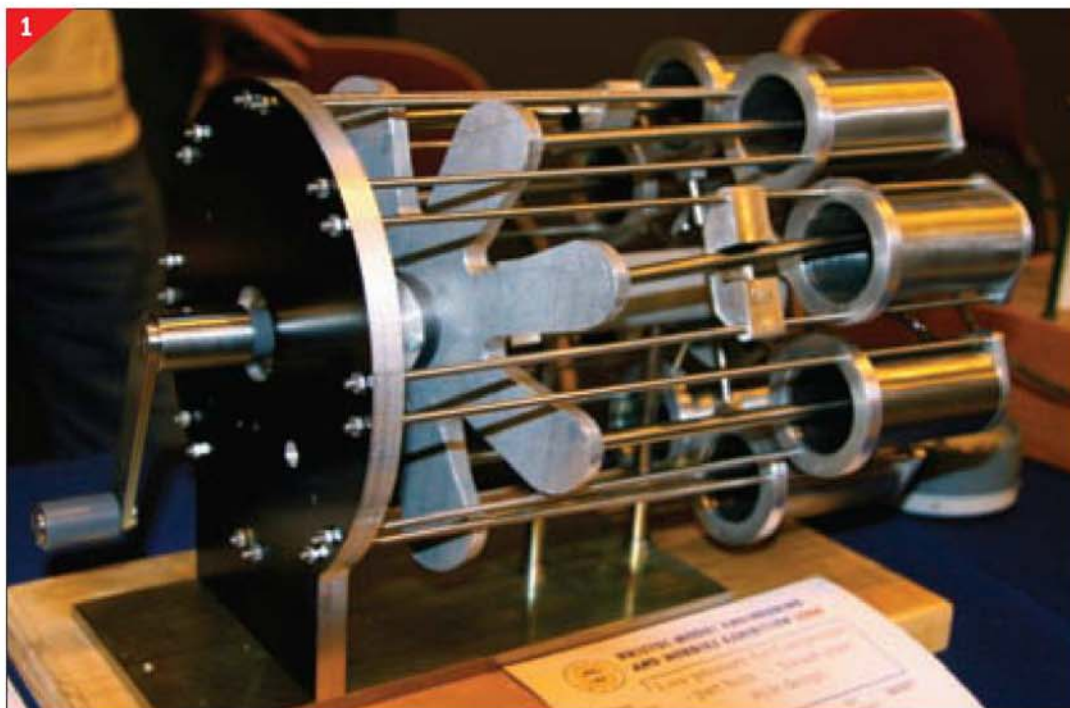
Contents subject to alteration

ON SALE 10 OCTOBER 2008

End panel parts for an electric locomotive designed and engineered to be made in wood.



Carl Jones driving a 3 1/2 in. gauge Hielan Lassie at 'Curly Bowl' held at Sutton Coldfield M.E.S.



by B. Philips (**Stroud Society of ME**). The aim was to produce a small, quiet, low-pressure compressor for driving small steam engines at exhibitions. The multi-cylinder approach is intended to obviate use of a pressure vessel and associated legislation. It is intended that the finished unit will have a pressure sensor to control the torque of the diving motor.

Wooden engines!

Model engineers have always made wooden patterns for making castings. Edward Addis takes this skill to the extreme and makes the whole of the finished engine in wood! **Photograph 2** shows a selection of his engines and mechanisms including: Watt 'Lap' beam engine, Newcomen atmospheric engine, Smeaton semi-portable steam engine, grasshopper steam engine, beam engine, steeple engine, Geneva index wheel, constant velocity coupling and lots more. The engines are powered by electric motor to allow them to be demonstrated. Edward makes no attempt to cover up the fact that the engines are made of wood. Indeed, it is the wood grain and beautiful finish that make his models unique.

Bristol Show

Michael Jones and Roger Bunce report on another splendid Bristol Model Engineering and Model Show held at Thornbury.

As model engineering shows go, the Bristol Model Engineering and Model Show is the best in the west (country). Organised by the **Bristol Society of Model and Experimental Engineers** its reputation as a friendly, not too big event is well-deserved.

This year's show was well attended by model engineering clubs, the trade and the public. There were over 70 stands in two spacious halls. Outside the activities included full-size and model engine demonstrations

(including miniature gas turbines!) and traction engine rides. Unusually, rain did not disrupt 'play'!

Partly built swash plate air compressor

There appears to be growing interest in axial or swash plate type engines after Nemett's article in *M.E.* 4325, 5 May 2008. However, the principle is equally applicable to compressors. **Photograph 1** shows a partly made 8-cylinder swash plate compressor made

Model wheelwrights

Staying with wood (**photo 3**): Brian Young presents the forerunner of the mobile phone - the mobile pigeon loft! These were introduced into France and Flanders at the beginning of the WW1 and remained in use until the mid 1920s. Later pigeon lofts were made from converted





double-decker buses - not quite the same appeal!

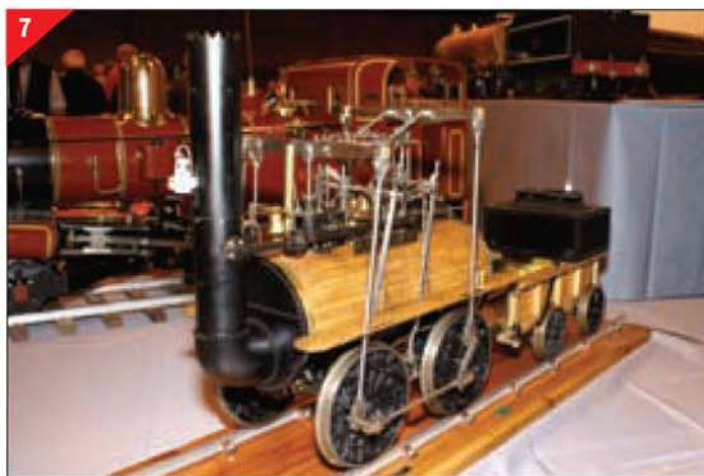
Still with the army: Brian's latest model is of a WW1 Water Cart (**photo 4**). These were used to supply clean drinking water to the troops at the front. The cart was not merely a simple bowser, it incorporated a pump, clarifying filter and a steriliser - we are not told how the water tasted!

Locomotives

From the workshop of H. Paviour was this interesting 3½in. gauge model of a Southern Railways Q1 Bulleid design (**photo 5**). The class was needed to meet an emergency requirement during WW2 for

freight motive power with wide route availability and a minimum of material to build them. The model illustrates just how Spartan the design was, using Boxpok wheels for strength and lightweight, and the engine is built without wheel splashers.

The 'George V' class of 4-4-0s (**photo 6**) were designed by George Whale for the LNWR and proved a powerful design enabling them to modernise haulage and eliminate the frequent double-heading that had been required up until that time. The model, built by John Whale in 2½in. gauge, shows the engine as it looked in 1914.



On the Stockton and Darlington Railway, *Locomotion* was the first locomotive of a batch of five. *Black Diamond* is one of the remaining four engines (the third) which had substantial differences from the first built. This interesting 7¼in. gauge model was built by A. G. Smith, a member of Plymouth Miniature Steam (**photo 7**).

N. Dickensen built a 7¼in. gauge Isle of Mann locomotive, No. 6 *Peveril* (**photo 8**). The prototype was presumably

named after a character in Sir Walter Scott's novel *Peveril Of The Peak*. The model, like the prototype, carries the 'Indian Red' livery of the post-war years.

The Bristol Society sought a different way to present 5in. gauge locomotive models and decided on a workshop setting (**photo 9**). Although it is loosely based on a Southern Railways works, the idea was to present the locomotives as if they were in a preserved railway shed. This way the presence of locomotives





from different railway companies would be typical. On shed this year (**photo 10**) were (left to right) the chassis of a British Railways rebuild of a Bulleid West Country Class 4-6-2, a Southern Railways 'King Arthur' class receiving some attention to its bogie, and an 0-6-0 Terrier tank based on the Simplex design.

Model engineering brothers

The brothers Hawkins must have a model engineering gene. Colin Hawkins' traction engine (**photo 11**), a 4in. scale Foster road locomotive, was completed just this year. Nearby in the show, Graham Hawkins displayed three superb 5in. gauge GWR 4-cylinder locomotives; a Star, a Castle and a King (**photo 12**). For now, the Star is 'tender-less' – he simply borrows one from the other locomotives in his roster.

Aero engines

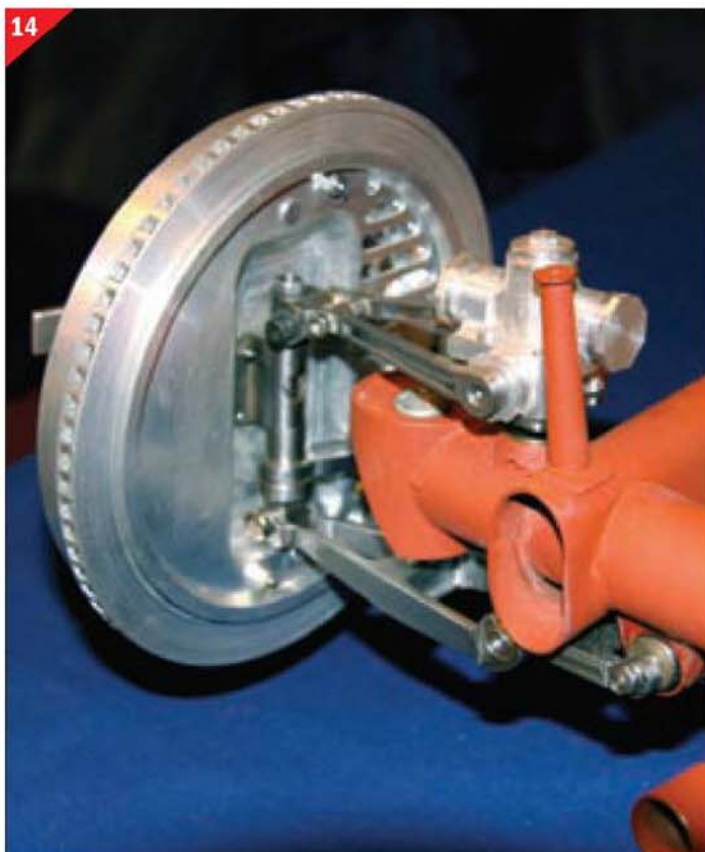
Brian Perkins is not known for doing things by halves. The cover photo of this issue shows the parts needed to assemble a 9-cylinder *Aquila* aircraft engine.

Before John Heeley embarked on his *Goblin 35* project (*M.E.* 4327, 6 June 2008), he built a lovely 9-cylinder Bentley radial (**photo 13**) which he displayed along with his gas turbine. Was the Bentley simply for practice?

Autos

And now for something completely different! Brian Perkins is well known for his superb models of multi-cylinder aero engines. For his next project, Brian has chosen to model a Mercedes-Benz Grand Prix racing car W165 (1939) in 1:3 scale. The model is being built from the original Mercedes drawings. The vented drum brake and suspension is

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shown in **photo 14**, and Brian is displaying the chassis in **photo 15**. We look forward to seeing the next stage of construction and, of course, hearing the engine run, please!

Medieval clock with bells

Photograph 16 shows Alec Price with his 1:4 scale medieval clock. The original clock is in Breamore House and Museum near Salisbury. It is the earliest four-train turret clock in England and dates from the mid 16th century. The clock has no hands and no dial, which was normal for a clock of that period. The quarters are struck on one bell and the hours on the other two. Originally the clock would have had a verge and folio escapement but was converted to pendulum in the mid 19th century.

Alec was responsible for the restoration of the original clock, which was done to celebrate the millennium, and decided he would like one himself - but the original is 6ft. long! - hence the quarter scale. Alex's clock has a verge and folio escapement, as the original would have had. Similarly, the wheels and pinions on the 'model' are

'iron', like the original. The four trains are driven by buckets containing weights. Timekeeping is adjusted by varying the weight in the going train bucket. The bells are struck by three jacks (models of men with hammers). Asked if the clock took pride of place in his house - regrettably no. It has to live in the workshop for obvious reasons!

Hydraulic crane

Photographs 17 and 18 show Derek Goddard's 1:10 working model of Armstrong's 11/4ton hydraulic crane c1864. These cranes were commonplace in railway goods depots in the mid-19th century. The fascinating aspect of hydraulics during that period was that the pressurised water was distributed around cities using a network of underground hydraulic pipes. London had 180 miles of hydraulic pipes. These still exist today but now they house optical fibres. Other cities with hydraulic networks included Liverpool, Birmingham, Glasgow, Paris, Buenos Aires, and Adelaide. These were quite separate from drinking water supplies. The water was pumped through the network using steam engines

15



16





and energy was stored by raising huge weight loaded pistons called accumulators. The water pressure to drive machinery, such as cranes and lifts, was an amazing 600/800psi.

The original crane was installed in Blackfriars Goods Depot, London (London Chatham and Dover Railway Co). The model took four years to research and make, and comprises around 1,800 parts. Sources of information included Armstrong's original drawings, museum models and the crane archive at Tower Bridge. Most of the mechanism would have been housed underground in a concrete pit. In the model, this is represented by the aluminium framework. The effective lift is four times the stroke of the main hydraulic cylinder and is achieved using chain and pulley.

Vacuum engines

Philip Handcock (Forest Classics) shows the Boehm Flame Eater engine, which is available as a kit (**photo 19**). The engine, which is styled along the lines of 'Dan Dare's ray gun', is made from high quality materials, and runs on ball bearings. Flame eater or vacuum engines are unusual. They are not internal combustion engines nor Stirling engines. The external flame is drawn into the engine through a port at atmospheric pressure. The hot gases cool within the cylinder, which lowers the pressure and causes the piston to be drawn into the cylinder. Engines of this

type are not very powerful but they do make a splendid noise, as the flame oscillates in and out of the cylinder.

Vacuum engines to the design of Jan Ridder (published in *M.E.* 4323, 11 April 2008) have begun showing up at several exhibitions. B. Cole's version (less burner) is shown in (**photo 20**). We understand he is currently experimenting with various types of fuel in order to minimise the effects of combustion residues within the cylinder.

LTD engine with designer

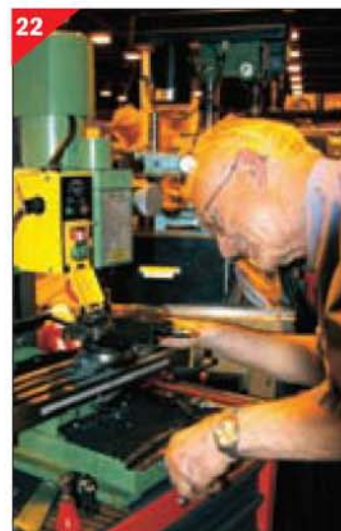
Photograph 21 shows Martin Gregory holding one of his LTD Stirling engines. This engine uses a rubber membrane to form the piston seal (actually it is a piece of latex rubber glove). This obviates the need for precision pistons and cylinders and makes this type of engine much easier to build. We are hoping that Martin will treat *M.E.* readers to a more detailed description of his engines including a construction article.

Milling demonstration

Terry Phelps was busy on the Bristol Society's workshop stand using a Warco milling machine to machine the horns of a locomotive bogie (**photo 22**).

Congratulations to the Bristol Society of Model and Experimental Engineers on a very well organised and successful show.

ME



The Bridgeport



Tony Griffiths describes the world's most popular milling machine.

In the UK one often finds ordinary horizontal and vertical millers badged as being made by Bridgeport. These were actually manufactured by Adcock and Shipley, a company owned at one time by Bridgeport and responsible for producing copies of the 'real American Bridgeport turret miller' in their Leicester and other factories.

Today the original form of the turret miller is, to distinguish it from later computer-controlled and larger models, referred to as the 'Series 1' (photos 1 and 2). It was first manufactured in 1938 by two immigrant Swedish engineers Magnus Wahlstrom, a toolmaker, and Rudolf F. Bannow, a pattern maker and radio ham.

The two men had first met in 1928 when Wahlstrom had called to buy wooden loudspeaker parts from Bannow, then president of the 'Bridgeport Pattern and Model Works'. By 1929 they were in business together and attempted to develop an electrically-powered hedge clipper. However, when this idea was abandoned, they began work on a vertical milling attachment designed to fasten to almost any of the hundreds of thousands of plain horizontal millers then in use. The accessory, which became known as the 'Master Milling Attachment', was originally designated by the partners as their 'Model C'.

Model C Head

The milling head was smartly presented with a polished aluminium housing, it was well engineered and equipped with a heat-treated and ground spindle running in four precision, pre-loaded bearings (with those at the pulley end allowed to 'float' to accommodate expansion



1. Bridgeport Series 1, Model 9BRM with the 0.5 hp Model M Head designed as a 'medium-light duty' machine. This model was identical to the BRJ but fitted with the lighter Model M Head.



2. Bridgeport Series 1, 1966, Model 9BRJ with the 1hp Model J Head. Series 1 machines were available with tables lengths of 32, 36, 42 and 48 inches with, 20, 24, 30, and 36 inches of longitudinal travel respectively. All the tables were 9 inches wide and had 9 inches of cross travel on the 9BRM, and 12 inches on the 12BRM - the only difference between the two Models.

and contraction of the spindle) and with a quill that accepted (as standard) 3in. long B-3 collets. The head was powered by a ½hp motor that gave, in conjunction with 6-step aluminium pulleys, speeds of 465, 675, 1,000, 1,500, 2,140 and 4,250rpm. The first production example was delivered in 1932 to the 'Atlas Tool' company of Bridgeport and the head continued in production long enough to become known as the 'Model M' when eventually fitted, some years later, to the first Bridgeport milling machine.

Competition

However, the partners were not alone in the conversion market and by the 1940s many similar attachments were available, the better-known of which were: the 'Tree' from Racine, the 'Halco' from Detroit, and Kearney & Trecker with their Dalrae-manufactured 'Midgetmill' and 'Speedmill' units. One special version of the Bridgeport Model C was made for use on precision Hardinge horizontal millers (early versions were badged Cataract MD5). These heads can be recognised by a Serial numbers beginning with the letter 'H'. Although identical (at a glance) to the standard Model C they were not as

long and used a shorter '2VB' Collet closer. From the centre of the mounting holes to the bottom of the 2VB collet closer was 5⅜in. whilst the same dimension on the B-3 collet closer model was 6⅜inches.

'Born' 1938

By 1936 the original head been improved by the addition of a ½hp motor and the inclusion of a sliding quill with 3.5in. of travel. This radically improved the unit's drilling and boring performance. There was choice of either No. 2 Morse or No. 7 Brown & Sharpe taper and an improved speed range of 275, 425, 700, 1,050, 2,100 and 4,250rpm. With this much more useful specification, business began to pick up. By 1938 sales were 500 units per annum, and seeking further expansion, the partners decided to incorporate the head in a completely new design of highly-versatile milling machine that they would produce themselves - the Bridgeport.

In true engineering tradition, the initial sketches were said to have been drawn by Rudy Bannow on a paper bag while waiting to unload patterns at a customer's works. In 1938 the Company changed its name to 'Bridgeport Machine Inc.' and in August of that year the first Bridgeport turret milling



machine was completed and shipped to the plant of the Precision Die Casting Company of Syracuse, New York. This first example, invoiced at \$995, was later recovered by Bridgeport and donated to the Henry Ford Museum at Dearborn, Michigan. Today it is in the Precision Museum in Windsor, Vermont, USA.

The Bridgeport was extremely well thought out and its versatility was quickly appreciated in both toolrooms and production plants.

Important features

Not only did the whole upper turret pivot on the main column, but the round horizontal ram (driven by a rack and pinion on some but not all versions) could be moved forwards and backwards over a distance of 12in. (photo 3). Once setting was achieved the whole assembly could, if needed, be swung left and right, and the head tilted over under the control of a large worm-and-wheel gear - the latter arrangement ensuring that alterations could be made quickly and with great precision. The value of this latter feature can only be truly appreciated if you have ever struggled to hold 75lbs of cast iron in one hand - over at an angle in perfect alignment with an engraved mark - whilst simultaneously trying to tighten a miserably-small nut, buried in some dark

and oily recess, hidden away at the back of the machine.

Probably due to difficulties with rigidity, not all models had a clevis end on the vertical-head end of the ram. Later types were offered, with a more robust flat fitting but retaining a clevis at the other end to mount a slotting attachment.

These early models had a 5in. diameter round horizontal ram, distinctly different to the 'square' type that was available from September, 1952. This later ram, and its mounting, could be used on earlier machines and was advertised for a time by the factory as a conversion unit. With the new design the rigidity of the ram had been sufficiently increased to allow the reintroduction of a clevis end for the vertical head (like that of the competing 'Cross' miller) that once again allowed it to be 'nodded' up and down through an angle of 45deg. each side of vertical. As an interesting aside: some early (round-ram) machines have been found with a Type C head having an improved quill travel of 5in. rather than the usual 3.5 inches.

Another vital ingredient in the machine's success was the location of the motor to one side of the spindle and V belt drive. This meant that both the fine and drilling feeds of the quill could operate along the axis of the tool, no matter what its angle. In a series of machining and drilling operations, that required different combinations of quick-action and fine feed movements of the quill, all could be carried out without having to reset the head. A further advantage of

the side-drive motor was that the quill was left clear for a draw bar to pass through to retain cutters or their holders. Some millers of this type, whilst having the same quill-feed arrangements, employed a motor fastened to (and blanking off) the top of the spindle housing that forced the use of awkward screwed retaining rings on their noses. A further consequence of this arrangement was the need to use expensive custom or at least non-standard or modified cutter holders.

Production

On March 18, 1954 the 20,000th machine left the factory bound for the Pioneer Electric Research Corporation of Forest Park, Illinois. Despite one machine being produced every 45 minutes, such was the demand for machine tools in the early 1950s, that a sixteen-month backlog of orders totalling over 3,600 machines was not an unusual position for Bridgeport to be in. Advertising expenses for 1953 of less than \$12,000 show that the millers virtually sold themselves - and it was not uncommon for little-used examples to fetch three times the manufacturer's list price.

Although for many years Bridgeport produced only one model, it was eventually converted into many forms both by the factory and third parties including: machines with 2D and 3D hydraulic copying in both manual and automatic versions; T shaped heads to allow a single head to be moved sideways, or up to three heads to be mounted side by side (photo 4); automatic copying and



precision tracing machines and, by the early 1960s, the Moog Hydra-point three-axis, numerically-controlled system, that was manufactured in England by Moog Hydra-point Ltd (photo 5), was fitted on a machine made by the Bridgeport subsidiary, Adcock & Shipley Ltd. Of Leicester. A & S had first built the Series 1 model under licence in 1960. By 1963 more than 60,000 examples had been manufactured, with plants in: Bridgeport, Connecticut. USA; Leicester and Bridlington in England; and in Singapore. It is a widely copied machine, with dozens of companies in Taiwan - and 14 in Spain at one time - turning out examples of varying quality and performance.

Bridgeport today

Today Bridgeport makes not just millers but turning and grinding machines. For example, in 2006 they supplied a large and complex grinding machine to Rolls-Royce for finishing jet engine parts.

As the years went by, demand for the machine changed and costs came under increasing scrutiny. Under various ownerships production was shifted around the globe and when owned by, for example, by Textron the column, knee and table was constructed in England, various heads in Singapore, with final assembly and painting in the USA. One would have thought a single plant could have achieved better cost savings than shipping components halfway around the world and

3. Early model with 5in. diameter horizontal ram.

4. Bridgeport with three heads.

5. The Moog Hydra-point, three axis, numerically-controlled system.



back. Bridgeport eventually became part of the Goldman Industrial Group together with other leading machine tool companies including Bryant Grinder, Fellows, Hill-Loma, J. & L. Metrology, and Jones & Lamson. In 2002 Hardinge took over the rights to Bridgeport's knee-mill designs and then, in November 2004, acquired full rights to the Bridgeport name to join Hardinge-branded high-precision lathes, Kellenberger cylindrical grinding machines, Hauser jig grinders, Tschudin high-production cylindrical grinders, Tripet internal-grinding machines and Hardinge-branded collets, chucks and indexing fixtures. In the UK the Bridgeport division, formerly based around Adcock & Shipley in Leicester, continued in operation - but not the Bridgeport manufacturing operation which, by November 2004, was in receivership. A total of \$7,250,000 was paid by Hardinge for the acquisition but this included finished goods (including CNC machining centres) worth an estimated \$4,100,000. The continued use of the Bridgeport name seems assured with Hardinge currently having over 800,000 square feet of manufacturing capacity in its operations in England, the United States, Switzerland, Taiwan and China.

Heads

A range of different heads and head accessories have been available for the Bridgeport since its introduction including: heavy-duty fixed-quill models; and high-speed heads incorporating fine-feed and quick-action (sensitive) drilling mechanisms. Heads were at first available with a choice of either a No. 2 Morse taper, or Brown & Sharpe No. 7 or B-3 tapers but later the 'designed-for-Bridgeport' R8 fitting became the standard. While some heads will only fit on the front of the ram, others can be mounted on the back as well including the Model T Cherrying Head. The following are the most popular types of head:

Model M Head

The Model M Head was the first type to be fitted to Bridgeport milling machines (**photo 6**). It had a 3.5in. quill travel with both fine and quick-action feeds, but was hand operation only. The spindle could be ordered with a No. 2 Morse, B & S No. 7, or a B-3 taper. The maximum collet capacity was 0.5 inches. Special tapers were available to order and it is highly likely that a factory, already equipped with tooling to a different specification, would have ordered its machines accordingly. The 0.5hp motor was available as either a 1,200rpm unit - which gave spindle speeds of 275, 425, 700, 1,050, 2,100 and 4,250 rpm - or as a 3,600rpm model with spindle speeds of 950, 1,350, 2,200, 3,250, 6,500 and 12,000rpm. The unit could be mounted either on the front or back of the ram and, if on the back, could be fitted to a swivel adaptor that allowed it to be angled in both planes.

Model J Head

For many years the standard head was the V-belt driven 'Type J' fitted with lathe-like backgear for slow speed (**photo 7**). This was introduced after the original M head and before the introduction of the variable-speed 2hp 2J2 head. The counterbalanced R8 quill was hard-chrome plated and ground, then lapped to fit the honed spindle bore. It had a 5in. quill travel and was fitted with both hand and power feeds. The hand feed could be applied through either a quick-action lever when drilling, or by a handwheel for fine feeds. The power feed, of 0.0015, 0.003 and 0.006in. per spindle revolution, worked in both directions and could be set to trip out automatically. A 0.001in. graduated micrometer stop was fitted as standard.

There was a choice of two types of 1hp motors, each wired for reverse: a 1,800rpm unit that gave (in direct drive and backgear) spindle speeds of 80, 135, 220, 330, 660,



1,100, 1,800 and 2,720rpm - and a 3,600rpm version that doubled each of the aforementioned speeds. When vertical, the head could be run continuously but needed modification to the lubrication system if used continuously in the horizontal position. A wide range of spindle adaptors was available on which to mount a variety of tooling.

Model 2J2 Head

By the 1990s the most popular head was the 2hp variable speed J Varidrive later called the 2J2 (**photo 8**). The less expensive 12-speed V-belt J type was also still available. The 2J2 was fitted with expanding and contracting pulleys and provided two speed ranges: 50 to 450rpm and 450 to 3,750rpm, in backgear and direct drive respectively. Small changes in the mechanical specification (and the type of electricity supply) meant that these ranges varied somewhat from country to country. Like all Bridgeport heads, the 2J2 quill was hard-chrome plated, ground and then lapped to fit the honed bore in the main casing. The spindle was fitted with a brake to slow it rapidly from high speed and could also be locked to aid tool changes. A clutch, designed to slip in overload conditions, protected the spindle from damage.

In common with the J head: The fine-feed of the 2J2 head could be hand or power operated and it also had the quick-action (sensitive) drilling handle. Three rates of



6. Model M Head.
7. Model J Head.
8. Model 2J2 Head.

power feed were provided. The operating wheel of the fine-feed and quick-action drilling handle are detachable.

For new owners of a Bridgeport with the 2J2 head, it is worth noting that, whilst the speed setting dial for the variable-speed head can only be turned whilst the motor is running, to engage backgear the head should be stopped and the spindle 'jigged' backwards and forwards until the gears engage. In backgear, the spindle runs in the reverse direction to normal and the reversing switch is used to change the cutter rotation. **ME**



My first boiler

Julia Old fits the front tubeplate and concludes the series by pressure testing the finished boiler.

*Continued from page 261
(M.E. 4333, 29 August 2008)*

I was told that the front tubeplate should be fitted last because there is often differential expansion between the barrel and the tubes when the boiler is heated. If the tubes were fixed at both ends it could either damage the tubes or stress the joints.

The last modification I had to do to the published design was to provide a dedicated connection for the top of the water gauge. In the past, the top of the water gauge was often connected via a pipe to the steam turret. This practice is no longer recommended as the gauge can be inaccurate when connected in this manner. I made a bronze spigot, which has a short pipe stub to pass into the boiler to provide additional joint integrity. I had delayed drilling the hole for this connection, until this point, as it clips the flange of the backhead. To support the spigot in the correct position, I used a $\frac{1}{2} \times \frac{1}{8}$ in. section steel strip with holes drilled near each end through which

46. Soldering the superheater tubes.

47. Soldering the barrel seam.

48. Soldering the water gauge spigot.

49. Water gauge spigot.



I screwed blanking plugs into the bush and the spigot for the boiler water gauge.

I soldered both the front tubeplate and the water gauge spigot at one heating - starting

with the tubeplate. I was then more accustomed to adjusting the oxygen/propane mixture and could quickly set the optimum flame. Starting with the superheater tubes, I worked





across the face of the tubeplate soldering the tubes, and finally tackled the barrel seam (photos 46 and 47).

The hot boiler was carefully rolled over so that the spigot was at the top. To make this repositioning as simple as possible, it was practiced whilst the boiler was cold and suitable supports for the barrel were already in place. This very last soldered joint on the boiler did not take long to complete (photos 48 and 49). The boiler was, by then, a very large lump of copper and was allowed plenty of time to cool before being slowly lowered into the pickle.

It was my practice to leave the boiler in a bucket of water for 24 hours to dissolve all traces of flux but, on this occasion, I could not resist polishing it (photo 50). There

was some rationale for this as I have found that, by the time I remove the boiler from the water, it has tarnished and the clean appearance from the pickle has been lost.

Longitudinal stays

To finish the boiler I needed to fit the two longitudinal stays. I could have soldered these directly to the smokebox tubeplate and the backhead, but I had committed to screwing them in place before I had gained confidence in my silver-soldering. The stay, bush and nipple are all threaded 40tpi and the nipple screw is engaging on both the bronze stay and the bush at the same time (photo 51). This is easier said than done as, depending on the relative start positions of the threads, there can be up to $\frac{1}{80}$ in. error. There were four nipples and two stays. Some combinations were better than others and once I found a combination that worked, I stuck with it. However, this was the least of my problems as I found that when I fitted the stays they interfered with the temporary fixing screws used to hold the crown stays in place for silver soldering. Had I known this before fitting the inner shell, I would have filed the head down when I had a chance.

Testing

In preparation for the hydraulic pressure test, I fitted the steam dome and plugged the bushes. When I arrived for the test, I discovered that many of my plugs leaked, but my biggest problem was a substantial leak between the steam dome and boiler bush. I had hoped to get away without

a gasket between the flanges but this was foolhardy so, before the test, I had to rapidly make a gasket from a piece of card. I had used aluminium washers for many of the plugs instead of PTFE tape. Those with PTFE did not leak, whilst many of those with washers did. Apart from this, the boiler had no trouble withstanding pressure, so I submitted it for test by two of our club's nominated testers.

The proof pressure test involves holding the boiler at twice working pressure for 10 minutes. The drawings suggest a working pressure of 80psi but indicate a design pressure of 100psi. After discussion with the testers, it was decided to test the boiler to 200psi. This would enable the working pressure to be raised in the future, without the need to repeat the test (photo 52). I was very pleased when the boiler passed first time.

I am most grateful to my mentors: Gerald Spenceley, Dave Deller and Bernard White for their help and encouragement with 'My first boiler'. I would also like to thank Jim Puttifer and Jack Ruler for helping to take the photographs.

ME



50. The 'polished' boiler.

51. Fitting the longitudinal stays.

52. Hydraulic testing.

LETTERS TO A GRANDSON

M. J. H. Ellis
describes high
tension ignition.

Dear Adrian, I would like to continue my description of ignition systems by considering the high tension ignition coil. This is used in practically all modern cars. It requires a separate source of energy in the form of a battery which, nowadays, consists of six lead-acid cells to give 12 Volts. At one time Ford used a three-cell battery giving only 6 Volts. The coil comprises a laminated soft iron core in the form of a bar, on which are two windings. The primary winding has comparatively few turns of thick wire, and has therefore a low resistance. Over the primary is the secondary winding, which has a great many turns of fine wire. Current is fed from the battery to the primary winding via the contact breaker. One end of the secondary winding is connected to 'earth', (which means, the metal of the engine), while the other end goes to the central electrode of the sparking plug (**fig 1**).

Just before a spark is required, the points of the contact breaker close, and current flows in the primary winding magnetises the core. The points then open, the magnetism in the core collapses abruptly, and the rapid fall of the

magnetic flux induces a large voltage in the secondary winding which give rises to the spark at the spark plug. A substantial reverse voltage is also produced in the primary. This would produce a small arc between the contact breaker points. This would soon ruin the points if it were not for the condenser C, which absorbs the energy harmlessly by being charged up. No sooner has the condenser been charged than it discharges again through the primary, thereby hastening the collapse of the magnetic flux in the core. All this takes place in the twinkling of an eye. A 4-cylinder engine could well be running at 5,000rpm. In which case, one revolution takes 12 milli-sec. and, as two sparks have to be produced in that time, the whole cycle has to be accomplished in 6 milli-seconds.

It seems to me that coil ignition has found favour with motor manufacturers primarily on account of its comparative cheapness and, providing the battery is properly charged, it works well. However, the starter motor takes such a heavy current that the battery voltage is 'knocked for six' (as we say in England; the idiom comes from the game of cricket, which you don't play in the US), and its voltage may be so reduced as to jeopardise the ignition. Observe how, at the best of

times, the car lights go dim when the starter is operated. How much better were the good old days of my youth, when cars had starting handles and high tension magnetos!

High tension magneto

We can now move on to the high tension magneto. When I was your age, I had a rough idea of how a high tension magneto worked, but it was a long time before I worked out the finer details. There are two important points to bear in mind:

1) Every conductor in which a current flows must form part of a closed circuit. If the conductor moves relative to magnetic flux the electromotive force, or EMF induced in the circuit, is defined by Michael Faraday's Law of induction:

'The induced EMF in any closed circuit is equal to the time rate of change of the magnetic flux through the circuit.'

Note that it is the rate of change of flux that determines the value of the EMF (voltage). If the direction of the flux were changed then the EMF polarity would be reversed.

2) The magneto combines the functions of a generator and induction coil.

There are at least five types of high tension magneto system, but they all work on the same principle and contain the same essential elements: A permanent magnet; a soft iron armature that carries primary and secondary windings; and a contact-breaker shunted by a condenser.

The soft iron armature usually rotates within pole pieces of the permanent magnet, but in one type, confined to stationary engines, it reciprocates. The earliest form of high tension magneto was another example of an innovation modelled on its predecessor - the low tension magneto. This type of high voltage magneto is still probably the most common. In my next letter I will describe its construction and how it works.

Your affectionate Grandpa.

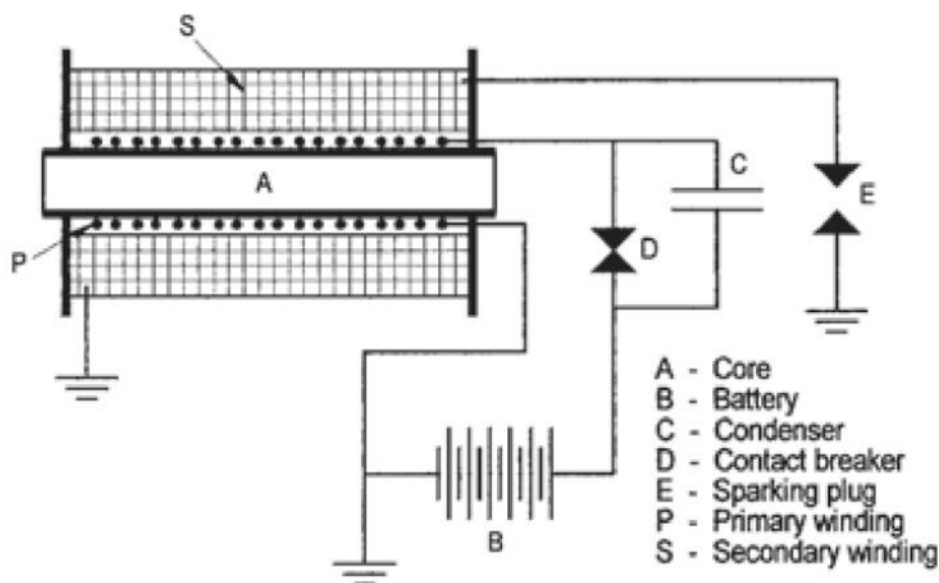
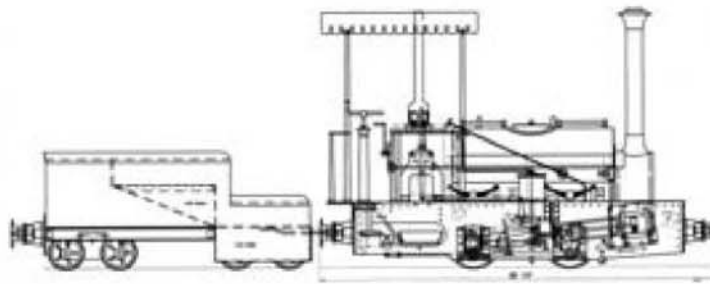


Fig 1

ANNA



A Manning Wardle locomotive for 7¼in. gauge

D. A. G. Brown and **Mark Smithers** in the final article of this series finish the tender and address a few modifications of which builders should take note.

*Continued from page 268
(M.E. 4333, 29 August 2008)*

As promised in the last instalment, **photo 1** is a picture of the underside of the completed tender. This view reveals the relatively small amount of plumbing which is involved, which has entailed drilling a few holes in the lower sections of platework. Standing in the doorway of my workshop, the assembly is lit by sunlight, which shows clearly all the relevant details. From the top down: the front bogie is slewed under its own weight and calculation enables it to negotiate a bend of 20ft. radius. The Bowden cables are neatly tucked under the brake support plates and above the axle, enabling them to pass through a couple of purpose drilled holes on their way to the brass anchor block.

The vacuum reservoir is a goodly size; the larger it is, the less attenuation of pressure occurs in the backside of the operating cylinder whenever the brakes are applied. It was merely rolled up from a spare piece of 16g copper sheet and silver soldered around two matching ends, the entry and exit holes having first been drilled in the middle of the ends, with ⅜in. x 32tpi branches silver-soldered into each end at the one heating. The ¼in. pipework connects

the backside of the brake actuator to the reservoir (right side as you look at it). The left side is led via a swan-neck behind the brake platform to a bleed point on the centre line of the tender chassis member. You can just see the small brass fitting which is fixed to the end of the pipe and which takes it to the outside world; this is in fact a cannibalised carcass of a Schrader valve, which has been adapted to accommodate two nuts, one on each side of the chassis. A Schrader valve is a perfect device for relieving the residual vacuum, or 'pulling the string' in railway parlance; it seals perfectly and just requires a few seconds application of a finger nail or blunt object to bring the pressure in the reservoir up to atmospheric.

The train pipe can also be seen alongside the vacuum relief pipe, making its way from front to back of the vehicle. A tee just above the brake platform leads via a flexible rubber pipe to the operating side of the actuator cylinder. While on the subject of the brake platform, it should be apparent just how easy it is to detach it from its two chassis brackets, by means of the four ¼in. screws. Immediately below the actuator and a little to the right of centre can be seen the water service line, which is led from a pre-drilled hole in the tender base, straight to the front of the tender, by way of a 10mm plumber's ball valve near the front of the tender base. This was adapted to be turned on and off by means of a simple lever, between the legs of the driver, easily visible in the photograph of the finished vehicle.

Proceeding down the photograph, to the left of the rear bogie it is apparent that the Bowden cables, not



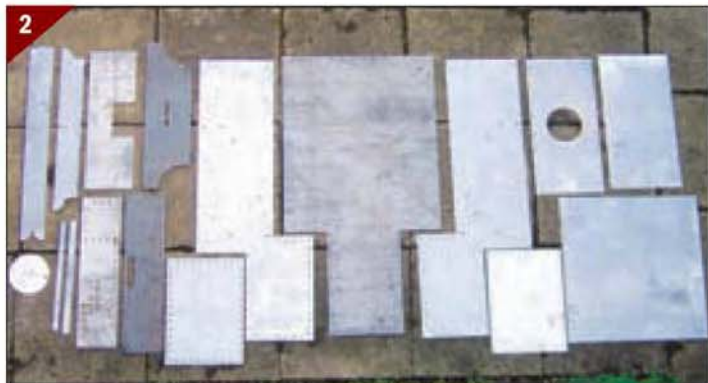
correctly routed beneath the brake support plates, would get mixed up with the wheel treads, if that detail were not corrected as proposed in the previous instalment. In both the bogie assemblies, the presence of the disc spring stacks, just outside the wheel extremities, is obvious. To the right of the rear bogie, and outside the tender frame, can be seen the brass drain plug; this is fitted with a fibre washer for sealing and is merely tapped ⅜in. x 32tpi into the hole provided in the tender base.

The tender body

Photograph 2 portrays the flat pack, comprised of 17 pieces of metal, all laser cut to fit together into the 'jigsaw' defined in the drawing of the vehicle. I can confirm that they all do go together rather better than an MFI kitchen and without the trauma of falling to pieces afterwards. The first two or three examples had three slots missed out from the rear panel, and a small relief was missing from the side panels, which enables the base to go right

1. The underside of the tender.

2. The 17 laser cut components of the tender body.



home; these small omissions during the design process are easily put right and I guarantee that all the current and future issues are correct in every detail. The design produces laser marked lines to indicate the positions of bends. It is essential that these be milled to half depth with a ball nosed cutter of about 3mm dia. in order to produce a sharp bend. In fact I found that the rigidity of the 2mm chrome steel material is such that it is advisable to increase the cut depth by a further 0.008in. (0.2mm). This leaves metal of about 0.031in. thick at the base of the crease, which allows the bending to be done quite easily by hand.

In the picture you can see the tabs and slots which the laser has cut to locate all the major pieces. Apart from the sides and base, the inclined coal plate for instance, has two tabs on each side which engage with slots in the tender sides set at the correct angle of 24deg. from horizontal. The vertical part of the coal plate is located by a single tab and slot on each side; should you get the position of the crease slightly wrong (an easy thing to do, you will have to adjust the lengths of the tabs slightly to compensate; we are talking of just a few strokes with a file.

Before assembling the major components of the body, it is necessary to perform all the riveting and it is essential to plan the sequence of joints within the foot wells, so that you have convenient access for the riveting dolly for all stages of the operation. For example, in fixing the bottom outside angle between the tender side and the bottom of the well, it is vital to fix the angle to the tender side first. Thus, it is possible to support the bottom rivets from the inside at a later date, using a snap extended upwards from a vice or anvil, while the rivets are closed by pressure from another snap working at what will become the underside of the foot well. The procedure which I have maintained is to use the manufacturer's rivet head where it will show, the forged head being where it is less obvious, to allow for imperfect heads!

To assemble the pieces for final riveting you will need helping hands; my long suffering wife provided the assistance. The final result fixes the buffer beams and enables the chassis members to be bolted in place. The tender base, now quite heavy, is ready to receive the rest of the components, all of which are located by tabs and slots. Assistance from a large sash cramp kept things together during the welding process. Tack welds were run with everything in position, but the inclined coal plate was sprung out of place before

the final welds were applied to the base joints. My welding is certainly not my strongest technique, so my final joints inside the water space are followed up with body filler to make sure of water tightness. With the base lines finished, the inclined coal plate could be sprung into position, before welding from the underside, as close to the point as possible, but recognising the need for final sealing as detailed above.

For supporting the rear tank cover plate I managed to source some 18mm stainless steel angle, which was welded into place during the assembly process. Laser drilled holes in the plate were used as a template to position tapped holes in the stainless angles. Stainless steel screws hold the parts together. I should point out that it is necessary to make the top of the water space removable, in order to give access to the whole of the inside of the tank.

Two of the 17 parts which the laser cut are the inner and outer rings for the water filler. They were rolled into complete circles and the longer of the two was welded into the pre-cut hole in the tank top panel, while the shorter one was fitted to the tank top and finished with its ball knob and retainer as described for the saddle tank filler.

The seat

Photographs 3 and 4 show the finished tender from each end. Note the seat, which has been beautifully trimmed in red

leather by our local specialist in car trimming; mixed up with Bentleys, Rolls-Royces and Aston Martins, my locomotive order caused slight amusement to the two people who run the firm; they are not cheap, but their work is to a very high standard and I reckoned that it was well worth the cost to get such a fine result. If you are interested in them, their website is: www.simtrim.co.uk

I provided the base wooden panel for the seat, with bolts sticking through at all four corners to engage with the appropriate holes in the support angle above the coal space; it has been my intention to fix the seat by at least two nuts which can easily be fitted before filling with coal, but on reflection it would seem to be easier to leave the seat loose, so that it can be removed for coal filling, thereby keeping it clean. The trimmers drilled three ½in. holes along the centre axis of the wood, in order to avoid the 'whoopy cushion' effect.

More tender details

In photo 3 you can also see the connections for the vacuum line and water supply to the engine, the latter just in front of the ball valve spindle mentioned in the previous part of the series. One detail which has not been provided in the drawings is the cover for the front of the coal chute. This is simply made from 1.5mm sheet steel, with a neat handle at the top; it slides up and down in two millimetre wide

3. The completed tender from the left front.
4. The completed tender from low down on the right rear corner.



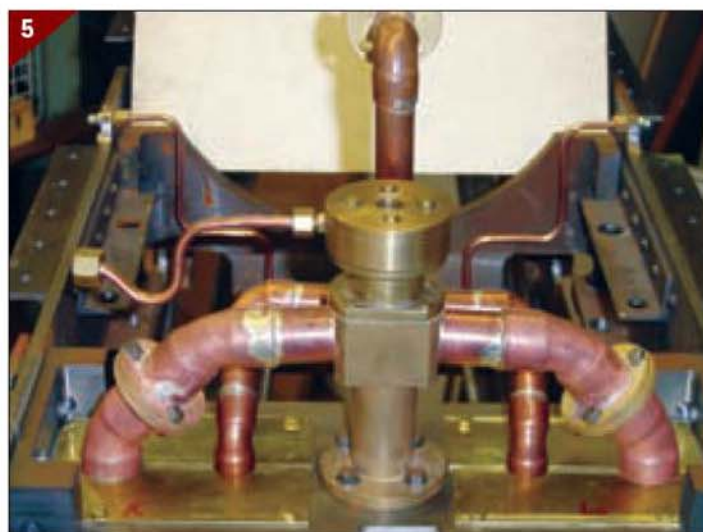
grooves which are milled in lengths of $\frac{1}{2} \times \frac{1}{4}$ in. steel strip, leaving about 1mm as extra clearance to ensure that the coal dust does not jam the works.

In photo 4, the details of the rear bogie are apparent, as well as the vacuum reservoir. Its position, tucked well up behind the footwell bulkhead ensures that it is out of harm's way above the track. The train connection for the vacuum pipe sits above the buffer beam, the rubber pipe finishing in its standard connection parked in its appropriate dummy at buffer beam level.

You will notice in the two photographs of the finished vehicle that the flared top trims of the sides and back give a nice finish to the whole thing. In the flat these five pieces are nested together into two profiles of two millimetre 3Cr12, which are portrayed at the top left of photo 2. The two long pieces for the sides are nested back to back, with an allowance between them for cutting after rolling; the back trim is paired with the two short pieces which go above the footwells. Each assembly must be rolled through about 40deg., so that when it is separated into discreet components the curves go right through to the extremities. Ideally there should be $\frac{1}{2}$ in. of flat on the lower edges. My bending facilities were not up to this task, but a visit to a friend with some heavy equipment made use of his massive (4in. dia.) rolls and the job was done in a trice.

Smokebox tangles

That concludes the pieces of note for the tender, but it remains finally to mention a handful of items which came to light as the locomotive was stripped down for painting. I had not wanted to strip some obvious items needing attention during the main building programme, since that would have led to much unnecessary work, instead I made a note of them and left them until the later stage. The area of greatest import was the smokebox. I had found it impossible to get my



5. The smokebox bottom plate stripped down and exhaust pipe for modifications.

rather large hands through the smokebox door to fit either the chimney or the main steam pipe; the exhaust pipe got in the way, so it had to be split at both ends. I was not prepared to unbolt the exhaust pipe unit from its joints with the cylinders, since that would entail taking up the smokebox floor panels, in itself a rather daunting task.

Photograph 5 reveals the solution to the problem. Each 45deg. section of the blast-pipe is cut to let in a pair of flanges. The three screws are a clearance fit in the upper flange and tapped into the lower one, a gasket is fitted between the two parts. The three screws are positioned carefully so as to allow easy spanner access to them within the confines of the smokebox.

In order to carry out this modification, the bottom had been stripped out of the smokebox (of which more later). It was bolted into the frames with a 2mm spacer to take up the correct position. This enabled alignments to be checked during the installation process. Before cutting through the copper pipe (one at a time), the original flanges at cylinder level were mated up with a template of six millimetre mild steel, similar to that used in the original fabrication job.

Silver-soldering to the lower stump of the bend was no real problem; the heating was sufficiently local to avoid running the lower joints. In order to fit the upper flange

the whole lot was bolted into the template and the loose flange was fitted to its lower mate with a washer separating them to avoid the silver solder bridging the gap. In spite of this precaution mine did bridge on one side of the assembly, so my advice is to fit two standard 4BA washers on each bolt in the gap to make sure. It goes without saying that it is essential to complete one side of the job before cutting the second joint on the other side of the smokebox. After completion and fitting the gaskets, any misalignment of the central blastpipe support can be corrected by some gentle persuasion!

Smokebox bottom plates

During the original installation four 4BA securing holes were drilled and tapped in each side of the bottom casting, but the fitting of the sealing bottom plates was left until the present stage, largely because I had appreciated the present need to open up sensible access for fitting them. In photo 5 you can see how the two pairs of 1.5mm brass plates fit snugly around the blast and steam pipes, lying on the machined surface of the smokebox floor. To allow this to happen I had to remove metal from the casting in the shape of a letter 'C', right down to smokebox floor level. Using one of those 8mm carbide end mills sold cheaply by suppliers such as J.B Tools, the width between cheeks of the casting

was opened up to give about $\frac{1}{16}$ in. land at the front and rear of the sealing area, as can be seen from the newly machined surface near the left and right edges of the photograph. By the same token, the side walls of the casting were reduced to about $\frac{1}{16}$ in. thick, to give a sealing surface of about $\frac{1}{4}$ in. wide for the brass plates.

To machine the brass plates the following was undertaken: the four embryo pieces were cut fairly accurately to size, ensuring that the mating edges were true. They were checked for approximate fit in the spaces where they belong. This enabled a sighting shot to be made at the position of one of the 4BA fixing holes. Now the two sets of four holes had been accurately positioned during the original machining, so the coordinates of their centres could be easily defined for positioning on the milling machine. Bolts screwed into the 4BA holes enabled measurements to be taken to define the coordinates of the steam and exhaust pipes relative to those of the small holes. This was effected by means of long pieces of tool steel bridging the screws, slip gauges making up the gaps to the surfaces of the pipes. One thing is certain: you cannot rely upon the commercial copper bends to be truly circular, so the measurement process finishes up within about 0.015 in. of the best compromise. This is sufficient for our purposes, since the 4BA holes may be enlarged and the holes for the pipes made say 0.008 in. oversize. The sets of four small holes and the large ones were drilled and bored respectively, while the pairs of plates were clamped over a piece of MDF on the milling machine table. A datum set to the joint line between the two sections of plate ensured that the large holes fell equally into both halves of the machined area. A slot drill took out most of the



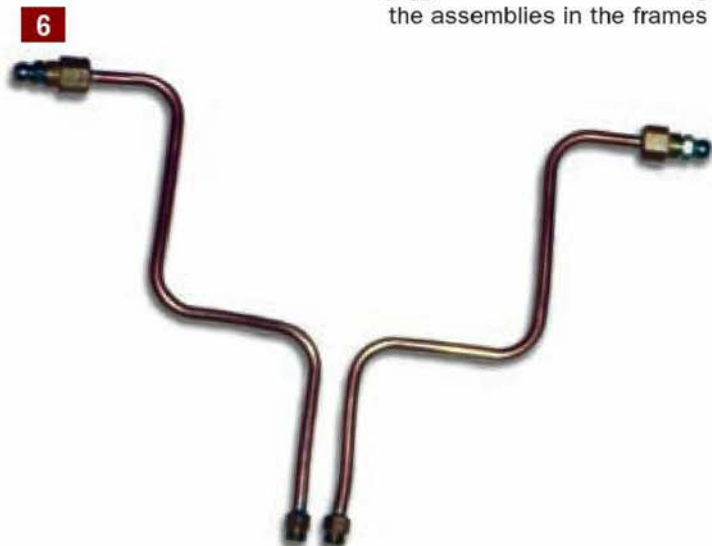
metal from each of the large holes, final boring being by means of a small boring tool. Final fitting includes smearing all the mating surfaces with a liquid gasket such as Loctite Flange Sealant 574. Making sure that the smokebox is airtight is, of course, very important.

While the smokebox bottom casting was accessible, some relief of the bottom area around the steam pipes was machined, so as to make it easier to fit the lubricator pipes in the positions drawn, without needing half an hour to make a couple of joints on final assembly. It is little alterations like this which make for ease in later life! In photo 5, the blastpipe has been refitted and the line from the blower elbow to the blower manifold is in its final position for illustration purposes.

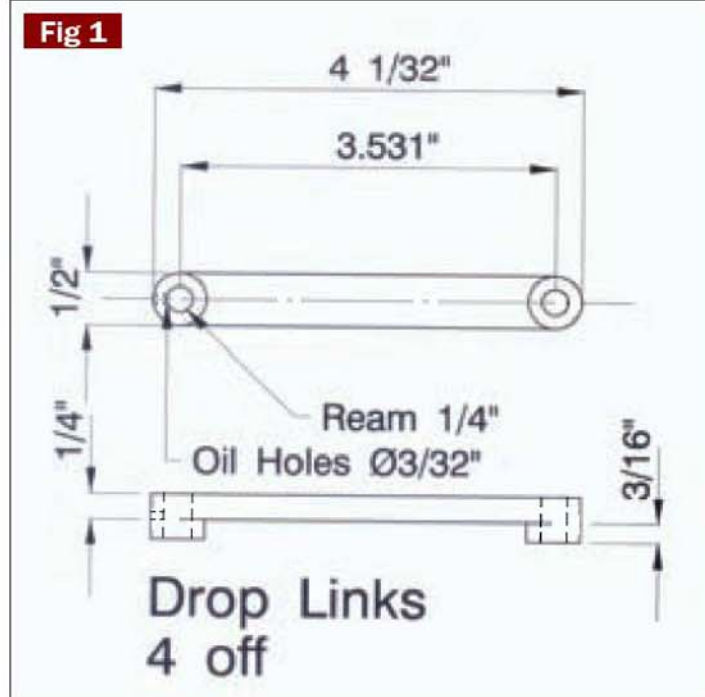
Valve spindle lubrication

The valve spindles have oiling points where they slide through the valve spindle guides, detailed in part six (M.E. 4229, 3 September 2004) of the series and on drawing No. 14 of the set. When the locomotive is fully assembled the only way to gain access to these oiling points is lying on your back under the beast, and even then you would need a Heineken oilcan to defy gravity.

Fig 1. Modification to the valve gear drop links (1/4in. shorter)
6. The oil pipes for the valve spindle guide.



So, with the animal stripped down to its underpants, so to speak, the opportunity was taken to install a pair of oil nipples and remote lines to feed the spindle guides. Going back to photo 5, you can see the two new lines 'Z'-shaped, plunging down to the oiling points which are out of view just in front of the frame valve stretcher. The upper ends of these lines pass through holes which are drilled in the main frame upwards extensions 1/2in. in front of the dummy 1/4in. screws on each side frame. Outside of the frames the lines finish in a standard M6 oil nipple, similar to that fitted to the steam brake cylinder. I have not detailed these lines, as I think that the photograph makes clear where they run and **photo 6** confirms what they look like. The M6 oil nipples screw into short lengths of 3/8in. brass hexagon, which are turned down for a length of 1/8in. to 5/16in. diameter. Six millimetre holes through the main frames are enlarged to 5/16in. from the inside, avoiding the break-through. This keeps the oil nipples in place. At their bottom ends the lines terminate in other short pieces of hexagon brass, this time turned down and screwed 1/4in. x 40tpi for just four threads, to fix into the ready drilled and tapped holes in the valve spindle guides. To insert them it is necessary to release the 2BA screws holding the guides into the frame valve stretcher and to joggle them in before re-fixing the assemblies in the frames



and cajoling the top ends of the pipes into their holes.

Valve gear drop links

I have relented in the matter of the drop links which support the lower ends of the expansion links. In the valve gear description and the details of the cladding around the boiler, I pointed out that Manning Wardle had to make sundry cut-outs to clear such things as the valve gear. I have furnished my own model with such modifications, but the expansion links in full forward gear must, of necessity, cause the drop links to come mighty close to the hot boiler surface. Shortening the links by 1/4in. gets over this problem and keeps them much cooler, which cannot be a bad thing, without jeopardising the valve events in either direction. This small detail change is portrayed in **fig 1**.

Harder suspension

The final small modification is to beef up the suspension coil springs which should improve the ride. The new specification is Lee Spring LC-112J-8. For anyone who has already purchased a set of springs from me, I shall be exchanging them for the new specification. We can make use of the surplus

ones for operating the buffers, where they will be just a little firmer, again not a bad thing!

Conclusion

So that concludes the *Anna* saga; should there be other aspects which you think we have not covered, please let the editor know and we shall see if further work is possible. But now it is nearly time to roll out one or two on the track; as I currently write, there are some 15 examples which have been started, or should I say money has been laid out. These include one 10 1/4in. gauge variant and another which is destined to follow not the Manning Wardle outline, but which will finish up as a Bristol product with *Anna* workings - such is the poetic licence in our great hobby. We do hope you have enjoyed the series as much as we have in producing it!

ME

Drawings, castings and laser cut components for this locomotive are available from the designers. Contact D. A. G. Brown, T. 01780 753162, E. dag@brownmallards.org.uk or Mark Smithers T. 01904 794430, E. mks1960@tiscali.co.uk



For those interested in this design it is a 4-cylinder 16-valve double overhead cam engine, with pressure oil feeds and dry sump lubrication. It is faithful to the prototype and uses the famous cup type followers. The model comes out at 11in. long and 7in. high. It has a 1.032in. bore and a 1.094in. stroke giving a displacement of 60cc (3.66 cubic in.). The compression ratio is 9.5:1 and the engine uses solid state Hall Effect spark ignition with dual magnets. The details were taken from Ron Collona's website at <http://www.ronsmodelengines.com> For those wishing to emulate Desmond and build the engine, sets of drawings and building instructions for the Offenhauser can be obtained from Ron via the site. The engine is machined from the solid, so no expensive castings are required.



1. The carburettor side view of Desmond Wallace's fine 1:4 scale Offenhauser engine.
2. The exhaust side of Desmond's engine.
3. Desmond and Vera Wallace with the Offenhauser.

4



4. John Brown's V-twin engine to Jerry Howell's design.

5. John Brown's engine running on the bench.

A V-twin from Australia

I have received details of another engine from an Australian builder, this time one of my regular correspondents, John Brown. The engine in this case is an almost completed Jerry Howell designed V-Twin (photos 4 and 5). John says that he followed the plans pretty carefully, although he used cast iron liners in aluminium alloy cylinders and had them black anodised. Apparently trying to get nice fins in cast iron didn't work out, heating distorted the fins and also the grooving tool. The pistons are aluminium alloy with the three cast iron rings. Metric screws were used, but where no close size was available John went to the next size up. He says that this "made things tight in places."

The engine is currently running on glow ignition to check that the timing is correct and then it will be changed over to spark ignition. It is a very similar set up to the NE15-S (which John has also built) but two coils may be needed to drive the 10mm NG10 spark plugs.

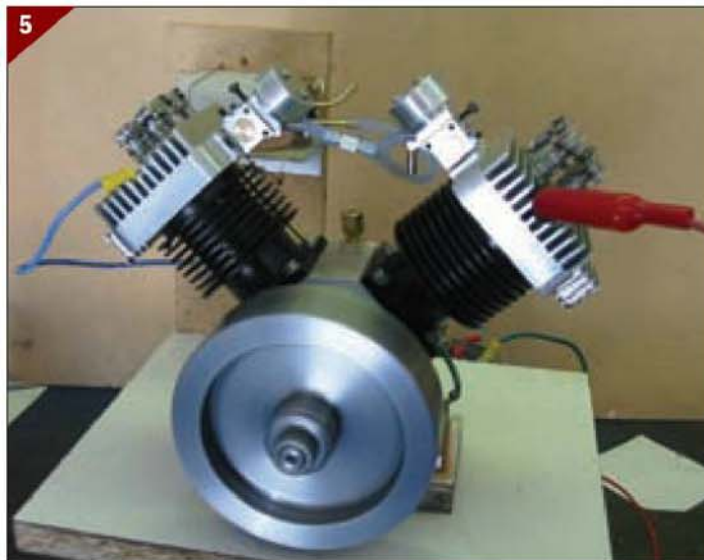
John also has some comments regarding the excellent quality of the drawings which I will quote in full: "Quite often we read of modellers complaining

that plans being used are either incorrect or lacking critical dimensions, Jerry's plans do not suffer this criticism. However, because it is a fairly complicated project, Jerry issues a warning to potential builders, I think it is necessary to have a very clear idea on how you intend to make the various parts and then redraw and dimension it to suit your equipment and procedure. Leave out information not needed at that point. A lot of machining moves from lathe to mill so it's best to get as much done at each set up." I thank John for his notes and pictures and congratulate him on his engine. For those wishing to build this engine, drawings and construction notes can be obtained from Jerry Howell's website at www.jerry-howell.com

This engine is a 90deg. V-Twin engine machined from solid. The single crank-pin 90deg. configuration makes for smooth and vibration free running. The engine is a long stroke, moderate speed design which provides plenty of torque. Forked aluminium alloy connecting rod ends operate on a crank pin making a compact engine. An internal oil pump provides oil to all the internal moving parts and the engine is equipped with ball bearings on all rotating shafts.

A sheet metal shroud on each cylinder/head (not on John's engine) directs cooling air from a pair of belt-driven fans. The valve rocker arms have ball bearing rollers on the valve-

5



stem end and clevises with lock nuts on the push-rods for valve clearance adjustment on the other end of the rocker arms.

The engine has O-ring seals at all joints and a crankcase check valve ventilation system which maintains negative crankcase air pressure to help prevent oil leaks.

The ignition system is twin Hall sensor and twin TIM-6 electronic ignition modules and two model engine coils operating on 6 Volts. Each cylinder is treated as a separate entity avoiding the need for a distributor. Spark plugs are the low cost 10mm NGK CM-6. The above information was taken from Jerry Howell's website.

2-stroke silencing

I have had an email from James Wells in Saudi Arabia who was concerned about my comments on 2-stroke silencing (M.E. 4331, 1 August 2008):

"SIRS, - I am a fairly willing, recent, convert from steam to internal combustion and am just grappling with building a 2-stroke and I recoil in horror at a comment by friend Nemett concerning 2-stroke exhaust systems.

My understanding has always been that "2-stroke exhaust systems are an integral part of the engine system and need to be tuned properly to match the engine characteristics"... but only where the maximum power and speed is required.

Before starting work on my 2-stroke I did look at several powered garden tools and as far as I could tell these seemed to be simple exhaust systems, mostly pressed steel sheet.

My construction has just reached the stage where I have constructed and fitted a simple straight baffled silencer to my 2-stroke engine. Being my first attempt at such a construction and only hoping for a reliably starting engine and modest power could Nemett comment on the possibility of using such an exhaust on a 2-stroke?"

James Wells, Saudi Arabia.

I apologise to James (and anyone else given the wrong impression) because he is absolutely correct in his assumption. I was making the point (or trying to) that 2-stroke exhaust systems can have a much more dramatic effect on engine performance than those on most 4-strokes. This is particularly true of high performance engines but those fitting silencers to the majority of engines will have no problems particularly if the silencer is made large enough. Another of my correspondents, Peter Gain, needed to fit a silencer to a Westbury designed Atom Minor (M.E. 4297, 13 April 2007) and found that the engine ran hot, possibly because it was not designed to be fitted with a silencer. In Peter's case, the silencer was a small one designed for use with

the engine in a model aircraft. This does illustrate the need for some caution, but I hope I have set reader's minds at rest; I don't like to think of any of you "recoiling in horror."

Exhaust systems and firing order

Ron Wright has also taken me to task for my comments regarding firing order of flat twin and flat four engines in the same article on silencing:

"SIRS, - Nemett mentions flat twin or 4-cylinder engines, presumably 4-stroke, with cylinders firing in pairs. Now I might be wrong but I have never heard of 4-stroke engines firing in this manner; in fact a basic rule of engine design is that pistons which move via TDC and BDC together are always on opposite strokes, -and a good example of this is the common 4-cylinder in-line layout in which pistons 1 and 4 and 2 and 3 rise and fall together which being opposite, i.e. - cylinder 1 on the power stroke, 4 on exhaust etc., determine the only two possible firing orders of 1, 3, 4, 2 and 1, 2, 4, 3. The same applies to an in-line 6-cylinder engine in which 1 and 6, 2 and 5, 3 and 4 pistons rise and fall together giving several possible firing orders, two of which are in common use; 1, 5, 3, 6, 2, 4 and 1, 4, 2, 6, 3, 5.

For any given engine a firing order will be selected to give even torsional loading of the crankshaft and even mixture distribution to the cylinders from the carburettor."

Ron Wright, Surrey.

Ron is also absolutely correct, I also have not been able to find examples of such engines with opposed cylinders firing together. I was just making the point that if that situation occurred, the exhaust system must be designed to take account of it.

In fact a flat twin with such a firing arrangement will behave much like a big single with one large power impulse every other revolution, but being a flat twin it will be in almost perfect mechanical balance.

The alternate firing arrangement will generate a slight sideways motion to the engine (as the cylinder on each side fires) but will provide much smoother power delivery with alternate power impulses. This illustrates the compromises that may have to be made between mechanical balance and smoothing the power impulses to get an engine which does run smoothly and also as Ron says, to even the torsional load on the crankshaft.

It is worth making the point that some full-size motor manufacturers have got it wrong on occasions, there was one V8 (I think a Buick) some years ago which had its camshaft (and hence firing order) changed to cure vibration problems. Also while I was searching the internet to check some firing orders I did find reference to the Alfa Romeo Alfesud flat four engine which, according to one site, had the cylinders firing 1, 3, 2, 4 where 1 and 3 were on one side with 2 and 4 on the other side which does not sound very smooth, but having owned one many years ago, I can vouch that it was exceedingly so and would hit the rev limiter very easily. The Subaru Impreza has the same firing order but a Subaru owner tells me that they always sound odd because the exhaust header pipes are not equal lengths.

If any readers know of examples of engines with 'odd' firing orders, please send any

details. I thank all those who have sent information and comments and would encourage others to do the same.

Future Nemett engine designs

I am now 'cutting metal' on the 15cc twin, so hopefully the engine will not be too long in the workshop. In the meantime I am thinking about future offerings and would like to encourage interested readers to think about what they would like to follow the twin. Because I have produced a standard 15cc pushrod operated overhead valve cylinder and head assembly, creating new engines will now be a much faster process.

Essentially the new engine can use any suitable arrangement of such cylinders

and I have no pre-conceived preferences for the next design other than using the existing cylinder/head assembly.

Some options are flat and V twins; 3-cylinder in-line; flat, V and in-line 4-cylinders; flat, V and in-line 6-cylinders; or even a radial engine. To give an idea of the look of the new engine, I have produced pictures of a 3-cylinder in-line engine (**fig 1**) and a straight six (**fig 2**).

I will take note of any preferences from those interested and would like to start on the design before the end of the year so that it can be available in a much shorter timescale than that for the twin.

Either write to me via the Editor or email direct to nemett@vodafoneemail.co.uk with your suggestions. **ME**

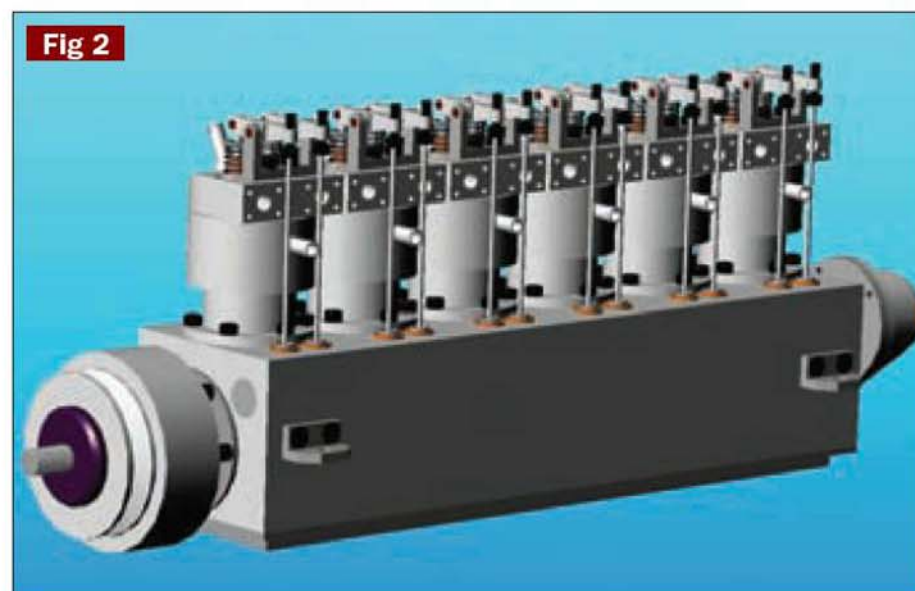


Fig 1. How about an air-cooled 3-cylinder in-line engine for the next design...

Fig 2. ...or even a straight six marine version?

A no-frills cylinder drain valve

Harold Pearson describes a simple, centralised valve for draining condensate from locomotive cylinders.

I have the highest respect and admiration for those in our hobby who construct fully detailed classic models, I freely admit that I am not capable of such dedication. An added complication being that the last 35 years of my working life has been spent moving from one developing country to another. The only period I was able to plan ahead, to some extent, was when based in Lesotho for four years. At that time I was able to sort myself out a reasonable home workshop and decided to build a 0-4-0 Ajax (I love 0-4-0s as I hate machining wheels). The locomotive was completed and first steamed in just 10 months, pulling its first passengers at the Bloemfontein society's track at the Modenzo Park in

Bloemfontein, South Africa. When I returned to Britain, Ajax was stripped down and modified to a 0-4-2 wheel arrangement. Amongst other modifications I fitted drain cocks, for some strange reason, drain cocks are not shown on the original drawings.

I feel drain cocks are quite an important item, in particular on locomotives with hefty cylinders. It is really not much fun having, what amounts to, half a cupful of boiling water and oil deposited upon one's head, when trying to pull away with cylinders that are not up to working temperature, passengers also tend not to see the funny side! The valve described in this article is for a 0-4-0 tank locomotive in 7½in. gauge.

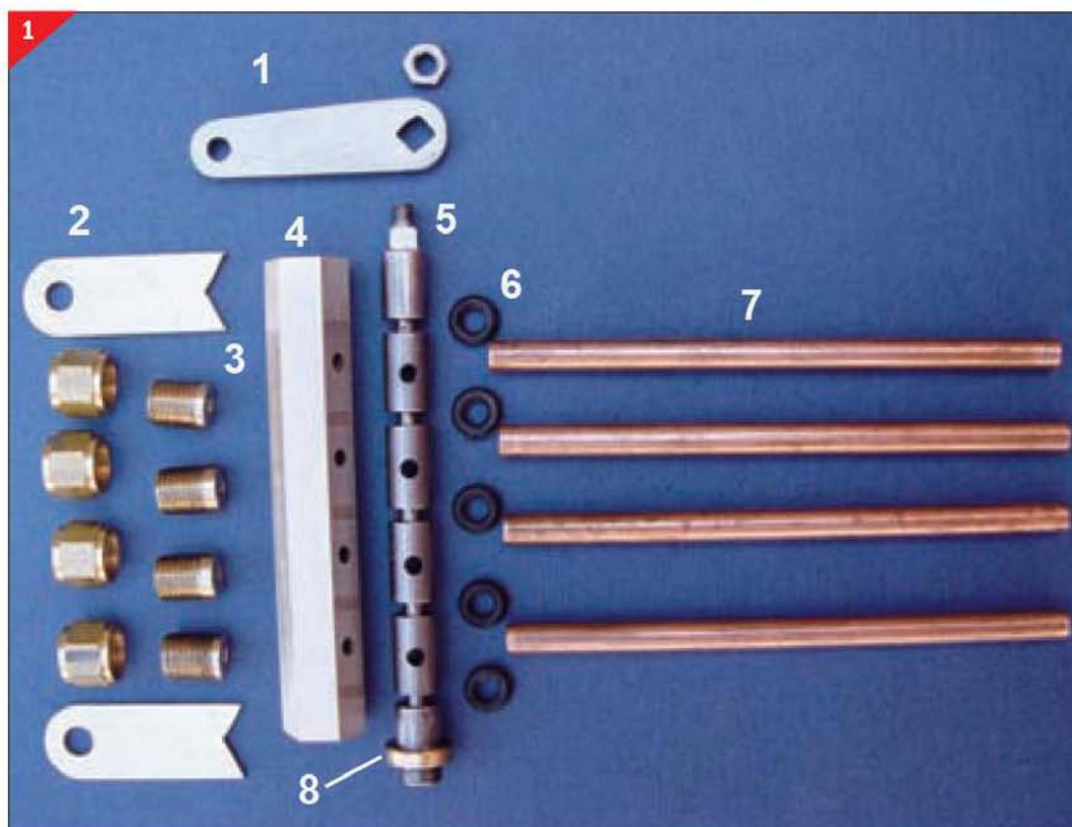
Early trials

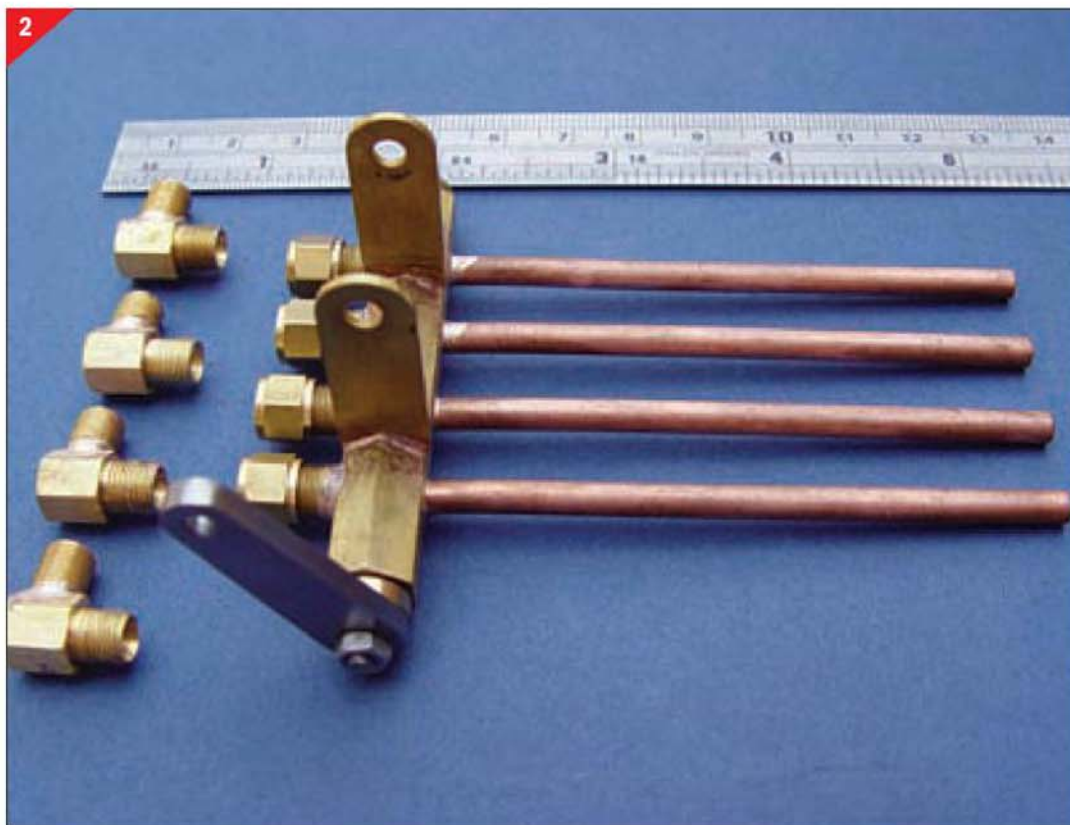
Whilst I had the locomotive stripped down for other modifications, I had drilled and tapped the cylinders to allow the fitting of drain cocks. However, I really wanted to avoid the fuss involved with the standard design, with its little tapered plug cocks and the complex, delicate, vulnerable mechanism required to operate them. Therefore my first attempt was with automatic drain cocks. These were quite simply little horizontal ball clacks without a spring. The idea was that when the locomotive was at rest, the balls would fall off their seating and allow any condensation in the cylinders to drain away. Once steam was admitted to the cylinders, the balls would be forced onto their seats, closing the clacks. In practice they didn't work very well. Most of the condensate did not drain out and, as soon as the steam was put on, the little clacks closed and the hot water and oil once again found its way out of the chimney, vertically upwards, staying aloft long enough for me to arrive underneath and be treated to yet another hot water and oil shampoo. (While coming up with the idea described below, I changed the locomotive's lubrication system from mechanical to hydrostatic. This did have the effect of reducing the amount of oil in the water, which pleased my long suffering wife who had the onerous task of washing my shirts).

Design

Having put further thought to the matter I began to wonder

1. Key to Parts of Four Port Cylinder Drain Valve: (1) actuating lever; (2) mounting brackets; (3) inlet bosses; (4) valve body; (5) valve core; (6) five O-rings; (7) copper drain pipes; (8) spacer (two required).





2. The assembled drain valve with the fittings that screw into the bottom of the cylinders.

3. My modified Ajax 0-4-2. The cylinder drain outlets can just be seen behind the buffer beam.

why it was necessary to have four separate drain cocks, why wouldn't one do and just pipe the four pipes from the cylinders into the one drain? After further deliberation, I came to the conclusion that this may not work very well for the following reasons: the cock itself would probably be a bit cumbersome and it would not be at all easy arranging all four pipes to meet at one point. It also occurred to me that there was a very good chance that the water leaving one cylinder would simply chase across and deposit itself in the opposite cylinder! However, not to be beaten I went back to the mental drawing board and came up with the idea of a single valve that would have four separate ports. The valve would only need one operating mechanism which could be arranged well out of harm's way, (I think the word valve better describes the gadget).

I went ahead and constructed a four-port valve, which I fitted to Ajax. That has worked without fault for over 10 years. Of course, I fully understand that the mechanism I suggest could

not be fitted to classic scale models. However, I do believe there is nothing wrong with fitting such a design to a workhorse model such as Ajax or to club locomotives where simplicity, reliability, long life and ruggedness are perhaps more important than pure aesthetics.

Photographs 1 and 2 should give enough information for anyone interested in designing the valve to fit their particular model. Also shown in photo 2 are the four adapters that screw into the bottom of the cylinders, these take standard $\frac{1}{4}$ in. x 40tpi unions for $\frac{5}{32}$ in. dia. pipe.

Construction and assembly

Silver-soldering a number of small parts in close proximity is not as difficult as it may seem. I have noticed that silver solder appears to require a higher temperature to melt the second time round. If you are careful and keep the flame on the move there is little chance you will undo previously made joints.

The valve body is made from brass or bronze 2.5in. long hexagon bar which makes drilling and mounting the parts

easier. The O-rings should be a good fit in the bore. It's also a good idea to slightly bell mouth the entrance of the valve body to assist the O-rings on their way in.

The valve core is made from $\frac{1}{4}$ in. dia. stainless or bronze rod and the core diameters turned a few thou over-sized to ensure the O-rings seal properly within the bore.

Five O-rings are required, their size is $\frac{1}{4}$ in. O/D x $\frac{1}{8}$ I/D.

Two spacers are needed to keep the spindle aligned in the body, see part 8, photo 1.

Referring to photo 1 for part numbers: First, I soldered the four inlet bosses (3) to the valve body. These bosses are $\frac{1}{4}$ in. x 40tpi to take $\frac{5}{32}$ pipe. Make sure everything is nice and clean, and only use the minimum of flux in a weak solution. Using hexagon bar does make life a little easier working with the flat surfaces. Flux up and carefully perch the inlet bosses over the holes in the body. I have found it easier to cut very small bits of solder and place one at each joint, rather than trying to apply solder via the shaking tip of the solder, which can stick and move the part being soldered!

Next, position and solder the mounting brackets (1). Space the brackets by putting a bolt through the two holes, positioning the brackets on the bolt with nuts. Flux up and solder as before.

Prior to soldering the four drain pipes (7), I very lightly counter drilled their positions on the body, creating positive locations for the pipe ends.

The completed valve body can be cleaned up by leaving it in a small dish of citric acid or vinegar. On assembly pop the O-rings on the spindle from the lever end and into the first groove first and so on; use a spot of oil to help them along.

The operating mechanism can be a simple push pull from the cab or, if you prefer, a nice little lever with an extension that goes down the side of the boiler, possibly directly to the drain valve operating lever or through an intermediary pivot. It would also be possible to use a Bowden cable.

On Ajax, the drain valve is mounted between the frames on a bracket held in place by one of the cylinder bolts; no need to drill any new holes in the frames. **Photograph 3** shows my 0-4-2 Ajax. The four outlets from the drain valve can just be seen above the guard rail, under the buffer beam.

ME





Roger Backhouse describes the man who made engineering heroic.

For most of history engineering has been largely looked down on by historians. One man did more than any other to publicise achievements of engineers and help ensure their place in history. He was Samuel Smiles, prolific author and moralist. Samuel Smiles was born in Haddington, East Lothian in 1812 the son of a paper maker and merchant. At school he showed little ability out of the ordinary. He was apprenticed to a doctor and studied medicine at Edinburgh University.

As a doctor, patients were few, so he wrote his first book on physical education. This led to many more articles and an invitation to edit the *Leeds Times*, then a radical paper. Smiles was a regular lecturer aligned with the moderate Anti-Corn Law League rather than the more working class Chartist movement. His first lectures were eventually published as his most popular

ENGINEERING'S LOCAL HEROES

Samuel Smiles of Haddington

book, *Self Help*. This was later followed by others with such moralising titles as *Thrift, Duty and Character*.

Railways expanded rapidly in the 1840s and Smiles was asked to be Company Secretary of the new Leeds and Thirsk Railway, later part of the North Eastern Railway. He learned of George Stephenson's work from a mutual friend and wrote a successful biography, taking the trouble to interview childhood friends and acquaintances. However, not all he wrote was accurate and, in idolising Stephenson, he played down the role of Timothy Hackworth in railway development.

Smiles was then appointed Secretary of the South Eastern Railway where he remained for many years. The SER suffered a divided Board which ignored the threat of the London, Chatham and Dover until it was too late. However, in his time it started the Charing Cross extension and experienced the first great train robbery when bullion vanished en-route for France.

Despite these duties he found time to write. His multi volume *Lives of the Engineers* describes careers of civil

engineers including Smeaton, Telford and Rennie before going on to describe Boulton and Watt. A later book *Industrial biography - iron workers and tool makers* covers Henry Maudslay, lesser-known lives like Benjamin Huntsman and near contemporaries like James Nasmyth. In these books engineers are the heroes, often rising from near poverty and fighting against many obstacles to succeed.

Smiles was no flag waving nationalist. He praised the energy of the Huguenots and wrote about the historic weaknesses in British engineering compared to the French. His books were translated into many languages including Japanese.

Smiles died at his home in Blackheath in 1904 where a blue plaque marks the house.

His words stand as a suitable epitaph "History, no doubt, deals with the affairs of courts, the deeds of statesmen and the exploits of warriors, and takes but little heed of inventors or mechanics, on whose industrial labours civilisation and history of the best sort mainly depends." **ME**

Alien Abduction!

James Wells has a 'close encounter' with a night light!



This little project started out as a simple demonstration to a class about forming a plastic shape. After the demonstration I had a couple of hemispheres to spare and my young daughter asked if I would turn the two pieces into a night light.

I was willing to do this and wondered just exactly she might have in mind as I thought that this might be

something that would normally just give a dim light but she wanted something like an 'Alien Abduction'.

This was fairly easily accomplished with series of LEDs based on the 555 series chip. By using different capacitors various flashing LED rates were possible. In subdued light, with the top LED flashing differently to the front flashing light sequence, it's quite an interesting sight. **ME**

Pico-Hydroelectricity and the model engineer

Marcus Rooks looks at the possibilities for running your own eco-friendly generating plant.

In this age of global warming and the perceived need for renewable energy sources, small scale hydro electric plants have been somewhat neglected in favour of wind power. In the heart of the Cornish countryside nestles a haven of hydroelectric power; Rupert Armstrong-Evans has been involved with providing hydroelectric plants for a generation.

For nearly 200 years the Evans family had been involved with industrial production of pumping systems; at one time Evans pumps were probably the largest manufacturer in the world. They also were responsible for the manufacture of most of the Pickering steam governors produced. Rupert has been responsible for the installation of possibly half of the small-scale hydroelectric plants fitted in the UK and has installed his own generating system. His knowledge about the subject knows no bounds.

There is a basic classification for small generating plants. The size that the model engineer would be looking at would be either classed as micro-hydro, referring to plants up to 180kW or more realistically pico-hydro, which relates to plants generating up to 5kW, which would probably be the range for the average amateur.

Not for the faint-hearted

Fitting a hydroelectric scheme, I think, is not for the faint-hearted. The problems of installation will always make it a minority way of generating electricity. Finding a suitable water supply is the chief problem and it is not sufficient just having a river running past your house!

The site in Cornwall is on that of an old mill so that it already had the advantage of having a leat providing water from the local river, from which it has been drawing water for over a century. The original mill used a traditional overshot wheel which was converted to generate

electricity by connecting it to a suitable generator. The problem with such a method is that the speed of rotation of the wheel would be measured in perhaps tens of revolutions per minute. To operate a suitable generator the speed had to be stepped up to about 1,500rpm, the speed of a comparable diesel engine.

The original wheel was abandoned a number of years ago and a dedicated powerhouse containing modern micro-hydro plants was constructed. The water flow was diverted from the old wheel and now flows from the leat via a series of sluice gates into the powerhouse. There is provision for an overflow weir to take away excess water.

There are three propeller-type turbines that can be used to generate the electricity. The two smaller turbines are about 12in. diameter, whereas the largest is over 2ft. diameter. This is the one that has been used regularly, generating 15kW on a continuous basis and up to about 20kW for

1. The original overshot waterwheel is now abandoned and rusting away. This was a slow running wheel that required considerable gearing up to achieve a working speed at the generator.



2. The leat gains the water from a nearby river. Two main sluice gates control the flow. If necessary it can be completely stopped and the two gates allow considerable flexibility with the flow rates.



3. The overflow from the plant is diverted over a weir and back to the source.



4. Sluice gates from the reservoir control the flow into the header tank.



5. Water flooding from the reservoir into the header tank and down into the turbines. The curved mesh acts as a sweeper and fish barrier. The turbine inlet valves are not visible in this shot as they are behind the sweeper net.





6. Having passed through the turbine the water is exhausted back to the source.



7. The heart of the plant is the turbine and generator. The turbine is housed in the sloping pipe allowing the drive shaft to exit the pipe. Pulleys connect the shaft to the generator mounted over the turbine. The main electricity supply cable can be seen running to the control box.

8. The switchboard contains the various control circuits and switchgear.

9. This is a simple impeller about 8in. diameter.

10. Wax patterns for bucket type blades for a Pelton wheel type of turbine. When cast these are attached to a main hub and water jets are directed into the buckets.



Model engineer use?

This set up is quite elaborate but is typical of a micro-hydro project that Rupert can install. The question for us is can any of this technology be used by a model engineer? I think that the answer to that question is definitely yes, but in certain circumstances only. I think that if anyone is interested than some of the following points should be addressed.

1. Is there a source of water especially with a suitable head of a metre or two? It is difficult to assess the flow rates by eye but, if possible, up to a cubic metre/second should be available. It is possible to estimate the amount of power available from source.

Power (kW) = Head (m) x Flow (Cu. m/sec) x Gravity

The head is relatively easy to calculate. It should be possible to estimate the flow of water over a set period. The force of gravity is rated at 9.81 metres per sec/per sec.

However, this would be the theoretic output, realistically mechanical and hydraulic losses could amount to 50%. These should be taken into account when deciding if there would be enough power available.

From the formula, as gravity is constant, the amount of

power available is directly proportional to the head and flow. Double the head and the power is doubled; double the flow and the power is also doubled; they are of equal importance.

Newer generations of water turbines are being developed and are known as low head turbines. These are designed to run of very small heads; some designs claim 70% efficiency from a head of only 20cm, being able to generate a steady 1.2kW. These low head turbines work by encasing and using the available water for the whole length of the drop rather than the traditional one point of power production.

2. Having decided that there is sufficient water, is it accessible? Such things to consider are: leats to supply the water; how much would it cost to take water from the source? This could be quite expensive. Unlike using the wind, which at the moment is free, access to water supplies is not. The relevant authorities may only allow a certain amount to be drawn off, as taking too much may

prejudice the ecology of the source. There may also be objections from interested parties such as fisherman and boating clubs; all would need to be consulted.

3. Protective measures such as anti-fish screens would have to be installed. They would need to be about 1cm mesh size. A method of cleaning the water source of leaves, branches etc. would also be needed otherwise the plant could be badly damaged.

4. If you wanted to sell excess electricity then you would have to liaise with the relevant electricity supplier as to how much they would pay; this could be anything between 3-6p a unit. The switchgear would also have to be approved as it would be necessary to supply the electricity in phase etc.

Help could be at hand in that there are now commercial wind powered electricity generators on the market. These out of necessity would have to overcome all of these hurdles. If it were not connected to the grid, although there would be no money from electricity sales, it would probably make construction and operation a lot easier.

The heart of the system is the turbine wheel itself, basically there are two types. The simplest would be a propeller type. Here the sheer volume of water passing over the inclined blades provides the necessary rotation. This can operate in two conditions. There can be a high pressure but low flow rate, or relatively high volumes of water under low pressure. However, if the water pressure is too low then the size of the impeller becomes unreasonably big.

Pelton wheel type

The other form would be a Pelton wheel type. Here the wheel comprises a series of buckets arranged radially around a central boss. High-pressure water in a jet form is directed into the buckets and the reaction causes the wheel to rotate. This is possibly more efficient but more difficult to make.

short periods. The chief limiting factor is the supply of sufficient water; at maximum output it requires about 1¼cu. metres/sec. flowing through it.

The other restricting factor when using high volumes of water is a cavitation effect that is set up by the water tunnelling down a vortex, similar to water going down a plughole. If it becomes sufficiently established, air is drawn down the centre and into the turbine and greatly reduces the efficiency. It is important that there is a method of destroying this vortex before it can become established.

The electricity produced is fed either directly into the house or into the national grid, allowing the unit to pay its way. There is sophisticated switchgear that allows automatic shunting of electricity depending on load and demand.

A micro hydro plant could be constructed using readily available materials. A metal impeller could be obtained from a cooling fan from a large internal combustion engine, these are relatively easily available. This has to be closely fitted into a suitable bore tube, such as heavy-duty plastic waste pipe, which can be obtained from builder's merchants. By fitting a bend in the tube the impeller shaft can be run outside the tube and connected via a series of pulleys to the generator.

There are suitable permanent magnet generators available, which can run off relatively low speeds. A 48V generator could develop 42W at 380rpm and a whopping 1472W at 610rpm. A 12V generator could develop 53W from just 260rpm. These develop A/C current so it would need to be rectified to be stored in a lead/acid battery bank.

If such a unit could be installed in a simple construction that allowed between 1-2 metres head,

then enough water should pass through. The water from the supply should be fed into a reservoir on top of the inlet. There should also be a simple overflow weir to allow excess water to bypass the turbine. All the wastewater should then be run back into source, such as a river. The water supply to the turbine could be regulated by a simple valve which can allow for variations in water pressure and volume.

What could we expect from our micro hydro plant? I think that a modest aim of a micro

hydro system would be to charge a battery driven car. This would be an admirable green goal as there would be absolutely no pollution involved in running the car. But I feel that quite a large plant may be required for this purpose but would be worthwhile trying.

I hope that I have whetted the appetite for hydroelectric plants and I would be interested to hear from any model engineer who has successfully (or not) built a micro/pico hydroelectric plant.

ME

A vice tip

Peter Spenlove-
Spenlove provides a suggestion for holding heavy round objects in the vice.

To protect the screw of your vice when clamping heavy objects, I've made a simple device out of 1in. thick aluminium plate (**photo 1**). Besides protecting the screw, it also raises work to the right height to be clamped by the jaws.

The shape of this fixture is determined by the size and construction of your vice, mine is a Record 75 in cast steel (5½in.) on a swivel base and the shape of the slot is shown in **photo 2**.

It's important that the lower sides of the cutout are a good fit, but not too tight, against the slide bar (**photo 2**). The steps that rest on the top of the slide bar are important, too. Shape the U-slot to suit the vice. The height can be whatever you require to suit the size material you need to clamp.

ME

1. The device is shown supporting a 3in. dia. piece of stock. It can also be used for square or rectangular work, too.

2. The shape of the cutout shows the steps which rest on the top of the slide bar and the U-shaped slot to clear the screw.



A Time-saving tip

Neil Heppenstall suggests a quick and easy way to keep tee-slots free of swarf.

The tee-nuts used on my milling machine are rather close fitting in their slots and they easily jam on swarf particles when being removed.

Consequently, I used to spend quite a time cleaning out the tee-slots between jobs.

I have now cut a length of ¾in. square, bright mild steel bar into pieces, which I drop into the vacant portions of the

slots almost filling them. Use whatever size fits the slots on your machine, of course.

By this means, I have a milling table surface which is much easier to keep free of swarf.

ME

Keith Wilson

muses on some of his outings to miniature railways this summer.



A boiler matter that I cannot recall reading about in 'ours' is the matter of how much silver-braze is required for so-and-so boiler! It depends to some extent on the skill of the 'brazer', of course, but for an urn about 8in. diameter and 30in. or so long, it can be done with one kilogram. A very rough guide of course; but several clubs buy in bulk and re-sell to club members showing a bit of profit for the club and doing a good turn to members.

GWRillian progress

At present working on my GWRillian kettle, it can take some time to get it 'tight'. Also some time to heat up, and even more to cool off. Tricky to get into acid bath (and for that matter, out of it!) and more than two reheats per day is about upper limit. But not much chance of avoiding, it just has to be done.

So use of small air-pump of some sort and stethoscope finds some leaks; as soon as these are treated smaller ones will show up. This process seeming everlasting; I can still carry on in the workshop, but not as fast as I used to.

Excel programs

My recent offer of Excel calculating programs for indexing has caused me to send off many copies of the program. Since I am mainly here to help, I mention some other programs available on the same terms, i.e., zilch. There are ones for plotting large radius curves, such as on cab roofs and tender coal guards; leaf spring calculations; offsets on curves, useful when checking bogie movements to go around curves; and one or two others - such as SWG sizes, numbered drill sizes, tapping

and clearance sizes for BA and BSP threads.

Without any intention of criticising authors of books of workshop information, much of the information is of great interest to some folk and useless for others, therefore all notes on swgs, drills, tapping and clearance all on one sheet can make life that little bit easier. E. keithgwrrloco@blueyonder.co.uk

Echills Wood Railway

On Sunday 3 August I was lucky enough to attend the Open Day at Echills Wood (Kingsbury Water Park), it's always complete but never finished. I managed to get a few photographs, which photographers of locomotives will confirm 'tis not one of the lighter tasks. About 12 locomotives were present, but not all in steam at once!

King Charles III was running (photo 1) and I had two circuits, on the second of which I lost 'ze puff' and had to be 'de-passengered' and shunted off the main line. But he ran steadily enough when Alan was driving, it always seems to go down if I drive too long, but with a firebox about 17½in. long it is no light matter to keep it well-coaled. Also, with such a long boiler, from the water gauge point of view there is a big difference between gradients 1 in 100 up and 1 in 100 down.

I understand there were several people visiting from Holland, and believe the smart

1. The King Charles III seen at Leyland with a fair load passes through the station area.
 2. A German tank locomotive visiting from the Continent.





3. Thirlestaine Hall doubled-headed with a prairie. The empty train was comprised of eight riding carriages.

4. The double-headed 'Royal Scots' sitting in the station.

black stoomlocomotief - I am not sure of correct spelling - a tank engine was beautifully made and ran very well. Black locomotives are one of the hardest to photograph without perfect lighting and background, but without either I have done my best. (photo 2)

Thirlestaine Hall by John Hancock, was double-headed with a GWR Prairie (originally made by me, but nicely rebuilt by the current owner), made a pleasant GWR sight, and you can see the length of the train they took. Although empty in the picture, when full it must have been not far short of 3 tons; quite a load (photo 3).

Another double-headed train was the one with two 'Royal Scot' locomotives putting up a fine show. Alas, they were both 2-cylinder versions (full-size Scots had three) but to find a 3-cylinder miniature Scot is a tough task. Cannot blame

the builders, because from operating point of view they work just as well (photo 4).

Many years ago (about 30) I did the design work for the third cylinder by special request, later repeated for a Schools class but I am not certain of the present location or state of either. I think that the Scot is up at the Stockholes Railway, whether the 'Schools' was completed by Alec Farmer I know not.

There was a nice Dart present plus a 'small Prairie' on the steaming bays, but I did not see either run. A fine 'Britannia' took its share of passenger hauling, and a Black Five did its share too.

An LNER Pacific took a good few loads round the track, and a Warship plus a Hymek did some useful work. A couple of small diesels pulling their owners (running light) helped keep the line busy by running

inbetween big passenger trains. At one time there was a fine freight train running around, a long line of scale goods wagons plus a Toad at the end. Loose coupled of course, therefore more realistic.

I think that there were one or two other locomotives present, but although my electric chair is happy on smooth surfaces, gravel loose-packed is another matter, likewise crossing railway tracks. I therefore offer apologies for any that I have missed.

'Scale day' at Leyland

Not sure just what 'scale day' means, but many visiting locomotives of course all welcome.

Steam, electric, diesel, and one or two diesel outline, but electric-powered. I list as many as I can and as above at Echills Wood, request forgiving for those missed.

I learned an interesting lesson, or at least realised something that I should have noted earlier.

There is an advantage of one sort in 3½in. gauge locomotives that 5in. can barely manage and 7½in. could, but dare not. Puzzled? Simple, once understood 'tis obvious. They can run at full speed, admittedly with lighter loads, whereas although 7½ handles the heavy loads but nowhere near such high speeds - relatively that is. Although I witnessed a 'Highlander' (7½ Black Five) reaching 31mph. (running with only the driver) I believe one of my Kings or Castles (or even Saints) might beat this due to bigger driving wheels, but I sure ain't gonna try, not no-how.

Recall that speed looks much faster at ground level, and that roughly 10mph for 'us' is about 78 if built to scale of 19/78 (which is dead right) or 1/8 (wrong but understandably so) and seems very much faster from the train.

I saw two 'Maisies'; one of Curly's most popular designs, and was lucky enough to photograph them together (photo 5). A Princess Marina (2-6-0) ran well, and an LNER





5. A pair of LBSC-designed 'Malsies' in 3 1/2 in. gauge.

6. A really cute 0-4-0, possibly based on LBSC's Juliet design, was a fine runner.

7. A Lancashire and Yorkshire 4-4-2 'high flyer'.

4-6-0. A 2-10-0 was doing fine work, and there were some others, for example the fine little 0-4-0 in **photo 6**.

Coming to 5in. gauge, a fine Saint did some work, and a nice London Transport 'Growler' looked good (they all do). I remember seeing these growling along the tunnel from the East into Baker Street Station and branching to the right en-route for Rickmansworth, where they came off the train and steam took over, fairly big tank locomotives being used - I think

they were 2-6-4T, but could have been 2-6-2T. I don't know far out they ran, probably to Aylesbury. Later, electrification was extended to Amersham and from there a Diesel service to Aylesbury on the old Great Central line.

Musical encounters

It was late in 1978 when Brenda and I met at a 'do' after providing some vocal work for one of the late Ralph Reader's big shows. A version of 'musical chairs' was in force but 'musical laps' is a better description. Just before the 'off' all girls had to move round one lap; that's how we met.

We did not do any singing to speak of until we discovered a fine little group in Devon. Until we had to leave Devon (financial reasons) we sang on a regular basis. We sang with a big choir in Wolverhampton for about three years. Then I

changed to a 'posher' choir - mainly because they rehearsed literally next door - and I was therefore more interested. A small consort in Wolverhampton then accepted us for the next 14 years, until we moved into a bungalow in Ashton-in-Makerfield, just south of Wigan.

I joined a male-voice choir, and surprise! The grandfather of our youngest piano accompanist is a fan. He was 'tickled pink' at the thought that I was living not so far away, and I hope to meet him someday.

It reminds me of a musician I met in Germany in 1956. After long chatting sessions we discovered that he had been in the same class, same school, as myself and young brother. Small world?

A touch of humour

I was camping at Gilwell Park many years ago, and a group of us was chatting generally, when one of the chatterers (one of the 'high-ups') remarked, "last week-end, one of the campers started to chop wood at 4 o'clock in the morning." Within a fraction of a second came the reply, "where's he buried?" Typical Scout humour, but it wasn't me for once.

Another good one occurred at a different time, and is a fine example of a gentle insult. Asked to show the way to some place or other, the reply was "down there for about 50 yards, and it's on the left." As he said it, he leant forward and touched the inquirer's left arm saying, "that's your left." Neat. **ME**

WILSON'S WORDS OF WISDOM

The boy stood on the burning deck whence all but he had fled. Twit!

Sir Spike Milligan





Malcolm Stride reports

UK club news

The raised track maintenance team at **Bristol SMEE** is having a well earned break during the running season while the track manufacturing team are busy trying to construct a "significant number of track panels" ready for the winter season. There are 37 individual panels to be laid this coming winter, so Ashton Court will be busy, in spite of having no trains running. The track manager, John Winter, reports that passenger numbers carried in a single day have passed the 2,000 mark, with more than 2,400 passengers carried on one day this year.

In order to improve signalling at the **Derby SMEE** track, a new distant signal has been installed. The new signal duplicates an existing signal to provide greater warning of possible hazards on a curved section of the track. Ray Summers was "cajoled or coerced into the dubious role of chief projectionist" for the members slide and film evening. A wide range of films was shown by Ray who was judged to "have put on a splendid show".

The **Model Steam Road Vehicle Society** rally was a success this year after last year's flooding. The live steam section had 65 exhibits booked in and the model displays were housed in a much smaller marquee with party tents and awnings providing a double row of exhibits which was named 'Model Avenue' with a suitable sign. Commentary was provided by Barry Coyston and his "virtual non-stop commentary made everything flow with military precision." Ray Stubbings was awarded the Andy Brown Memorial Trophy for outstanding service to the society by a young

person. This is the second year that Ray has been awarded the trophy.

The Gala Weekend at **North London SME** was a great success with a good selection of activities including several locomotives on the track and slot car racing. Entertainment was provided by a jazz band on the Saturday evening and a 1960s themed band on Sunday afternoon. Those present enjoyed "a truly magnificent weekend." The standard gauge enthusiasts were delighted that a standard gauge locomotive was running on the ground level track, this was Chelmsford member Melvin Bright's magnificent 7½in. gauge 9F which was in steam throughout day. Andrew Smith, Managing Director of landlords Three Valleys Water, took the controls of the first locomotive to officially open the ground level extension and raised track deviation during the day. The July general meeting saw several hot air and steam engines demonstrated, the latter with the aid of *Edward the Compressor*. Several "ponderous and very old single-cylinder vertical steam engines" were coaxed into life. These included a beam engine built by De Havilland apprentices which was removed from its glass case for the occasion.

Club events

I regularly receive short reports on club events of all types and have decided to start a special section in *News* for such things. I would encourage all those responsible for club events to send in notes and pictures for these pages.

I will start with events at **Worthing DSME** and **Reading SME**.

Worthing DSME Exhibition

The bi-annual exhibition took place in April this year and was opened by honorary member John Brierley with a visit by the local Mayor and her Consort later in the day.

The exhibition had a wide variety of model engineering exhibits ranging from clocks to Stirling engines via locomotives, traction engines, boats, railway layouts and I/C engines. Two of the most impressive exhibits were displayed in the centre of the hall. The first was Chairman Kevin Ayling's 5in. gauge Kitson-Mayer articulated locomotive (**photo 1**) and the second was Brian Brookes' enormous 5in. gauge Bayer-Garratt (**photo 2**). The latter required a side window of the hall to be removed to get it in! Those with a penchant for the smaller gauges were catered for by some small gauge layouts (**photo 3**). The new club

1. Kevin Ayling's Kitson-Mayer articulated locomotive at Worthing.
2. Brian Brookes' 5in. gauge Bayer-Garratt had trouble getting in.



In Memoriam

It is with the deepest regret that we record the passing of the following members of model engineering societies. The sympathy of staff at *Model Engineer* is extended to the family and friends they leave behind.

Alan Halliday
Geoff Wren

Vancouver Island Model Engineers
North London SME



LNER 2-8-0 locomotive, Worsfold (**photo 4**) was on display for the visitors and looks to be a powerful locomotive. Another impressive locomotive was the LNWR 4-6-0 *Cloughton* by Michael Wheelwright (**photo 5**). The traction engine enthusiasts were well served with several examples at the show and I am sure the nice group of smaller models (**photo 6**) attracted much attention. John Bibby's Gnome rotary engine (**photo 7**) was one of the exhibits for the I/C enthusiast. I thank Peter Guy and Brian Trickey for providing

3. One of the smaller gauge layouts at Worthing.
4. The new Worthing Club LNER 2-8-0 locomotive, Worsfold.
5. Michael Wheelwright's LNWR 4-6-0 *Cloughton*.
6. A nice display of smaller traction engines at Worthing.
7. John Bibby's Gnome rotary engine.

the notes and photographs. I have not been able to include everything submitted but have selected a selection to give a flavour of the exhibition.

Reading SME Open Day

I spent a few hours at the Reading SME open day and collected some photographs which I hope will be of interest. I think because of the weather forecast, there were not many visitors to the day but those that did go enjoyed some quite pleasant weather. I have heard comments from others that several events and shows have seen reduced visitor numbers this year which may be both due to the weather and the cost of fuel putting people off. The first item to greet visitors at Reading was the sectioned Lister D-type single-cylinder engine (**photo 8**) which was turning slowly all day. As somebody commented





"that must have taken a lot of hacksaw blades." There were a few locomotives circulating on the track and one was this very nice 0-6-0 tender locomotive (**photo 9**). Unfortunately I did not get the name of the builder or other details, so if he sees this and contacts me, I will be pleased to give due acknowledgement. Another locomotive was the part built Shay (**photo 10**) of Peter Ballard from Reading. Peter's last project was a triple expansion engine, so he must have developed a liking for three cylinders. Readers who built model

8. This sectioned Lister D-type single-cylinder engine was at Reading.

9. This nice 0-6-0 tender locomotive belongs to an older era than most.

10. Peter Ballard from Reading is building this Shay.

11. Paul South's Aerokits Sea Commander replica.

12. Phil Abbott's flash steam straight runner was demonstrated at Reading.

boats in the 1960s (as I did) may well remember the popular Sea Commander kit by Aerokits. This nice replica with additional detailing (**photo 11**) was by visitor



13. The V4 engine in Phil Abbott's flash steamer.

14. Reading President, Les Dawson on his Atkinson steam wagon.

15. The Dremel SpeedClic system makes tool changes easy.

Paul South. Paul had brought several model boats to display and was joined by flash steam doyen Phil Abbott who had his large collection of boats and steam plants on display. Phil demonstrated the vintage V4 flash steamer (photos 12 and 13) and several visitors were fascinated by the maze of pipes leading around the engine and the procedure used to start up the steam plant which relies on an engine driven pump to supply the paraffin/petrol fuel mix into the burner. This means that until the engine is running, fuel has to be hand pumped, as does the water to the flash boiler, so at least three hands are needed! I believe this boat was originally constructed by Ted Vanner. The final shot from Reading is of Club President, Les Dawson (photo 14) on his Atkinson steam wagon.

Trade news

'Speedclic' system from Dremel Power Tools

This September, Dremel is launching a new line of SpeedClic accessories for cutting, polishing and sanding. The new accessories make it really quick and easy to change cutting wheels via this new, patented system. Just one mandrel (photo 15) is needed for SpeedClic, with no wrenches or screws required to perform tool changes. Just pull the spring-fitted mandrel, twist and click for a keyless wheel change in less than 10 seconds thanks to the unique metal insert shape and technology.

The larger, 38mm diameter wheels make faster, deeper cuts in standard materials and have a longer lifespan than other available accessories. There are 10 different accessory packs to choose from:

- **The SpeedClic Starter Set** includes the mandrel and two 38mm universal cutting wheels - **£11.49** (SSP).
- **The 38mm Wood Cutting Wheel** is ideal for making freehand cuts in soft and hard wood including laminate flooring - **£14.99**.



- **The Plastic Cutting Wheels** (5-pack) are suitable for all types of plastic such as PVC tubing and plexi-glass. The plastic around the cutting area does not melt whilst cutting - **£8.99**.
- **The Abrasive Buffs** pack includes one coarse and one medium non-woven abrasive for even sanding

of irregular surfaces and is ideal for restoring furniture or hardware, woodcarving and model-making - **£3.99**.

- **The Fine Abrasive Buffs** pack contains two fine buffs for the finishing touches when sanding wood - **£3.99**.
- **The Diamond Cutting Wheel** cuts through up to 12mm thick floor tile, marble,



porcelain and brick perfect for installing bathroom or kitchen outlets, and creating openings for floor drains or the water pipes - **£14.99**.

- **The Cutting Wheels** 5-pack contains five 38mm cutting wheels for tasks such as cutting bolts, screws,

metal tubing or sheet, and modifying computer cases - **£8.99**. Alternatively, the bigger value 12-bulk pack has 12 cutting wheels for £12.99.

- **The Thin Cutting Wheels** 5-pack is designed specifically for delicate, precision cuts to, for

example, fine screws in electronics and toys - **£9.99**.

- **The Polishing Cloth Wheel** is for rapid polishing of silver or brassware - **£2.10**.

SpeedClic accessories are compatible with all Dremel rotary tools - including the 300 Series

and 400 series Digital, plus the Stylus Lithium-Ion and 10.8V Lithium-Ion cordless power tools. For further information visit:

<http://www.dremeleurope.com>

The SpeedClic Accessories range will be available from all good DIY shops from September 2008.

DIARY

SEPTEMBER

- 26 **Hereford SME**. Gordon Wood: History of Barrs Court Station. Contact Nigel Linwood: 01432 880649.
- 26 **Newton Abbot & District MES**. AGM. Contact Graham Day: 01626 772739.
- 27 **Brighton & Hove SMLE**. Public Running. Contact Mick Funnell: 01323 892042.
- 27 **Cardiff MES**. Bits & Pieces. Contact Don Norman: 01656 784530.
- 27 **Romney Marsh MES**. Boiler Testing. Contact John Wimble: 01797 362295.
- 27/28 **St. Albans DMES**. Annual Club Exhibition at Francis Bacon School. Contact Roy Verden: 01923 220590.
- 27 **York City & DSME**. Ask the Panel. Contact Pat Martindale: 01262 676291.
- 28 **Bedford MES**. Public Running & Teddy Bears' Day. Contact Ted Jolliffe: 01234 327791.
- 28 **Bristol SMEE**. Public Running. Contact Trevor Chambers: 0145 441 5085.
- 28 **Cardiff MES**. Public Running. Contact Don Norman: 01656 784530.
- 28 **Chichester DSME**. Steaming. Contact Ian Simpson: 01243 544 021.
- 28 **Edinburgh SME**. Friends & Family Barbecue. Contact Robert McLucke: 01506 655270.
- 28 **Harlington LS**. Public Running. Contact Peter Tarrant: 01895 851168.
- 28 **Ickenham DSME**. AGM. Contact Ian Mortimer: 01895 635596.
- 28 **Leicester SME**. Traction & Track Open Day. Contact John Lowe: 01455 272047.
- 28 **Lincoln DMES**. Running Day. Contact Terry Peacock: 01522 681424.
- 28 **Maidstone MES (UK)**. Public Running. Contact Martin Parham: 01622 630298.
- 28 **MELSA**. Sunday in the Park. Contact Graham Chadbone: 07 4121 4341.
- 28 **Norwich DSME**. Running Day. Contact Shirley Berry: 01379 740578.

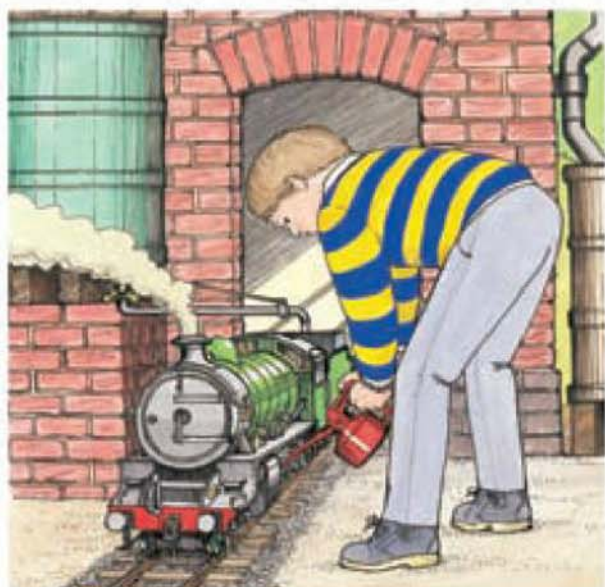
- 28 **Nottingham SMEE**. Public Running. Contact Pete Towle: 0115 987 9865.
- 28 **Saffron Walden DSME**. Public Running. Contact Jack Setterfield: 01843 596822.
- 28 **Taunton ME**. Public Running. Contact Nick Nicholls: 01404 891238.
- 28 **Westland & Yeovil DMES**. Public Running. Contact Gerald Martyn: 01935 434126.
- 30 **Romney Marsh MES**. Meeting. Contact John Wimble: 01797 362295.
- 30 **Wigan DMES**. Bring & Buy. Contact John Chamberlain: 01744 882255.

OCTOBER

- 1 **Birmingham SME**. Library & Chit Chat Evening. Contact John Walker: 01789 266065.
- 1 **Bradford MES**. Meeting. Contact John Mills: 01943 467844.
- 1 **Bristol SMEE**. Canon Brian Arman: A Broad Gauge Journey. Contact Trevor Chambers: 0145 441 5085.
- 1 **Chingford DMEC**. Bits & Pieces. Contact Ron Manning: 020 8360 6144.
- 1 **Hull DSME**. Photographic Competition. Contact Tony Finn: 01482 898434.
- 1 **Leeds SMEE**. Meeting. Contact Geoff Shackleton: 01977 798138.
- 1 **Tyneside SMEE**. Bits & Pieces. Contact Malcolm Halliday: 0191 2624141.
- 2 **Cardiff MES**. Bring & Buy. Contact Don Norman: 01656 784530.
- 2 **South Lakeland MES**. Meeting. Contact Adrian Dixon: 01229 869915.
- 2 **Sutton MEC**. Bits & Pieces. Contact Bob Wood: 020 8641 6258.
- 2 **Westland & Yeovil DMES**. Meeting. Contact Gerald Martyn: 01935 434126.
- 3 **Rochdale SMEE**. Quiz Night. Contact Bob Denyer: 0161 959 1818.
- 3 **Romford MEC**. Competition Night. Contact Colin Hunt: 01708 709302.

- 4 **Birmingham SME**. Non-Steam Running Day Open Event. Contact John Walker: 01789 266065.
- 4/5 **Dockland & E. London MES**. Public Running. Contact John Slocombe: 01708 222658.
- 4/5 **East Somerset SMEE**. Open Days. Contact Roger Davis: 01749 677195.
- 4 **Ickenham DSME**. Public Running. Contact Ian Mortimer: 01895 635596.
- 4/5 **Kew Bridge Steam Museum**. Festival of Models. Information: 020 8568 4757.
- 4 **Leighton Buzzard NG Rly**. Steam Glow. Enquiries: 01525 373888.
- 4 **Nottingham SMEE**. Miniature Traction Engines/Night Run. Contact Pete Towle: 0115 987 9865.
- 4 **SM&EE**. Roddy Turner: Building a Ruston Bucyrus. Contact Maurice Fagg: 020 8669 1480.
- 4 **Welling DMES**. Open Day & Gauge One Get-together. Contact Bob Underwood: 020 8859 6919.
- 4 **West Riding SLS**. Locomotive Efficiency Competition. Contact David Batty: 01924 363908.
- 5 **Bristol SMEE**. Fun Day. Contact Trevor Chambers: 0145 441 5085.
- 5 **Frimley & Ascot LC**. Public Running. Contact Bob Dowman: 01252 835042.
- 5 **Leicester SME**. Public Running. Contact John Lowe: 01455 272047.
- 5 **Maidstone MES (UK)**. Public Running. Contact Martin Parham: 01622 630298.
- 5 **Malden DSME**. Public Running. Contact John Mottram: 01483 473786.
- 5 **Northampton SME**. Public Running. Contact Pete Jarman: 01234 708501 (eve).
- 5 **Norwich DSME**. Running Day. Contact Shirley Berry: 01379 740578.
- 5 **Nottingham SMEE**. Miniature Traction Engines/Public Running. Contact Pete Towle: 0115 987 9865.

- 5 **Oxford (City of) SME**. Running Day. Contact Chris Kelland: 01235 770836.
- 5 **Plymouth MSLS**. Public Running. Contact Malcom Preen: 01752 778083.
- 5 **Reading SME**. Public Running. Contact Brian Joslyn: 01491 873393.
- 5 **Royston DMES**. Running Day. Contact Jeff Dickinson: 01763 261670.
- 5 **Saffron Walden DSME**. Public Running. Contact Jack Setterfield: 01843 596822.
- 6 **Peterborough SME**. Bits & Pieces. Contact Lee Nicholls: 01406 540263.
- 6 **Saffron Walden DSME**. Club Night. Contact Jack Setterfield: 01843 596822.
- 7 **Romney Marsh MES**. Meeting. Contact John Wimble: 01797 362295.
- 7 **Stamford MES**. Duxford talk. Contact Derek Brown: 01780 753162.
- 8 **Birmingham SME**. Bits & Pieces. Contact John Walker: 01789 266065.
- 8 **Bradford MES**. Meeting. Contact John Mills: 01943 467844.
- 8 **Chingford DMEC**. Paul Middleton: Ride On Railways. Contact Ron Manning: 020 8360 6144.
- 8 **Norwich DSME**. Peter Bower: History of the Barton House Railway. Contact Shirley Berry: 01379 740578.
- 8 **St. Albans DMES**. Guy Bagley: Design & Build of Legoland Models. Contact Roy Verden: 01923 220590.
- 9 **Cardiff MES**. Chris Tuthill: Victory to Vanguard 5. Contact Don Norman: 01656 784530.
- 9 **Leyland SME**. Bring & Buy. Contact A. P. Bibby: 01254 812049.
- 10 **Hereford SME**. Stan Compton: Pumps and Clacks. Contact Nigel Linwood: 01432 880649.
- 10 **Polegate & District MEC**. Tim Lawrence: Colonel Stevens' Other Lines. Contact D. F. Pratt: 01323 645872.



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	1 - 2 - 3 + 3/32 x 3/4, 1.	10.95
A1	1/8 x 3/8 - 1/2 - 5/8 - 3/4, 1.	07.20
A2	3/16 x 3/8 - 1/2 - 5/8 - 3/4 - 7/8 - 1.	08.80
A3	1/4 x 3/8 - 1/2 - 5/8 - 3/4 - 7/8 - 1.	11.75
A4	5/16 x 1/2 - 3/4 - 1 - 1 1/2	14.55
A5	3/8 x 1/2 - 3/4 - 1 - 1 1/2. EN8M	15.35
A7	1/2 x 3/4 - 1 - 1 1/2.	23.10
B.M.S. ROUNDS		£
B1	1/8 - 5/32 - 3/16 - 7/32 - 1/4 - 5/16 - 3/8.	05.75
B2	1/4 - 5/16 - 3/8 - 7/16 - 1/2 - 9/16 - 5/8.	10.10
B3	5/8 - 3/4 - 7/8 - 1.	17.35
B5	3/8 - 1/2 - 5/8 - 3/4 - 7/8 - 1 EN8M	22.95
B.M.S. HEXAGONS		£
C1	3/16 - 1/4 - 5/16 - 3/8	05.75
C2	1/4 - 9/32 - 5/16 - 7/16 - 1/2 - 5/8	10.90
B.M.S. SQUARES		£
D1	5/32 - 3/16 - 1/4 - 5/16 - 3/8	05.00
D2	7/16 - 1/2 - 5/8 - 3/4	10.90
BRASS ROUNDS		£
E1	1/8 - 3/16 - 1/4 - 5/16 - 3/8 - 1/2	16.65
E2	1/16 - 3/32 - 5/32 - 7/32 - 9/32 - 7/16 - 9/16 - 5/8	26.50
BRASS SQUARES		£
F1	1/8 - 3/16 - 1/4 - 5/16 - 3/8	16.00
F2	1/4 - 5/16 - 3/8 - 7/16 - 1/2	29.20
BRASS HEXAGONS		£
G1	5/32 - 3/16 - 7/32 - 1/4 - 9/31 - 5/16	10.95
G2	1/4 - 9/32 - 5/16 - 3/8 - 7/16 - 1/2 - 5/8	30.50
BRASS ANGLE		£
H1	1/4 x 1/4 x 1/16	
	5/16 x 5/16 x 1/16	
	3/8 x 3/8 x 1/16	11.35
	1/2 x 1/2 x 1/16	
H2	5/16 x 5/16 x 1/16	
	3/8 x 3/8 x 1/16	
	1/2 x 1/2 x 1/8	21.15

DRAWN STEEL ANGLE		£
H3	16mm x 16mm x 3mm, 20mm x 20mm x 3mm, 25mm x 25mm x 3mm	13.50
SEAMLESS COPPER TUBE		£
J1	1/16 x 28g - 3/32 x 28g - 1/8 x 24g - 5/32 x 24g	09.10
J2	3/16 x 22g - 1/4 x 20g - 5/16 x 20g - 3/8" x 22g	11.30
STAINLESS STEEL ROUND 303 F/C		£
K1	3/32 - 1/8 - 5/32 - 3/16 - 7/32 - 1/4	10.00
K2	3/16 - 7/32 - 1/4 - 5/16 - 3/8 - 7/16 - 1/2	25.90
BA STAINLESS STEEL HEZAGONS 303 F/C		£
L1	152" - 193" - 220" - 248" - 275" - 312"	15.45
BA BRASS HEXAGONS		£
M1	152" - 193" - 220" - 248" - 275" - 324"	13.85
BA STEEL HEXAGONS		£
M2	193" - 220" - 248" - 275" - 324"	04.50
BRASS FLATS		£
N1	1/16 x 1/4 - 3/8 - 1/2 - 3/4 - 1	08.65
N3	1/8 x 1/4 - 3/8 - 1/2 - 3/4 - 1	20.65
N4	3/16 x 1/4 - 3/8 - 1/2 - 3/4 - 1	35.00
N5	1/4 x 3/8 - 1/2 - 3/4 - 1	35.45
ALUMINIUM ROUND F/C		£
P1	3/16 - 1/4 - 5/16 - 3/8 - 7/16 - 1/2	13.65
P2	5/8 - 3/4 - 1	23.75
PHOSPHOR BRONZE ROUND		£
Q1	1/8 - 5/32 - 3/16 - 1/4	12.70
Q2	5/16 - 3/8 - 1/2	32.95
SILVER STEEL		£
S1	3/32 - 1/8 - 5/32 - 3/16 - 7/32 - 1/4 - 9/32 - 5/16 - 3/8 - 7/16 - 1/2	22.45
S2	3mm - 4mm - 5mm - 6mm - 7mm - 8mm - 9mm - 10mm - 12mm	19.50
ALUMINIUM FLATS		£
R1	1/8 x 1/2 - 1/8 x 1 - 1/4 x 1/2 - 1/4 x 1 - 1/4 x 1 1/2 - 1/4 x 2	18.90
R2	3/8 x 1/2 - 3/8 x 1 - 3/8 x 1 1/2	15.55
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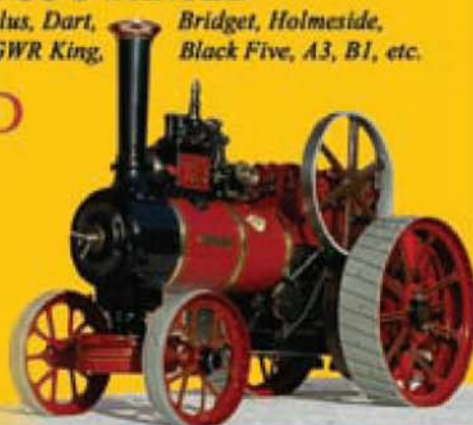
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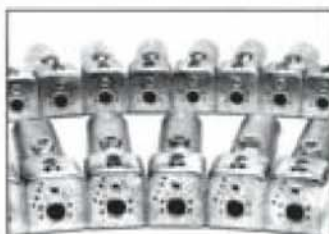
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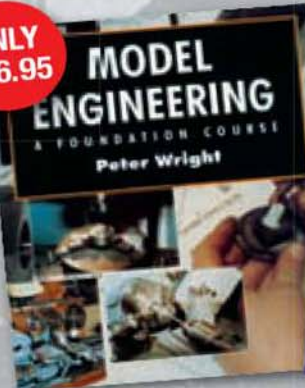
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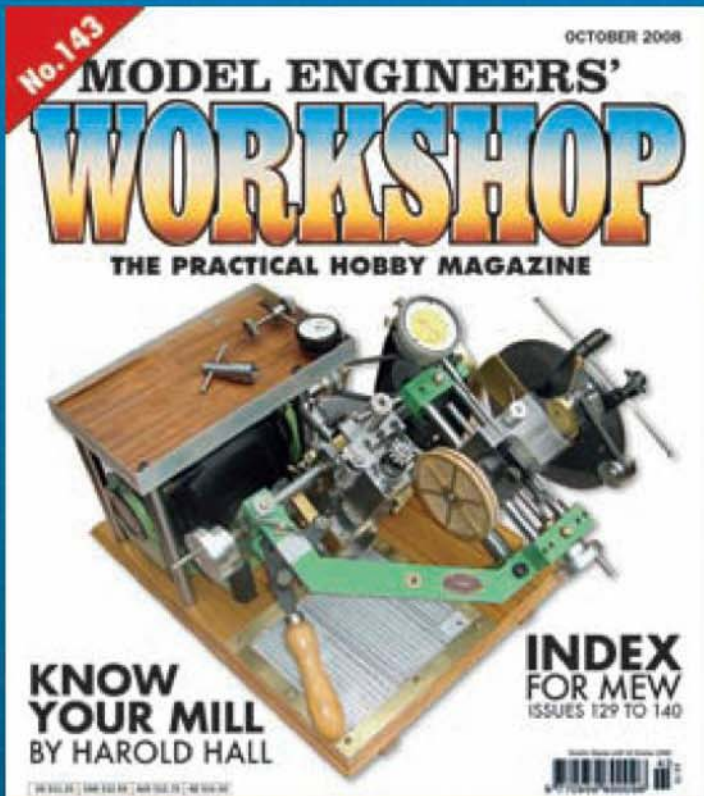
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and
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broaching
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Boxford 6" 4 jaw chuck £85 - £125
Myford collets boxed £275
Boxford collets + draw bar £175
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motors in stock at just £120
and £140 each!!!**



Colchester Student 1500rpm
in the rare Summer sun!



Myford TAS vertical milling machine / R8 taper



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Waltons 50" 16g guillotine + stops



Boxford 1130 5 1/2" x 30" + stand



Kerry 1124, 5 1/2" x 24" late
square head lathe



Bridgeport slotting head



Colchester Master 2500 lathe + DRO



Milling/Drilling ground X-Y table



Harrison 11" + gearbox + gap bed



Boxford BUD 4 1/2" x 18" +
power crossfeed



Boxford CUD 5" lathe + inverter



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+ capstan equipment, 240 volts



Bridgeport milling machine
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£50 each

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£70

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£425

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£1200

Harrison L5 lathe



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£2250

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£950

Colchester Student 1500 6" x 24" lathe



£1400

Colchester Student 1200 + dual dials



£425

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£40

Harrison L5 travelling steady (L5A, L6, Student, Master also)



£145 each

Bridgeport cabinet (less contents)



£425

Boxford 125 TCL



£950

Cowells miniature milling machine



£40 each

Dickson toolposts to suit Colchester Mascot (others available)



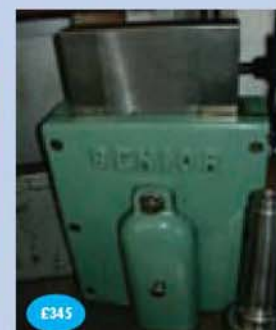
From £20

Eclipse angle plates



£425

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£145

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Table Size 500x140mm
Motor 600w
Shown with optional stand

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Variable Speed • Digital Quill Readout • Dovetail Column • Supplied with Keyless Drill Chuck & Arbor

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Fully equipped with 3 & 4 Jaw Chucks, Steadies, Centres and Lathe Too

Centre Height 250mm
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Motor 1200w
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Conquest Lathe



£415

Supplied With
3-Jaw Chuck • Quick Change Toolpost Change Gears • Variable speed • Lathe Tools

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Distance between centres 325mm
Motor 400w
Weight 38kgs

100mm 3-Jaw Chuck



£41.12

Mag Base and Dial Gauge



£18.00

100mm 4-Jaw Independent Chuck



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£59.00

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T1 Quick Change Toolpost and 5 Holders



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