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IN THIS ISSUE

● Vol. 196 No. 4273 12 May 2006 ●

On the cover ...

In this issue Nemett begins construction of the Nemett 15S on page 553. This 4-stroke engine, using either glow or spark plugs, has been designed to be made by the average model engineer. If you can make a steam engine, this will hold no terrors for you. The author guides you in this issue through the business of making the cylinder liner, crankcase, and cylinder head, with clear, conscise instructions, plenty of photographs and CAD drawings. There is also an unmissable clue to his real identity.

(Photograph by Malcolm Stride)

TURN TO PAGE 579 TO SEE WHAT'S IN THE NEXT ISSUE

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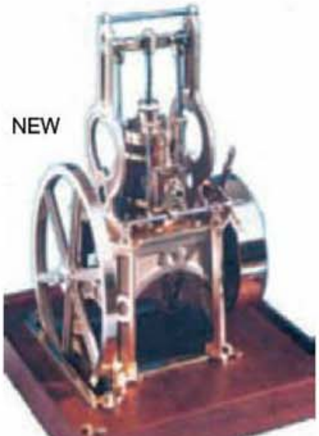

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SMOKE RINGS
With the Editors

Rempstone Anniversaries

The Steam Plough Club will celebrate its 40th anniversary with a steam ploughing challenge at Beeby's family farm at Rempstone near Loughborough in Leicestershire on September 9 and 10. At the same time the Beeby family will celebrate 100 years of steam at the 200-acre farm.

More than 11 sets of steam ploughing engines will be working over the weekend together with a static display of ploughing engines and other steam engines.

Other attractions will include vintage tractor ploughing, horse ploughing, hedge laying, thatching, threshing, steam wood sawing, and various country crafts.

There will also be a display of model ploughing engines and tackle to complement the full size display. Details are available from Brian Redfern 01283 219162.

Burrell Museum reopens

The Charles Burrell Museum in Thetford (where else?) has reopened in this year, the centenary of the death of Charles Burrell. The museum is situated in the old Burrell works, and one new attraction is the operation of a line-shaft system driving some of the machines previously in static display.

Charles Burrell inherited the business the same year that Victoria came to the throne, 1837. He was born on the same date as the Queen, but two years later, on May 24.

Despite his great achievement in the engineering world, little is known about the great man. The same cannot be said of the machines he created.

Virtually nothing is known until 18 October 1837 he placed a notice in the *Bury and Norwich Post* to inform the public:

"*that he intends to carry on that branch of the business which relates to he manufacture of agricultural machines, upon the premises lately occupied by his father for that purpose in Saint Nicholas Lane…*"

He was probably born in St Nicholas House, St Nicholas Lane, now Minstergate, next to the works. After 1844, more is known about his activities and personal life. In 1846, the year after the railway arrived in Thetford, he married Elizabeth Cowen in Nottingham. To continue the Burrell story, join the Friends of the Charles Burrell Museum to receive their newsletter. Details about the museum, the Friends, and related activities can be found by calling 01842 765840.

Whissendine spectacular

More than 60 road steam vehicles from 1/8th to 1/2 full size will be on display at this year's Whissendine Miniature Steam rally over the weekend of June 3 and 4. This year's event, organised as ever by the Melton Mowbray and District MES, will have an added attraction.

The 2005 event coincides with the 150th anniversary of Foden Engineering, and there will be a full size Foden steam wagon, traction engine, and steam roller at the event.

There will also be a large display of a wide variety of miniature versions of Foden products, plus a pictorial display covering the whole 150 years.

This event is run by model engineers for model engineers, with the general public welcome to visit on both days. It is on the Saturday that the participants take two runs through the village. On the Sunday engine drivers will put their machines through their paces with demonstrations and rides. Another road run will go through the village, leaving at 12 noon. Judging also takes place on Sunday.

If that's not enough, there will be a static exhibition of model engineering, and the society's railway tracks in all four popular gauges will be busy with members' and visiting locomotives. And there will be a bar and food available at lunchtime, with light refreshments available all weekend.

There is no charge for admission, and the event will be signposted from the A606 Melton Mowbray to Oakham road. More information from Norman Smedley 01664 434349.

You don't have to work in metal! Nigel Edwards carried off a top prize at the Stoneleigh Park exhibition organised by our sister publication,* The Woodworker. *This finely executed model was based on a Ransomes, Simms and Jefferies 2hp portable steam engine of 1902.

Gremlin

In the last article in the Gorgon Engine series, the bearing number quoted might cause some difficulties. The number to ask for is HK 0810. not RHNA 081210. The correct size is 8 dia. x 12 dia. x 10. For further information and advice speak to Ketan at Arc Euro Trade on 0116 2695693

Oxford class change

The ME evening class at Oxford CFE has been changed to the Tuesdays. It will run weekly (barring half-term) for 8 weeks at the Oxpens campus (the one near the ice-rink in the city centre) and although it is listed as a 6pm start it is always a good idea to get there early.

There is a mixed group in terms of ages and experience, and although it is not a formal taught course in the strictest sense (most of the regulars use it for the access to bigger machines than they have at home) complete beginners can join and will receive supervised instruction in all the basics of machine tool use (lathes, milling machines and so on).

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

POST BAG

Emitting light on the subject

SIRS, - The article on Stirling engines by Mr. James G. Rizzo (*M.E.* 4253, 5 August 2005) is interesting. However, he does point out that he is an old-timer and perhaps does not know about light emitting diodes (LEDs).

All LEDs have operating voltages and currents quite distinct from each other and all need a resistor to allow safe operation.

The relevant formula is:

(Vs - Vf)/ If

where Vs is the supply voltage, Vf is the forward voltage of the LED and If is the current (usually in milliamps) for the LED.

Mr. Rizzo has been fortunate that his LEDs have not 'popped' due to over-voltage on his motor operated as a generator.

The following are the operating limits for general-purpose 5mm diameter general purpose LEDs:

Colour	If (mA)	Vf (volts)
Red	20	1.7
Green	25	2.2
Yellow	30	2.1
White	20	4.0
Blue	30	4.5

You can mix the colours but you have to work out the load resistor for each type. For example, for a red LED with a supply voltage of 12 volts D.C,

R = (Vs - Vf)/ If

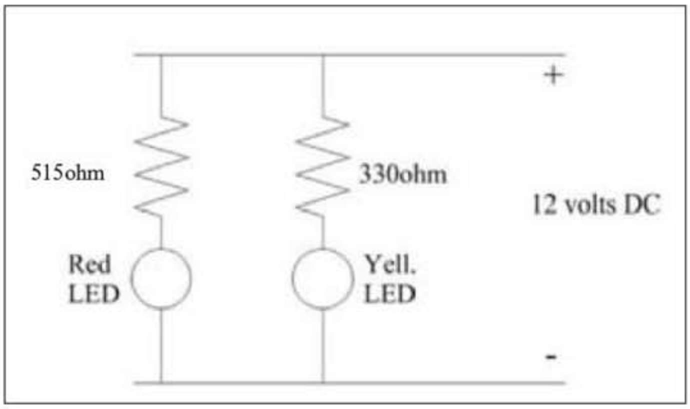
R = (12 - 1.7)/ 0.02

R = 515ohm

For more information on LEDs may I recommend the catalogues by Maplin and Squires 01243-842424 (usual disclaimers).

May I say how much I enjoy *Model Engineer,* the workmanship is fantastic, and that's just the magazine.

Julian Shaw, Lancashire.



CNC lathe identity

SIRS, - As a reader of *Model Engineer* and its counterpart *Model Engineers' Workshop* I have seen that many problems of particular engineers have been solved by others of our great fraternity when inserted in your pages.

I have just purchased at a favourable cost a CNC lathe of 1993 manufacture that appears never to have been used.

Unfortunately, all instructions and software have been lost over time I therefore wonder if any of our readers out there have the necessary copies of software, etc for this machine.

It is a 'Connect Numerical Control Cadet Plus'.

The information plate is stamped SER N/o V or W 194/298 it is a 240v single phase machine and I enclose a photograph.

Michael Mansbridge, Dorset.

Michael Mansbridge's CNC lathe - does anyone have instructions for it?

Radial engine geometry

SIRS, - In *Nemett's* piece on radial engine design (*I/C Topics, M.E.* 4257, 16 September 2005), his Figure 2 and his discussion of it caused me some concern.

His dimensions clearly show a layout where the master connecting rod has a centre distance of 90 millimetres. Yet figure 2 also gives the crank radius as 45mm, i.e. a stroke of 90 millimetres. In any practical sense these figures are unworkable, because, amongother 'fouls', a rod-to-stroke ratio of 1:1 would mean that, at BDC (bottom dead centre), the gudgeon pin's axis would intersect the 90mm crank circle.

While the piston skirt and crank could, probably, be made to miss each other, the con-rod side-thrust angle, and thus frictional losses, would be pretty savage.

Rough measurement of a 9-cylinder radial's master con-rod (Alvis Leonides) yields a centre distance of 258 millimetres. This confirms my understanding that, despite the potential penalty of increased frontal area, radial engines usually have a 'long' rod-to-stroke ratio of around 2:1 or more. (In this example a stroke of 112mm yields a ratio of circa 2.3:1).

This would avoid the more extreme consequences of master/slave angular anomalies which the proportions of *Nemett's* figure 2 would make much worse than normal.

Incidentally, as *M.E.*'s technical editor, Neil Read, has reminded me, Manly's brilliant 1903 radial engine design (not forgetting Baltzer's earlier contribution, as Manly was once tempted to do) managed to avoid the master/slave problem entirely. He devised an ingenious solution which has since been borrowed by many other designers.

By a happy coincidence, on p395 of the same issue of *M.E.*, there is a picture of Ernie Henne's handsome 3-cylinder radial steam engine model. This uses broadly the same solution as Manly's in its big-end construction (but without the conical adjustment of 'slipper' clearance).

I hope this letter appears in time to prevent anyone copying *Nemett's* geometry too closely in laying out the basic design of a model radial engine. Apart from the problem already outlined, an average cylinder bore size, even with as few as five cylinders, would present such a large polygon for the crankcase I/D that that alone would necessitate longer con-rods to prevent the pistons 'falling out' at or near BDC.

Have a look at Manly's tour-de-force from more than 100 years ago; you will find it in the standard work, *A History of Aircraft Piston Engines* by Herschel Smith (McGraw Hill 1981 or Sunflower Press 1986).

Richard Kinnersly, Romsey.

Nemett replies:

The dimensions of the diagram were deliberately chosen to accentuate the problem. The diagram was never intended to be used as a basis for a design. Mr. Kinnersly makes the point that the dimensions shown would make the situation worse than normal, which was the intention of my diagram because it makes things much clearer to see and explain. Perhaps I should make this point clear should the situation arise again. I thank Mr. Kinnersly for his comments and am happy to make the situation clear.

More on radial engines

SIRS, - I have been following *Nemett's* series on I/C engine topics with great interest and indeed inspiration, so please keep them coming. The discussion of the subtleties of radial con-rod geometry particularly interested me since a while ago I designed and built a small 5-cylinder radial and had to address those issues myself.

When I originally looked at the problem I could not find any quantitative information or formulae which would predict the position errors for the slave small ends at TDC, or the errors in crank angles. I ended up developing a pair of spreadsheet programs which allowed me to find the true crank angle for the slave TDCs by inspection, and hence the position errors.

There are a couple of points I would like to add to the analysis that *Nemett* gave (*M.E.* 4257, 30 September 2005). It is not clear from the article (apologies if I have missed something) how the analysis could be extended to actually discover the crank angles for the slave TDCs. However, a little more trig leads to an expression for the small end position as a function of crank angle, which would allow

TDCs to be found by trial and error. (I know a proper engineer would look for the zeros in the first differential, but I haven't managed that yet.)

$$R_S = R_C\cos(\gamma - \theta) + R_B\cos\varphi + L_S\cos\beta$$

where:

$$\beta = \sin^{-1}[(R_C\sin(\gamma - \theta) + R_S\sin\varphi)/L_S]$$

and $\varphi = \sin^{-1}[(R_C\sin\theta)/L_M]$

R_S = radial distance from crank centreline to slave rod small end,

θ = crank angle from master TDC,

γ = offset angle of slave cylinder and slave big end pin,

L_M = master rod length,

L_S = slave rod length,

R_C = crank radius,

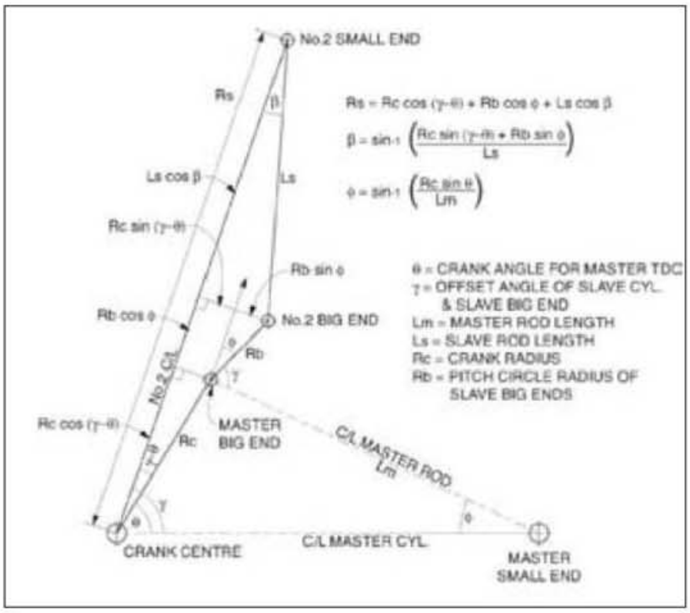
R_B = pitch circle radius of slave big end pins.

Actually, for all practical purposes the position error calculation you gave is sufficient. The error at the actual TDC for No. 2 small end is only 0.1mm smaller than the value given for the nominal TDC. The error for No. 3 at the nominal TDC seems a little further from that at the true TDC but still only about 0.3 millimetres.

When I did my design calculations I was surprised by how small the crank angle errors turn out to be. Even for the geometry given in *Nemett's* article, which seems fairly extreme, I believe that the TDC crank angle for No. 2 would be only about 4deg. different to the nominal value.

When I built my radial, I did correct for the TDC position errors by adjusting the piston crown heights, because otherwise the variations in compression ratio would have been about ten percent. The crank angle errors affecting ignition timing were about +/- 3deg. at most and I did not bother about that. I later discovered that I could not anyway manage to make a five-lobed contact breaker cam assembly that would work to that degree of accuracy.

Mike Ackerman, Bristol.

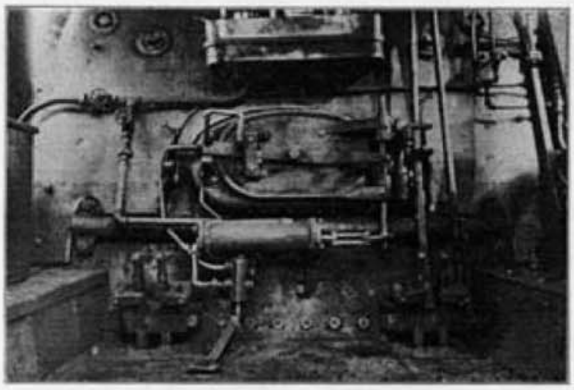


Fire hole doors

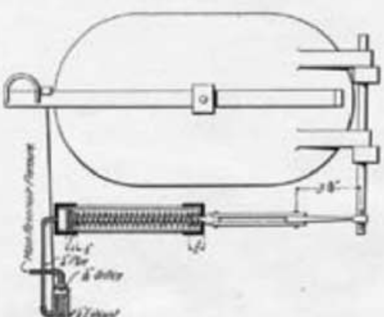
SIRS, - I have been an avid reader of your magazine for many years. It has been a great help to me especially the articles on how to make things and how to do things. I enclose a small item (**see right**) about pneumatically-operated fire hole doors that may be of interest to someone since it does not seem to have appeared in anything you have published so far as I can tell.

Peter Cawrey, Lincolnshire.

1846 COMPRESSED AIR.



[illegible]'S PNEUMATIC FIRE-DOOR OPENER.



PNEUMATIC FIRE-DOOR OPENER—SECTIONAL VIEW.

Lady Stephanie valve rods

SIRS, - With reference to the letter from Mr. Neil Wyatt concerning the availability of 1/16in. square mild steel for his *Lady Stephanie* beam engine.

I cannot suggest a source of material, but he might consider the method I used when making the eccentric rod.

I marked out the rod on 1/16in. thick steel plate and carefully removed the inner portion with a piercing saw, finishing with needle files. The method is not unlike the crossing out of clock wheels.

The outside can be finished with hand tools in the normal way. Using this method you get a solid rod with no risk of distortion from brazing such thin section material.

When painted the rod looked very well, indeed my own *Lady Stephanie* won an award at the Midlands Model Engineering Exhibition at Donnington.

I hope the above information will be of some help.

J. R. Lill, Derbyshire.

More on global warming

SIRS, - Mr. Robinson does not seem to accept the 'CO_2 warming theory' (*M.E.* 4267 17 February 2006). There are, however, certain matters which are not in dispute:

1: CO_2 is a greenhouse gas; it traps heat from the sun and the atmosphere warms up (the runaway greenhouse effect on Venus is an extreme example).

2: CO_2 levels have been increasing since the start of the Industrial Revolution and at present stand at 380ppm.

3: The ice sheets of Greenland, West Antarctica and the Arctic basin are melting;

and

4: Mountain glaciers (with a few exceptions) are in retreat throughout the world.

CO_2 levels now observed are almost twice as high as they have been over the past 400,000 years. This has been revealed by an analysis of ice cores taken from Greenland and Antarctica. Moreover, there is some evidence from geological studies that the level of CO_2 is higher now that at any time since the Eocene period 55 million years ago. High temperatures were a feature of the Eocene period and the land and sea surfaces became barren. Many species of animal and plant became extinct. It took about 200,000 years for the Earth to recover from this catastrophe. Possible causes were the release of methane (a powerful greenhouse gas) and CO_2 in huge quantities due to natural events such as volcanic activity.

The indications are that we are heading in the same direction as the Eocene, but this time the cause is pollution by human beings. Of course Mr. Robinson may be right that there is no warming effect. He is entitled to his opinion and I hope for the sake of the environment that he is right, but the clues seem to point in the opposite direction.

N. M. Macnaughtan, Edinburgh.

GWR tank locomotives

SIRS, - I always enjoy the historical type of article in *Model Engineer* and Mr. P. Rich's piece on the GWR Pannier tanks (*M.E.* 4267, 17 February 2006) was very good.

It should be made clear, however, that the boiler designation *"B4 groups K and L"* which he mentions was not of GWR origin. It appears to have been devised by H. M. Le Fleming when he wrote his section on GWR boilers for the Railway Correspondence and Travel Society book *The Locomotives of the Great Western Railway, Part 1 Preliminary Survey* published in 1968.

The Swindon designation for the 57XX boilers as given by the RCTS were PH2, PJ2, PK2 and PL2. The K and L versions were similar to the H and J respectively but had different top feed arrangements.
D. M. Hughes, West Yorkshire.

Involute curves

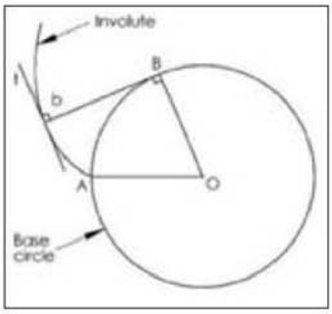
SIRS, - Sorry, but the involute curve starts tangent with the radius (See M.E. 4243). Here is the demonstration:
The mathematical definition of the involute implies that the line 'Bb' is the radius of curvature for point b, B being the centre of cuvature, so 'Bb' is perpendicular with the tangent 't', the base circle radius 'OB' is also perpendicular with its tangent line 'Bb', thus the radius 'OB' is parallel with the tangent 't'; hence, at the starting point, the tangent is colinear with the radius 'OA'.

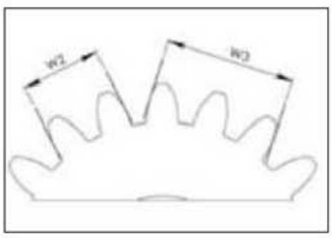
***Note 1:** At the starting point the radius of curvature of the involute is nil! This causing a high contact pressure between the mating gear profiles. A contact near this point is to be avoided and this leads the gear makers to do addendum modification even if there is no risk of undercutting.

*Note 2 : Here is a method which can be used to determine the module and pressure angle of a gearwheel, using only the tooth profile (the profile must be of involute shape).

Example: for a 20 teeth gear measure W_3 (spanning 3teeth) and W_2 (spanning 2 teeth) using a sliding caliper or a disc micrometer.

$W_3 - W_2 = m \times \pi \times \cos\alpha$ (it's the base pitch, m being the module and α the pressure angle).





Thus: $m = (w_3 - w_2)/ \pi\cos\alpha$

Try a first calculation with α = 20deg., if the result is very near a standard module (or diametric pitch equivalent), you have found the module and pressure angle.

If the result is far from standards, try a second calculation with α = 14deg. 30min (usually these teeth look slimer than the previous).

If no result is satisfactory:

1: The module and/or pressure angle are perhaps not standard.

2: The teeth profile is badly worn.

3: The teeth are not of involute shape.

4: The measurement has not been taken the correct way (see later).

For a gear having a different number of teeth, you must make the measurement on (n) and on (n+1) teeth; n being chosen for the measure to be taken between two tangents of the tooth profile, not on an edge, whether it be on the top or in the bottom of the tooth (the calliper's edge in that case).

This method works even if there is an addendum modification, and on helical gears too, it uses the properties of the involute curve.
Jacques Maurel, France.

More on Wellingtons

SIRS, - I am always amazed at the detailed knowledge of your correspondents and writers of such as steam engines, rolling stock and involved machining techniques and would take their words as gospel. However, in matters aeronautical, I can claim great interest since my first 'five bob flip' in 1936 and varied degrees of involvement ever since.

Therefore, when catching up on my reading (*M.E.* 4266, 3 February 2006) I felt that I must correct some of the statements made in Cyril Cannell's letter headed *Wedding ring Wimpeys.*

The first four minesweeping Vickers Wellingtons, known as 'DWI Wellingtons' (named Directional Wireless Installation to mislead enemy intelligence) had Ford V8 engines driving a 35kW Maudesly generator. These were replaced and subsequent aircraft fitted, with a de Havilland *Gipsy Six* engine driving a 90kW English Electric generator.

Minesweeping was carried out at low-level and the experimental, pressurised high altitude versions of the Wellington were quite different. In fact only two were built with Mk. VIII Bristol *Hercules* engines which struggled to get above 30,000ft.; the rest with Rolls-Royce *Merlin 60s* which rated a Service Ceiling of 38,500 feet. Neither version went into service but provided useful information and experience on building pressurised cabins, which was passed to the Americans and helped in the design of the B-29 Super Fortress. The information also came in useful in later years for the Vickers Viscount and Vanguard.

The normal Wellington's service ceiling ranged from 18,000 to 23,500ft., depending on the engines fitted. Incidentally, RAF practice was for oxygen to be used after gaining 10,000ft. or from the ground up at night.

The Warwick was a larger version of the Wellington fitted with Bristol *Centaurus* or Pratt & Whitney Double *Wasp* engines and used by Coastal and Transport Commands as well as BOAC.

The Bristol sleeve valve engines were the same as most other radial engines with regard to hydraulic lock in the bottom cylinders through oil seepage past the piston rings. The procedure for any radial engine that had been standing a while was to pull the propeller through several revolutions by hand, before starting. Initial firing would be accompanied by a cloud of black smoke from the exhaust.

The Westland Whirlwind fighter was only ever powered by the Rolls-Royce *Peregrine*, the ultimate development of the *Kestrel* with early *Merlin* experience added. Only 20 examples of the Rolls-Royce *Goshawk* were built to investigate the possibilities and properties of evaporative cooling (sometimes called 'steam cooling', a rather misleading term).

Rolls-Royce *Kestrels* were supplied to Germany to power the Junkers 87 (*Stuka*), and Messerschmitt 109 prototypes in 1935, while they awaited delivery of Junkers *Jumo* 210 engines, as well as for the Junkers 86 airliners ordered by South Africa in 1936. The *Kestrel* followed a long line of Rolls-Royce V12 engines but was the first with a single cast block for the six cylinders of each branch of the 'V'. First run in 1927 it would not have been a great secrecy lapse when sold to the Germans in mid 1930s.

Jet engine development was progressing in many countries aided by Whittle's patents which were open to all. Germany was much quicker getting theory into practice because of our Government's dilatory approach to its manufacture. A bigger sin was to give complete, developed and working jet engines to the Russians in 1945.

I am sure that I will still enjoy *Model Engineer* even if, perhaps, a little more sceptically when reading other articles in future.
Bob Shilling, West Midlands.

Far Eastern lathes

SIRS, - With reference to the ultimate sentence in Mr. Anthony Mount's letter, (*M.E.* 4264, 13 January 2006) I would like to make the following reply:

In the 65 years since starting my engineering training, I have operated many first-class lathes, from Pultra,Wolf Jahn, Rivett and Boley instrument lathes through Holbrook, Harrison, South-Bend to large Lang and Dean, Smith & Grace with a 30in. swing. A reasonable experience, I think.

Twenty years ago I part exchanged my Myford Super 7 for a Myford 254, available with a taper turning attachment and a vertical mill as optional extras. This machine is a joy to use, solid, accurate, and reliable and after 20 years of careful use is as good as the day it left the works. Within four years this superb machine was withdrawn, forced out of the market by cheap copies produced by sweated labour working under conditions which would be illegal in the West. You are 20 years too late, Mr. Mount!
Mr. Philips, Suffolk.

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I/C TOPICS

Nemett
commences machining the parts for the new 15cc four stroke engine.

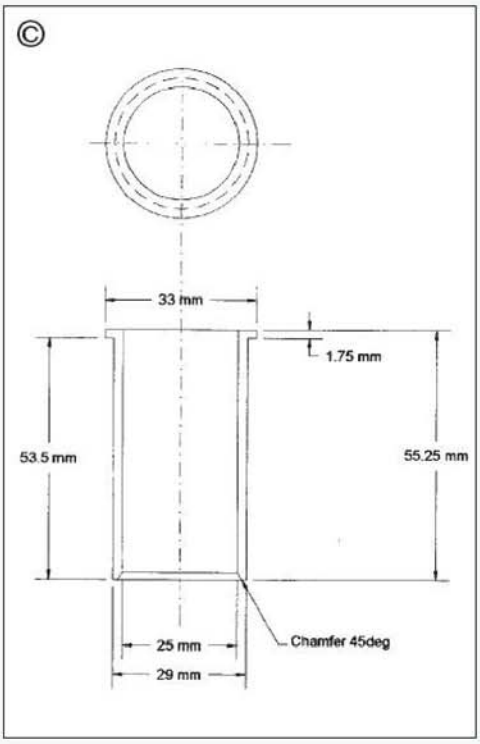
Before starting on the machining proper, I will update readers with the latest testing news. I have run the engine on glow plug ignition and have now measured the speed at 5750rpm on a 14 x 7in airscrew. I still have some tuning to do on the carburettor and also to run the engine on spark ignition and once this has been done I will be releasing the drawings to the big wide world.

Machining the NE15S

It is time to start cutting some metal for this engine and I will describe the machining in the order in which I machined the parts. Obviously the machining of some parts is easier if corresponding parts have been machined first but if you wish to alter the sequence then feel free to do so.

The other thing I will say now is that the procedures described are as I did them. If you prefer a different procedure then feel free to use it.

I am going to start with the cylinder liner which may seem a strange choice but has the merits that the major cast iron item is out of the way first and the lathe can then be cleaned ready for all the other parts and also once the liner is machined it can be used to judge the fit when machining the crankcase body and cylinder jacket.



Boring the cast iron cylinder liner.

07 Cylinder Liner

Start with a piece of cast iron bar (cored is easier if you can get it) long enough to machine at one setting in the chuck. I used a piece of 50mm diameter cored cast iron 80mm long.

Hold in the chuck and face the end true before machining the outside diameter to 33mm (flange dia) for the full length.

Now turn down the outer diameter to 29mm diameter for a length of 53.5mm.

Centre the end and use drills to remove the majority of the metal in the bore. Finally use a boring bar to bore the cylinder (**photo 1**) to 25mm (1in if using 1in rings).When within 0.25mm of final dimension, run the boring bar through twice at each setting and the run the tool through at least three times at final setting.

Now turn the 45deg chamfer on the lower end of the bore by offsetting the top slide and using the boring bar. This is to ease the entry of the piston rings on assembly.

Now part off from the bar stock allowing for cleaning up the top flange.

Reverse in chuck and face the top flange to 1.75mm thick. This dimension is one of those that control the camshaft to crankshaft distance so take care with this dimension.

If you wish, you can then use a small spring hone (from Bruce Engineering, usual disclaimers) to remove any machining marks from the bore.

05 Cylinder Jacket

For this you need a piece of aluminium alloy bar (HE30) 65mm diameter and approximately 80mm long.

If you can hold such a bar safely in the chuck then follow the instructions immediately below.

Set in the chuck so that the bore and outside length can be machined at one setting allowing for parting off. A centre at the end may be a help here.

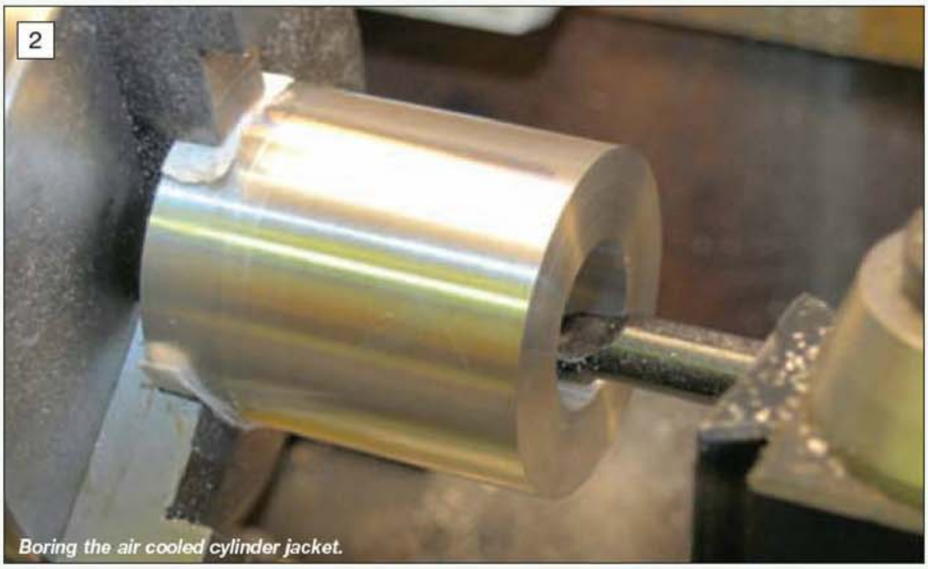
Machine the outside diameter to 60mm for the full length and face off the end.

Bore the inside to fit liner (29mm) running bar through twice for final couple of cuts and three times for final cut (**photo 2**). The cylinder liner should be a close sliding fit in the jacket.

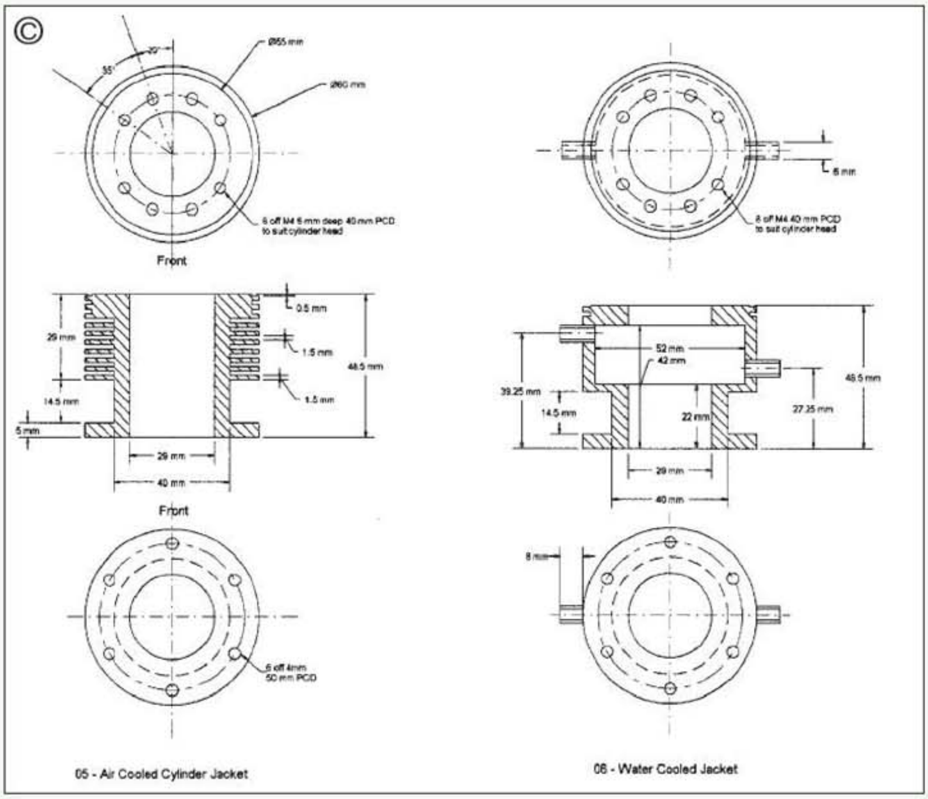
If you cannot hold a long enough piece of bar in the chuck use a piece just slightly longer than the finished liner and bore the inside first. Then mount on a suitable mandrel to carry out all the other machining. You will see from the photographs that this is in fact what I did.

Machining the air cooled fins

Machining deep fins in aluminium alloy can be tricky but if taken carefully should be trouble free. The trick is to use plenty of coolant (I use a



Boring the air cooled cylinder jacket.



05 - Air Cooled Cylinder Jacket

06 - Water Cooled Jacket

50/50 paraffin/neat cutting oil mix) and to retract the tool very frequently to clear the chips.

Use a parting tool 1.5mm wide, and machine fins at the end nearest the chuck. Use lathe indexes for positioning fins, starting by machining the part fin at head end with the outer edge of the tool 48mm from the projecting end of the bar. Then cut first two gaps 2.5mm deep followed by rest of fins 10mm deep. Clear tool frequently and allow extra thickness on final fin for cleaning up (**photo 3**).

Once the fins are cut, use a wider parting tool to cut away surplus metal at bottom part of jacket and finally clean up this area to size. The 14.5mm section is the minimum to allow insertion of the cylinder holding bolts.

Now part off the jacket to length allowing a fraction for final cleaning up before reversing in the chuck and very carefully face of the head end to accurate length. A mandrel can be used for this final operation if desired.

Drilling cylinder bolt holes

Set jacket up on rotary table with cylinder face uppermost. Offset the table to give 50mm PCD for bolt holes. Centre all holes then drill through 4mm (**photo 4**). The jacket is now finished other than the cylinder head bolt holes which will be drilled once the head is made.

Do not alter the setting at this stage because the next thing to do is to make a simple jig for drilling cylinder bolt holes in crank case. This is a flat plate with a spigot turned to close fit in jacket bore and is drilled at the same setting as the cylinder jacket (**photo 5**) and put aside for use later. This jig can also be used to drill an alternative cylinder jacket should one be made.

The water cooled jacket

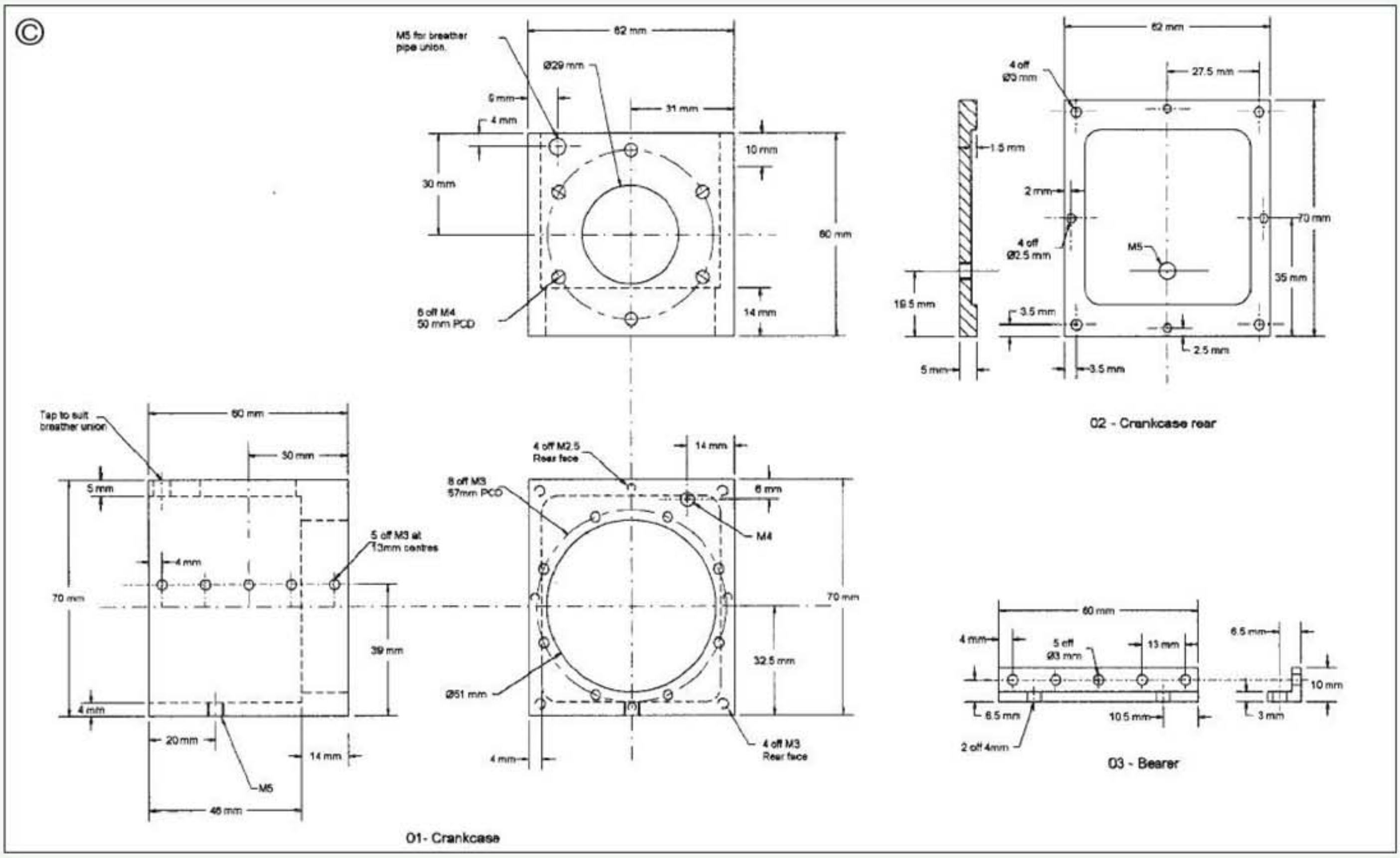
The water cooled jacket follows a similar process except that there are only two shallow fins and the inside needs boring out and the holes for the water inlet and outlet pipes need drilling. These can be placed to suit the individual requirements but the top one should be at the very top of the water space to avoid air pockets.

If the two jackets are made exactly the same length then they can be swapped to use the engine in both air cooled and water cooled options.

Put aside until the cylinder head bolt holes are to be drilled and tapped using the head as a template.

01 Crankcase

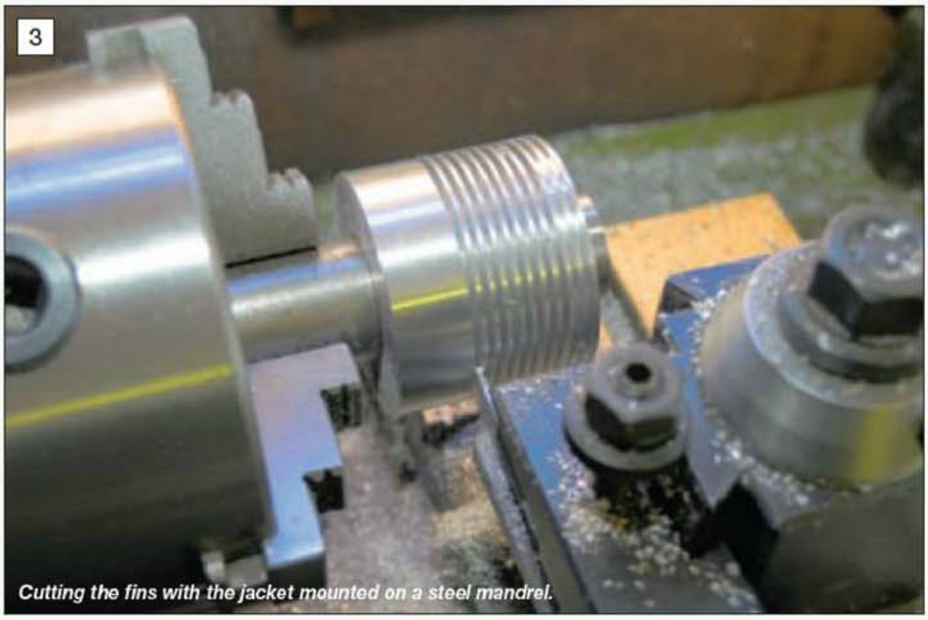
This item is part machined before the rear cover is made and fitted and the whole lot machined to size. This approach leaves a clean joint between the cover and the crank case.



01- Crankcase

02 - Crankcase rear

03 - Bearer



Cutting the fins with the jacket mounted on a steel mandrel.

Start with a suitable length (75mm) of 65mm (2 1/2in) square HE30 aluminium alloy bar and mill one of the long sides true. This will be the front face of the crankcase.

Set the bar in the milling vice and ensure this side is truly vertical (**photo 6**) and then clean up the top face. Mark these two faces which should be at right angles.

Machine the rest of the bar to the outside dimensions (**photo 7**) plus a small allowance for cleaning up once the rear cover is fitted.

Leave this item now until the rear cover is made and fitted then clean up to final size as a unit.

Machining the inside of the crankcase

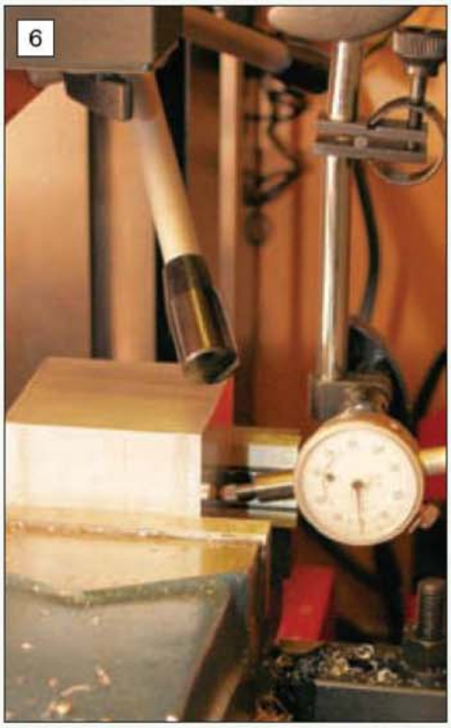
My preferred option for machining items like this, where a large amount of metal has to be removed from the inside, is to bore any large holes first because this removes some of the excess metal and also gives holes for the swarf and coolant to escape when removing the rest by end milling.

Boring the crankcase front and cylinder holes

I bored these in the lathe but either of these holes could also be bored in the milling machine using a micrometer boring head if preferred.

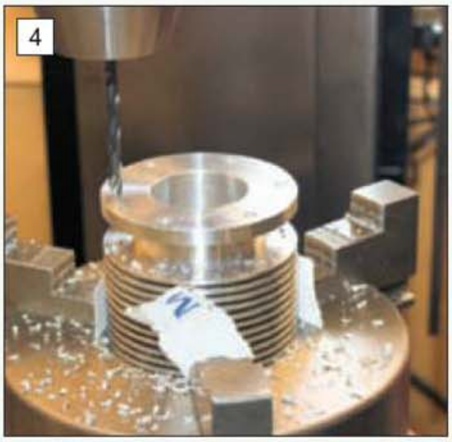
The critical dimensions are the distances of the holes from the front top edge of the crankcase. The holes should also be on the vertical centre line so take care with the marking out (or indexing if using the mill).

After marking out the and centre punching the hole centres in the top and front faces , I set the crankcase up in the four jaw chuck and centred the centre mark for the large hole for the crankcase front. I checked that the face was at right angles to the lathe centre line using a dial test indicator (**photo 8**) and then centred and drilled right through the block with 15mm drill.

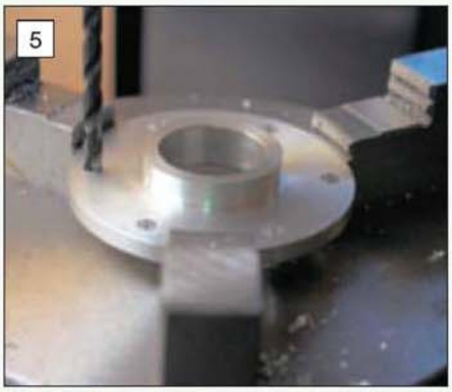


Setting the crankcase front face truly vertical in the mill prior to machining the top face.

Machining the top face using a tipped facing cutter.



Drilling the cylinder bolting down holes on the milling machine.



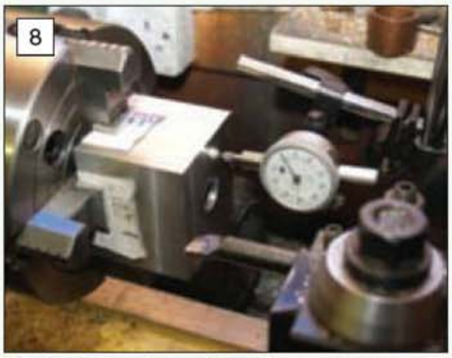
Drilling the holes in the cylinder bolt hole drilling jig.

The large hole was then bored through the block (**photo 9**) and finished to 51mm diameter.

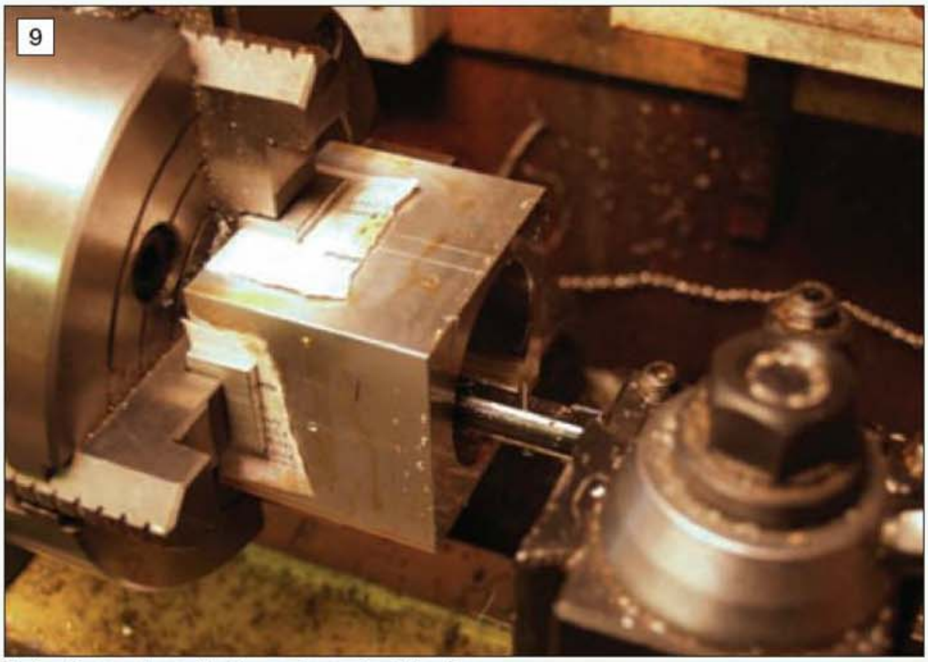
This process can be repeated for the smaller (29mm diameter) cylinder locating hole in the top face, but don't bore right through this time, just go fully into the large hole (**photo 10**). This hole must be finished to a close fit on the cylinder liner. Boring these two holes has removed the majority of the metal from the inside so we now need to finish this by setting the crankcase up in the mill with the rear face uppermost and drilling/milling the rest away.

Removing the rest of the metal from the inside

I used the mill indexes to position four 12mm holes close to the inside corners of the crankcase and drilled down 45mm at each position. I then used a 12mm long end mill to remove the rest of the metal, finally taking a light finishing cut all round the edge (**photo 11**) and finishing off the depth to 46mm deep.

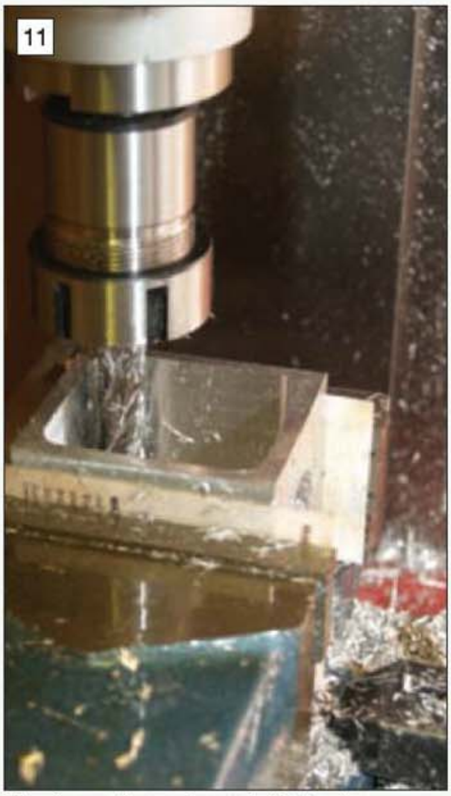


Setting the crankcase front face to run true before boring the front location.



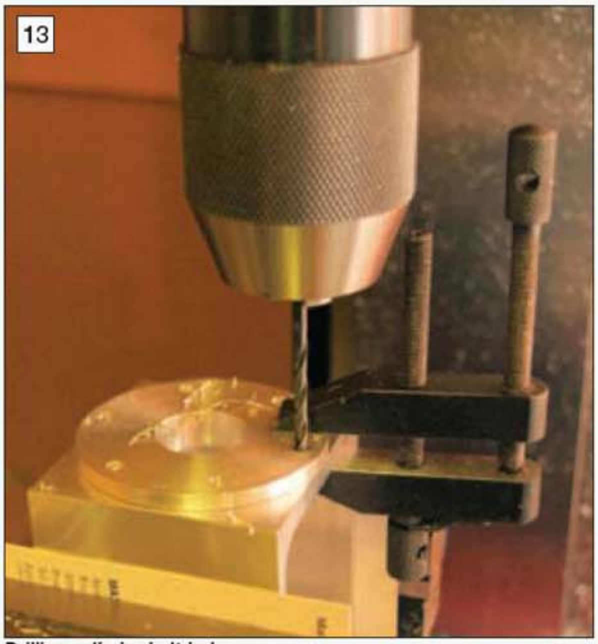
Boring the crankcase for the crankcase front location.

Boring the cylinder location in the top face of the crankcase.



Cleaning up the crankcase inside to size.

Setting the drilling jig for the cylinder bolt holes in the crankcase top face.



Drilling cylinder bolt holes.

Drilling the cylinder bolt holes and breathers

The previously made drilling jig is now used to drill the 6 cylinder jacket bolt holes in the top face before tapping them M4. The jig was located by setting the crankcase on its side on the surface plate, using a square to set two of the jig holes vertical and clamping the jig in position with a toolmakers clamp (**photo 12**). The job was then transferred to the drill for drilling and tapping the holes (**photo 13**).

The hole for the breather can be drilled and tapped to suit available unions. I took a vent pipe from this up to a feed union into the side of the cam box.

I have shown a drain plug on the bottom of the crankcase, but did not fit it on my engine only for the reason that if fitted the engine does not sit flat on the crankcase bottom. If you decide to include it, drill and tap the hole now.

The M4 hole for the timing belt tensioner will be positioned once the cam belt is installed. The dimensions shown on the drawing are those of the prototype but may vary because the belt tension is affected considerably by small variations in the camshaft to crankshaft distance.

I suggest that the bearer bolt holes are left until the bearers are made. The crankcase front bolt holes will also be drilled and tapped later.

●*To be continued.*

Above left: The Boost Energy Systems demonstration rig. Above right: The sophisticated digital readout display and sensor unit from Allendale Electronics.

TRADE STANDS
AT THE 75th MODEL ENGINEER EXHIBITION

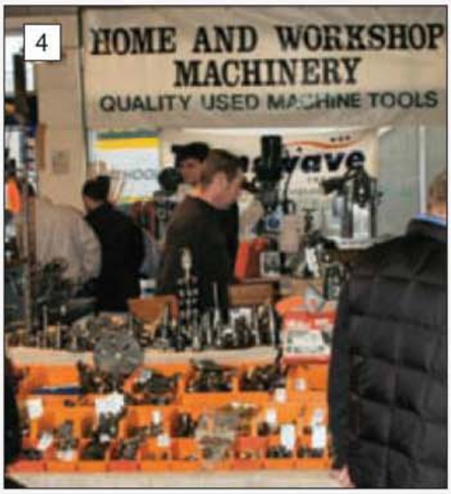
Malcolm Stride
visits the trade stands at the Model Engineer Exhibition and finds lots to tempt him.

In spite of the threat of inclement weather and the set up day this year being a Bank Holiday, a wide variety of suppliers brought their many and varied wares to the exhibition to tempt visitors into parting with their money for that latest project or tool. However, there were some of the regulars who did not make it this year. For no other reason than that it was the first photograph I took, this year I will start off by looking at some of the machine tool accessories.

The first stand I came across that fell into that category was Boost Energy Systems (01344-303311, **www.boost-energy.co.uk**) who supply variable speed power supplies suitable for machine tools and had a demonstration set up (**photo 1**) on their stand to catch the attention of visitors.

A different type of accessory becoming more popular these days are digital readouts on both lathes and milling machines. Having fitted such read outs to my own mill, I can testify to the benefits of using them and Allendale Electronics (01992-450780) had a demonstration of their system at the show. This was attracting a lot of interest when I saw them and theirs is certainly a very sophisticated system (**photo 2**) providing a lot more than just the basic read out.

The Warco WM 16 and ZX 15 milling machines were two of many on their well-stocked stand.



Lots of interest in the items on the Home and Workshop Machinery stand.

Of course if you have not got a lathe or mill to fit accessories to, you will have no doubt been interested in the range of machines on offer, both new and 'pre-owned' (to quote the favoured description for 'second-hand') from the various suppliers. I picked out the two mills on the Warco stand (01428-682929, **www.warco.co.uk**). The nearest to the camera (**photo 3**) is the WM 16

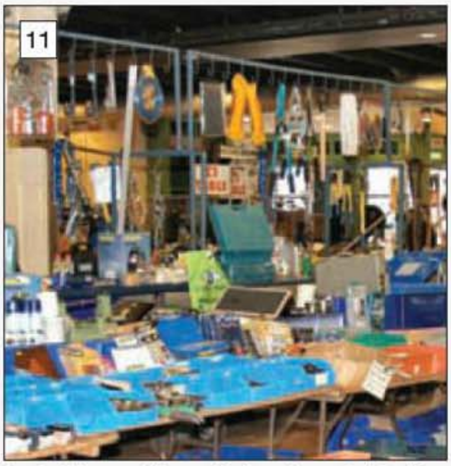
Left: The Myford Super 7 Plus attracted lots of interest, no doubt plenty are using it in their workshop. Below: The small Hobbymat lathe seen on the R. A. Atkins stand.

Milling cutters for all occasions on the JB Cutting Tools display.

Another supplier with a good range of cutters was HJH Tooling.

A excellent range of diamond files was on display at Tools 2000.

Chronos displayed a wide variety of measuring and marking out aids.



Part of the usual large display of assorted tooling and other items from Tools (UK).

These will be familiar to those with an interest in woodwork and were on the Ryan Tooling stand.

which is a variable speed machine and the other is the more basic mill/drill machine with tilting head, the ZX 15.

Among those with a range of used machines on offer was Home and Workshop Machinery (0208-3009070) who had a range of machines and accessories on display which was creating a lot of interest (**photo 4**) when I photographed the stand.

Another of the regulars who was at the show was Myford (0115-9254222, **www.myford.com**) and I picture this fine Super 7 Plus lathe (**photo 5**) which seemed to be fitted out with just about all the accessories including DRO and quick-change gearbox.

Cleaning, polishing and other cloths on display by M. H. Textiles.

The next stand with a small lathe on offer was that of R. A. Atkins (01483-811146) who had this unused Hobbymat lathe (**photo 6**) still in its original packing on display. I have to admit to picking this out because the first lathe I bought was a Hobbymat and it earned its keep with me for about 15 years before being sold on and it is still working away some 10 years later making model boat fittings.

Once you have got your lathe or mill, one of the things to spend money on at shows is cutting tools and JB Cutting Tools (01246-418110) had come all the way down from Yorkshire to ply their trade at the show and had a good range of milling cutters (**photo 7**) on display.

Another regular at the show selling a range of cutting tools and other items was HJH Tooling (01373-832756) who doesn't provide a mail order service but do visit many shows around the country (**photo 8**).

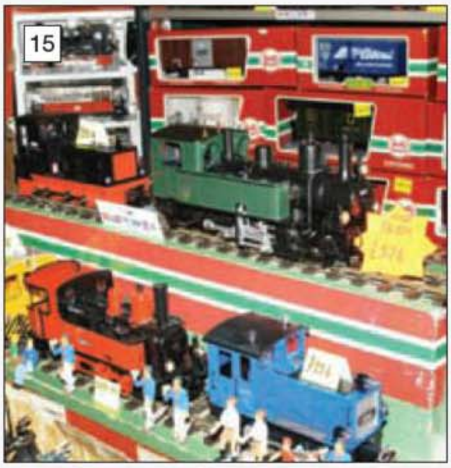
Apart from cutting tools, an item of hand tooling that many model engineers have come to

A wooden Porsche kit for the younger visitors by Pat Richardson.

appreciate is the ever-increasing range of diamond files. I found an excellent range of needle files (**photo 9**) on the Tools 2000 (07960-076350) stand.

Moving on to more general tools another regular participant at the show is Chronos (01582-471900, **www.chronos.ltd.uk**) who were displaying a very wide range of tooling. I picked a selection of measuring and marking out equipment (**photo 10**) for my report.

One of the largest displays of general tooling and other bargains is always that by Tools (UK) (01884-34415) who travelled from Devon to be at the show. **Photograph 11** shows a small part



Part of the excellent range of garden railway items on the Chalk Garden Rail display.

This wooden clock kit from Rite Time may well have encouraged more interest in clock making.

Some of the parts for Penrhos Grange by Neville Evans on the Polly Models stand.

of their large display of useful tooling.

For those with an interest in woodworking, the display of planes (**photo 12**) by Ryan Tooling (0207-2491744) will have been of interest.

Once you have got all these tools and used them, you will have a need for cloths to clear up, wipe cutting oil off work, polish and a multitude of other purposes. A wide range of suitable cloths (**photo 13**) was available at M. H. Textiles (01788-833102) who I think are new to the show.

I suspect that many visitors to the show will have been looking for their next project and, in many cases, that may mean buying a kit of parts or even a ready assembled model. Many traders at the show catered for such things, ranging from the simple kits suitable for presents for small relatives to the larger locomotive kits.

For the former, I found the range of wooden kits by Pat Richardson (020-8673-4381) including the miniature Porsche kit (**photo 14**) of interest.

Many youngsters start off with small-scale railways and the garden gauges are very popular with many clubs setting up layouts at their club sites. Chalk Garden Rail (01474 351672) will have provided many new items for such railways from their excellent range (**photo 15**) whilst at the show.

Another wooden kit, but this time of a somewhat different type was the clock (**photo 16**) found on the Rite Time Publishing (01420-487747) display. A completed version of one of these was running on the stand and hopefully will have encouraged some new interest in horological activities.

A lot of visitors will have been looking for a larger locomotive as their next project and these could be found in all shapes and sizes ranging from the traditional GWR 4-6-0 steam locomotive typified by *Penrhos Grange* to be seen in kit form (**photo 17**) on the Polly Models (0115-9736700) who of course have Bruce Engineering under their wing now for the fittings and Anthony Mount's range of unusual stationary engines.

The more modern locomotives on the M.E.P (Bexhill) display proved attractive to those seeking an easy way into model locomotive driving.

Many of those who want to drive a model locomotive have a preference for more modern diesel types and these could be found at M.E.P. (Bexhill) (01424-223702, **www.model-engineering.co.uk**) who have a very good range of different types to suit all tastes (**photo 18**).

Another stand supplying this type of locomotive is of course Compass House (01892-852968, **www.compass-house.co.uk**) who I did not photograph this year.

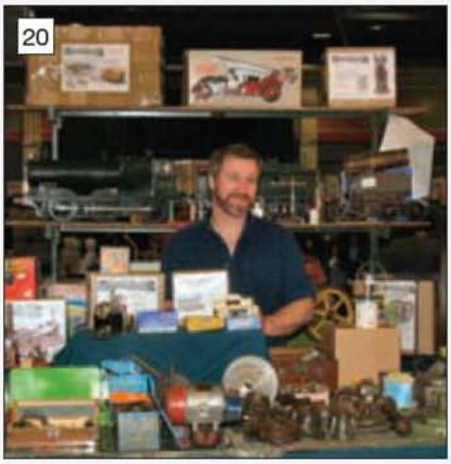
A company with a range of very different items on display was the unusually named Green Man Dancing (01674-840969) who had a range-encompassing gem stone cutting and polishing to model boat kits of various types (**photo 19**).

During the course of my conversations with the various traders on the final day, I gained the impression that the majority of them were very pleased with their trade at the show. In particular, Adrian Grimmett of L. A. Services (01455-220340, **www.theengineersemporium.co.uk**) seemed very pleased; he even smiled for the camera (**photo 20**). Many readers will be familiar with Adrian's range of unusual kits and other items which were on display at the show.

I will finish off with something that many of you will be aware of but will have never examined at close quarters, a miniature gas turbine. The example shown (**photo 21**) was being shown by Heward Microjets (01954-250166, **heward-microjets.co.uk**) and certainly the parts on display looked to be very good quality and the complete unit and accessories were displayed in a very nice fitted case.

As is normal with these reports, the selection I made is a personal choice and I must thank all those traders who took the time and trouble to attend the show and hope that they had a successful event. If you visited the show, hopefully I will have brought back some pleasant memories and if you did not, I hope you have got a flavour of what was on offer and will be encouraged to come this year.

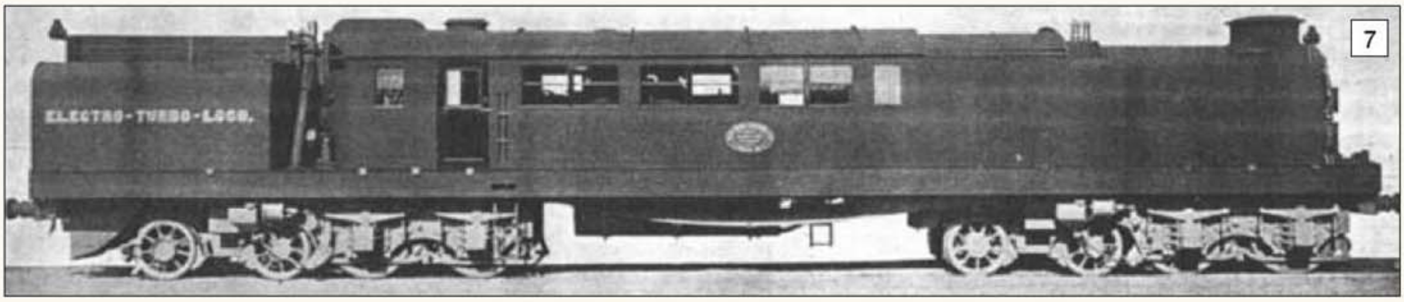
Model boats to gem stones, the display at Green Man Dancing.



The traders seemed happy with the show, particularly Adrian Grimmett from L. A. Services.

The very nicely made and presented gas turbine on the Heward Microjets stand.

7



Reid-Ramsay. 'Electro-Turbo-Loco' with the smoke box at the back.

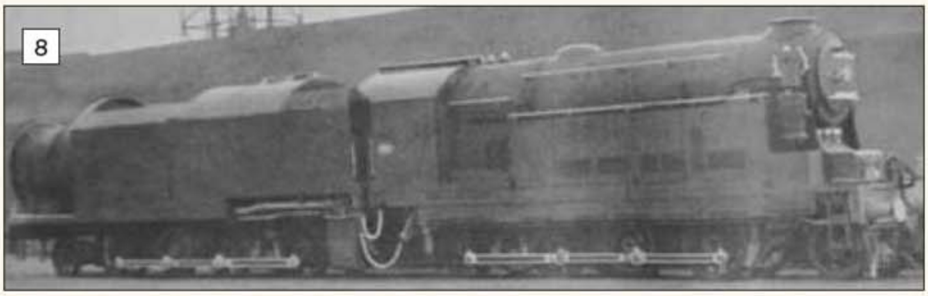
P. J. M. Southworth continues his look at these unusual but fascinating locomotives.

●*Part II continued from page 444 (M.E. 4271, 14 April 2006)*

STEAM TURBINE LOCOMOTIVES OF THE WORLD

Five steam turbine locomotives were produced in the UK. Intended for express passenger work, the first was built by The North British Locomotive Co. Ltd. (Reid-Ramsay) in 1910. The boiler at one end was of the conventional locomotive type with both coal and water supplies in tanks either side of the boiler. The turbine, generator and cab were in the centre and the condenser at the other end which was the front of the engine, all mounted on a girder frame bellied in the centre. In **photo 7** the front facing to the left was open to catch the air for cooling. The turbine running at 3,000rpm and producing 800hp, was coupled directly to a continuous current variable voltage dynamo supplying current from 200 to 600 volts. Current was supplied to four series wound motors, two on each bogie, the armatures of which were built onto the axles. Each bogie had four driving wheels and four smaller truck wheels. Air forced into the cooler by the forward motion of the engine, was assisted by a fan. The condensing water was circulated by turbines driving centrifugal pumps situated alongside the main turbine. Air for the fire was circulated by a turbine driven fan, first passing through the cooler, which would have warmed it up. It ran for short distances on the Caledonian and North British Railways, but never entered service. Length 67ft. $^{1}/_{4}$in., boiler pressure 185psi, driving wheel diameter 48 inches.

8



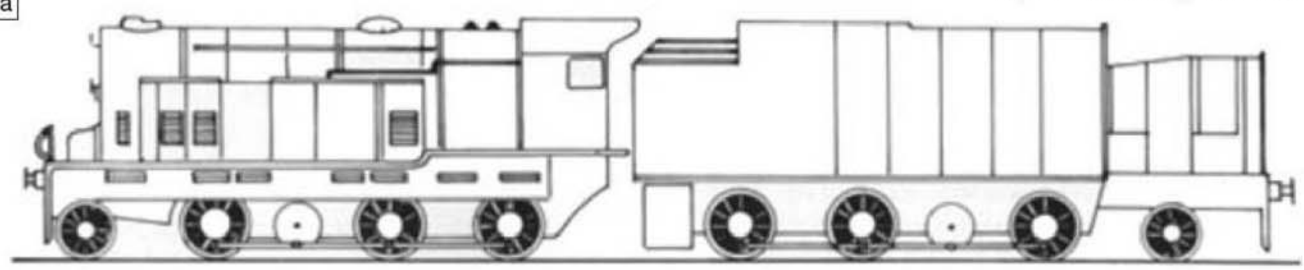
Ramsay. The round rear of the tender is the casing of the air circulating fan for the condenser.

Sir W. G. Armstrong-Whitworth, UK (Ramsay)

Built in 1922 by Armstrong Whitworth & Co. for the Ramsay Locomotive Co. Ltd., it had been designed and built without any user collaboration. The turbine drove a generator which supplied current to four, 3-phase 275hp motors, two on each vehicle. The tender was a bunker and cooling water tank with condenser, air being drawn in by a rear mounted vertical fan. It exceeded its estimated design weight by 17 tons and had excessive axle loadings. Tested on Lancashire & Yorkshire rails between Bolton and Southport with trains of empty stock, it never entered service. To quote *The Engineer "Its maximum and final performance was to average 38mph from Southport to Wigan with a train of 170 tons, the hectic maximum being 50mph"* – it didn't look as they thought much of it.

Length including tender 69ft. $7^{1}/_{2}$in., boiler 205psi, grate 28.4sq. ft., heating surface 1243sq. ft., turbine 1,200hp at 3,600rpm, driving wheel diameter 48 inches.

8a

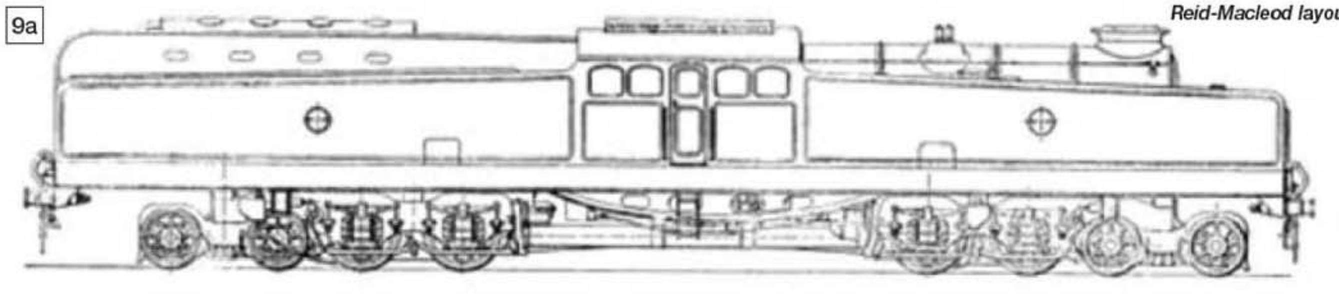


Layout of the Ramsay Turbo-Electric.

9

Reid-Macleod, another locomotive with the smoke box located at the back.

9a

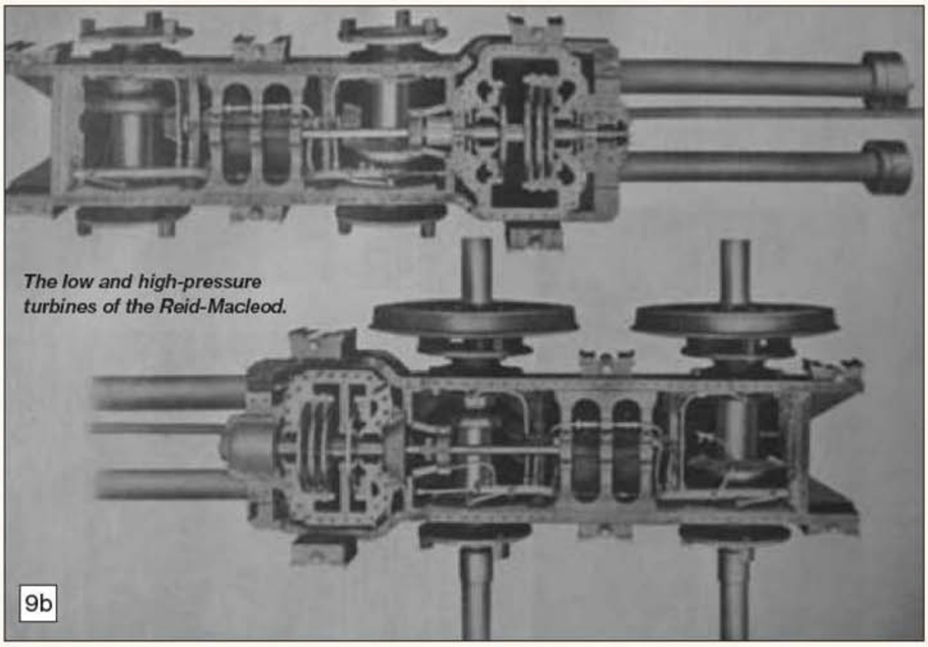


Reid-Macleod layout.

North British Locomotive Co., UK (Reid-Macleod)

The third British engine, was again built by the North British Locomotive Co. Ltd. in 1924. Designed by Reid & Macleod with the intention of hauling 225 tons at 60mph. The frames and boiler from the Reid-Ramsay were used to form the basis of this new venture. The two eight wheel bogies had four powered wheels and the others idling. The high pressure turbine was installed on the trailing bogie and the low pressure turbine on the leading with the wheels driven through a double helical gear, then bevel gears to the axles. The condenser was in the front part of the engine with the whole of the front open, covered by a grille, to let air in, this was assisted by a turbine driven fan sited between condenser and cab. With condenser at the front, enclosed cab in the middle, a standard locomotive boiler terminating with the chimney and smokebox at the back making up the locomotive. A separate turbine driven fan was used to deliver air to the ash pan. To prevent blow back when the fireman opened the fire-hole door a device on the door-latch shut off the forced draught and opened a damper. Both high pressure and low pressure turbines delivered the same power, driving the wheels through an 8 to 1 double helical gear, then to turn the drive through 90deg. through bevel gears having a ratio of 2.38 to 1. The reverse turbines were on the same shafts as the forward turbines, giving about 70% of power. All the gearing was enclosed in oil tight casings. Oil was delivered to all bearings and rotating parts of both main and auxiliary machinery, except the axle boxes, by a steam driven reciprocating pump. A vertical reciprocating pump was also used for the boiler feed. It only had two trips out, the first in March 1926 there was trouble with the circulating pumps and in April 1927 the turbine failed. It then disappeared.

Overall length 67ft. $^3/_4$in., boiler 185psi, turbines 2 x 500hp at 8,000rpm, overall gear ratio 19:1, tractive effort 15,000lb, maximum speed 60mph, driving wheel diameter 48 inches.



The low and high-pressure turbines of the Reid-Macleod.

9b

London, Midland & Scottish Railway, UK

LMS 6202 was put into service in June 1935 costing twice that of engines 6203-12 of the same class. The engine was never named, but even in official records, it was referred to as *Turbomotive*. It was well documented in the engineering press of the day, so information is reasonably easy to find. The original photograph (**photo 10b**) turned up at The National Railway Museum, York in 2000 and was printed in their *Review*, it also appeared in *The Engineer* in 1935.

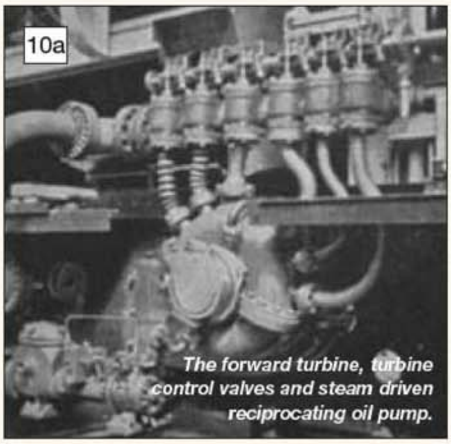
Metropolitan-Vickers made both turbines and the transmission reduction gears. The forward turbine having 16 stages was rated at 2,600hp at 62mph and permanently connected to the wheels via triple reduction gearing having a ratio of 34.4:1. The less powerful reverse turbine as originally designed was inadequate to propel an empty train from Euston up Camden bank, but this weakness was eventually overcome. The reverse turbine was engaged by a dog clutch, the forward turbine having to come to a dead stop first. This clutch initially caused trouble until an interlocking system was installed to prevent the turbine steam valves being opened before the clutch was engaged. All bearings in the turbine and gearbox were force lubricated and the gears by sprayers, with the oil being circulated by two Worthington-Simpson steam operated reciprocating pumps along with a gear pump. One of the reciprocating pumps was kept running after the engine had stopped to remove heat from the turbine, the oil passing through a cooler. During running the regulator was kept fully open, with power requirements for each turbine controlled via cam operated valves, one valve to each steam nozzle. The forward turbine having six nozzles and the reverse three. The number of nozzles being open depending on power requirements.

Differing from the other engines of the class, 6202 had a larger superheater and firebox volume, a double blast pipe, feed water heater and Timken roller bearings fitted to all axles

10

LMS 6202 'Turbomotive', the forward turbine cover is seen through the cut-out in the casing.

10a



The forward turbine, turbine control valves and steam driven reciprocating oil pump.

including the tender. Due to its smooth running, it gave drivers little concept of speed, so it was always fitted with a speedometer.

In a series of tests against standard Pacifics, The engine showed a coal economy of 3.7% as compared with one freshly out of the shops, and of 10.7% with one that had run 19,500 miles since its last general overhaul. It could produce 12% more horsepower than a conventional Princess type with much the same coal consumption.

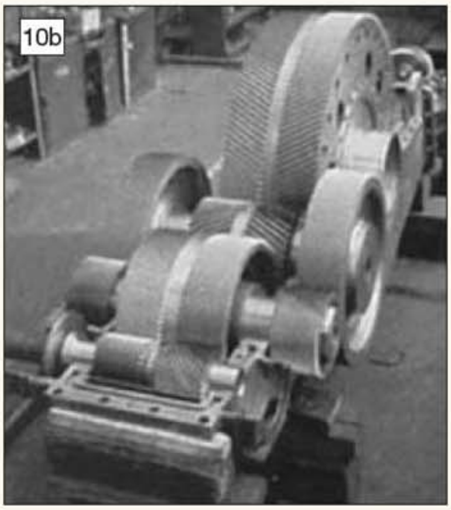
Turbomotive, unlike some of its turbine driven predecessors and successors, was basically a simple engine, the two turbines taking the place of the cylinders. There was no condenser, no electrics and no extra turbines to produce draught for the fire etc. What was against it was the initial cost, the inevitable high cost of maintenance and it being out of service for various reasons, which was inevitable with it being a one off and experimental. In April 1950 there was a major transmission failure, and with the cost of rectifying it being very high. Mileage travelled up to 1946 was 300,000, with a total of 461,487 before rebuilding. It was rebuilt as a four-cylinder reciprocating engine named *Princess Anne* and was involved in a multiple crash in October 1952 at Harrow & Wealdstone Station and condemned.

Length including tender 74ft. 4[1]/4in., weight 165 tons, coal capacity 9 tons, water capacity 4,000 gallons, boiler 250psi, grate 45sq. ft., heating surface 2,168sq. ft., superheater 540sq. ft., turbine 2,600hp 13,500rpm at 90mph, tractive effort 40,300lbs, driving wheel dia. 75 inches.

In 1946 R.C. Bond, who was the Deputy Chief Mechanical Engineer of the LMS, gave a paper to the Institution of Locomotive Engineers: *"Doubts have sometimes been expressed regarding the suitability of high-speed geared turbines for the arduous conditions of locomotive service. The experience already gained with engine no. 6202 has, it is submitted, effectively dispelled any doubts on this matter. The ahead turbine and gear transmission has, over 300,000 miles running, exhibited a degree of mechanical reliability at least as great as that of the cylinders, valves and motion of a reciprocating engine. Since they were redesigned, the reverse turbine and reversing mechanism have given good service, and unsatisfactory features in the lubrication system have been largely overcome. The remaining problem of oil leakage is certainly not insoluble".* He continued *"The decision to build the turbine locomotive was originally based upon the prospective advantages which such an engine appeared to offer in three important respects, namely:- a) Reduced coal consumption. b) Increased availability and lower repair costs. c) Greater power capacity within a given weight. Whereas the earlier condensing turbine locomotives of which the L.M.S. Railway and one of its constituent Companies had experience completely failed to realize their builders expectations and showed no promise of reasonably consistent service. Engine No. 6202 has, on the contrary, achieved a considerable measure of success, and with further development might well be made to give an adequate return on the expenditure incurred".*

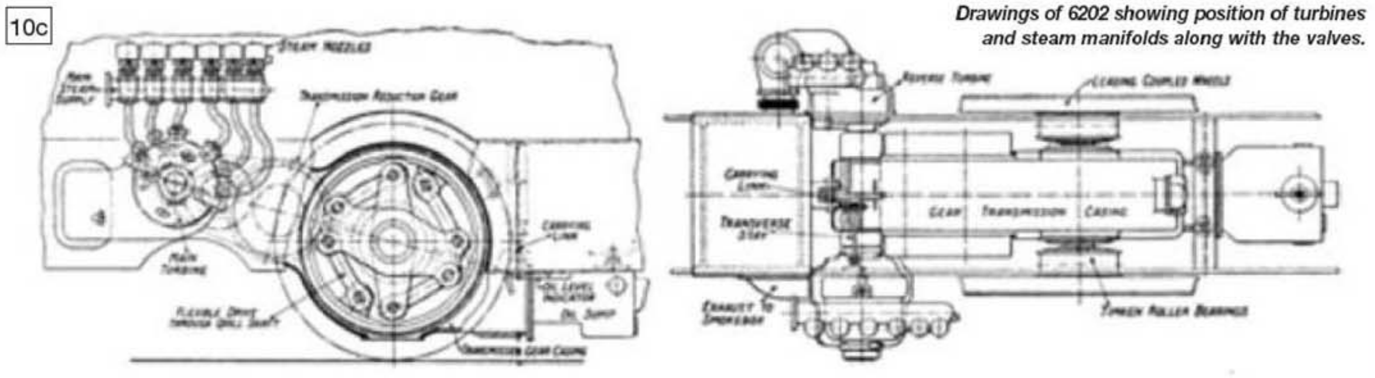
In the event this proved not to be. As has already been stated, in 1950 due to the replacement cost of the turbines being too high, it was rebuilt as a four-cylinder reciprocating engine named *Princess Anne,* and as such travelled 11,000 miles before it was written off after crashing at Harrow and Wealdstone station in October 1952.

10b



The triple reduction gears having a ratio of 34.4:1.

10c



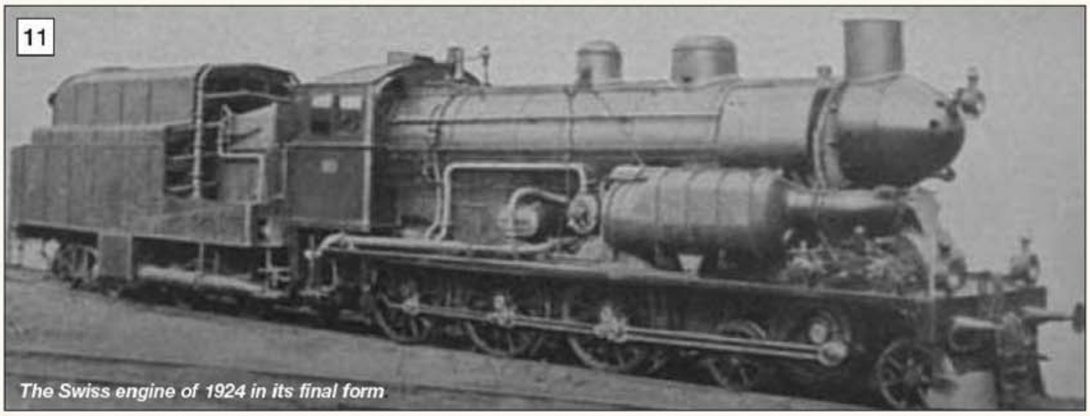
Drawings of 6202 showing position of turbines and steam manifolds along with the valves.

Swiss locomotive & Machine Works, Switzerland

Designed by Dr. Zolley and built in 1921 by the Swiss Locomotive & Machine Works, Winterthur in conjunction with Escher Wyss & Co. of Zurich. Inspired by the coal shortage of 1918 it was rebuilt in 1924 with a number of modifications after trials. The main turbine of 1,000bhp, which could be increased to 1,500bhp in an emergency, was mounted in front of the smoke-box driving a jackshaft, via 28.7 to 1 double spur gearing. Power was then transmitted to the driving wheels via coupling rods. The 700bhp reverse turbine was in the same case as the forward. Draught for the fire was generated by a turbine driven fan inside the nose cone. There were two condensers, one either side of the boiler. A turbine driven centrifugal pump circulated cooling water from the condensers to the water cooling plant in the tender, where it was cooled by the passage of air in contact with the fine water spray. Air circulation in the tender was assisted by a 75in. dia. fan at the rear of the tender. The condensate which was at about 50deg. C. was further heated by a pre heater before re-entering the boiler. The firebox was fitted with a rocking grate.

Engine length 38ft. 3/4in., weight in service 102 tons, coal capacity 6 tons, water capacity 2,640 gallons, boiler 206psi, grate 25sq. ft., heating surface 1,013sq. ft., superheater

11

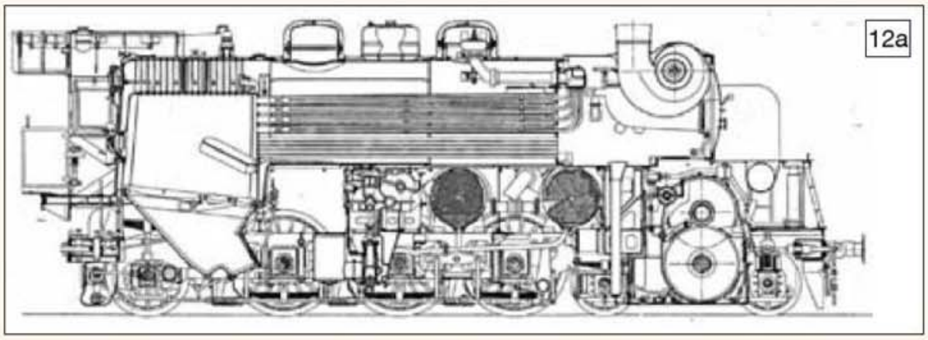


The Swiss engine of 1924 in its final form

12

The first German turbine locomotive of 1924. The two 'drums' are the ends of the condensers.

12a



Schematic showing the draught fan, and gearing from turbine to jackshaft between the bogie.

407sq. ft., turbine 1,500hp at 6,500rpm, maximum speed 47mph, driving wheel diameter 60 inches.

Krupp, Germany

Two steam turbine locomotives were built in Germany, the first in 1924 by Krupp-Zolly. The six-stage forward turbine and the three-stage reverse were situated under and to either side of the smoke-box with the double reduction gearing to the jackshaft between them, this in turn was connected to the driving wheels via connecting rods. Under the boiler mounted transversely were two condensers. The tender contained the water tank, coal bunker and cooling system for the cooling water for the condensers. The turbine steam/water circuit was sealed with only a little water being used to make up for any loss. The main water loss was in the cooling water, which was sprayed on the cooling elements and as air was circulated through this water it was driven off in vapour which had to be replaced.

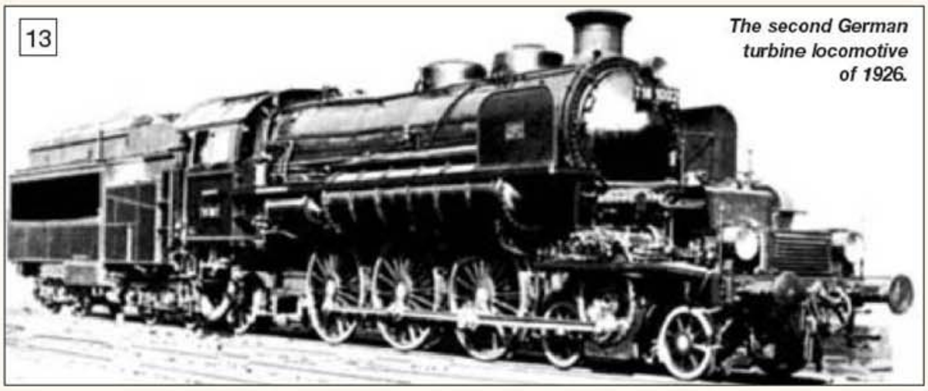
Overall length 76ft. 11in., weight in service 114 tons, coal capacity 6.5 tons, water capacity 42,900 gallons, boiler 220psi, grate 33.4sq. ft., heating surface 1,534sq. ft., superheater 710sq. ft., turbine 2,800hp at 8,000rpm, tractive effort 27,400lbs, driving wheel diameter 65 inches.

J. A. Maffei, Germany

The second German engine was built in 1926 by Krupp-Maffei, similar in arrangement to the first, but very different in detail. The turbine, as the first one, drove the wheels via gears and a jackshaft. This time the condensers were sited either side of the boiler with the cooling system in the tender being used to cool the condensers cooling water. Also in the tender was a coal bunker and water which made up losses in the cooling system. In the smoke box door was a turbine driven fan to generate draught for the fire.

Overall length 79ft. 2in., weight in service 104 tons, coal capacity 6 tons, water capacity 5,350 gallons, boiler 325psi, grate 37.5sq. ft., heating surface 1580sq. ft., superheater 550sq. ft., turbine 2,750hp at 8,800rpm, tractive effort 24,200lbs, driving wheel diameter 69 inches.

13



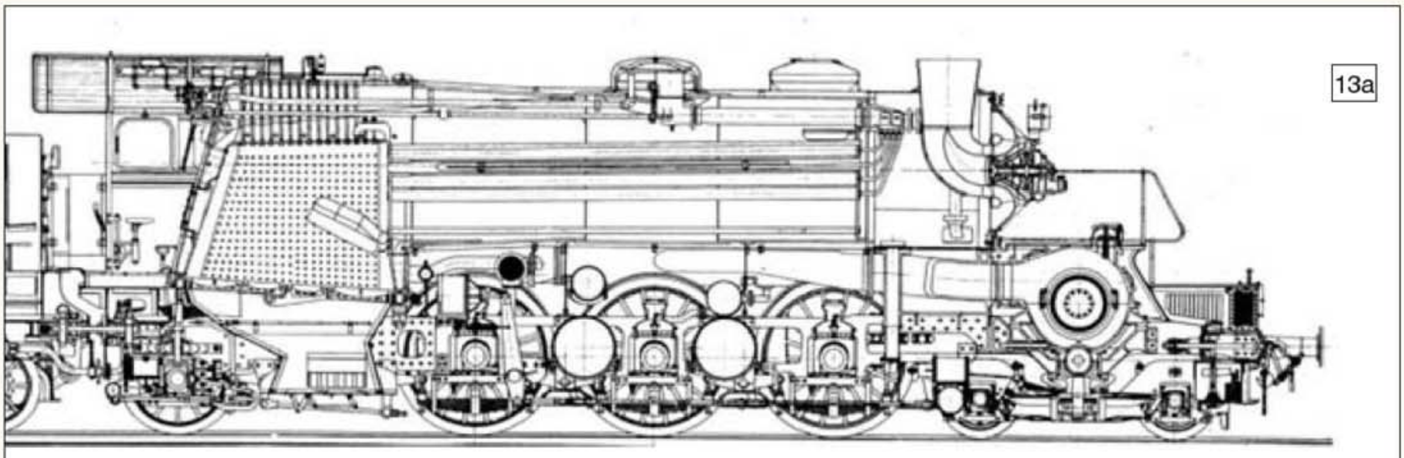
The second German turbine locomotive of 1926.

Henschel & Sohn, Germany

Though not a turbine locomotive as such, in 1927 the firm of Henschel Sohn in Germany fitted into a condensing tender a 600hp booster turbine running at 9,300rpm. This drove two coupled wheels via a jackshaft. The steam for the turbine came from the exhaust of the conventional cylinders at the front of the engine. This arrangement of using the exhaust steam and extracting more work out of it, was used in ships that had a reciprocating engine. The steam from the low-pressure cylinder of a triple or quadruple engine passed into a turbine, the power from this was often coupled, via gearing, to its own propeller. Though the system was used before and during the first world war of 1914/18, it was the Bauer-Wach system, first introduced in 1927 by Gustave Bauer that made it popular, and increased the efficiency by as much as 20%.

● *To be continued.*

13a



Section of the 1926 German locomotive. The draught fan is now in the smoke box door, the turbine in front of the door and is easier to get at.

LETTERS TO A GRANDSON

M. J. H. Ellis
discusses the work of John Bird.
●*Number 88*

Dear Adrian, I dare say that when you came to the end of my last letter you had the impression that I would have more to say about Auguste de la Rive and Marc-Antoine Thury's dividing engine. But now I come to think about it, I don't really think that there was much more to be said. You have heard the important part, and the mechanism which advanced the work and engraved the graduation would have been fairly straightforward. In any event, I have no information about its details. It was these two gentleman, by the way, who got together, like James Watt and Matthew Boulton had done, and pooled their talents to found in 1860 the scientific instrument business which developed into the Société Genevoise d'Instruments de Physique, which acquired an enviable reputation, and made notable contributions in the field of metrology.

Amongst other things, Thury invented the iris diaphragm, used so extensively in cameras. One of the 'other things', by the way, was the correction bar which I referred to in my last letter. It has just occurred to me, that if some firm which manufactured micrometers wanted to exploit the miserable vice of one-upmanship, it could bring out a deluxe model, in which the normally straight line engraved along the barrel, against which you read the graduations of the thimble, would be wavy, so that it could be claimed that the micrometer was 'individually calibrated' to correct the 'inevitable' slight errors in the pitch of individual screws.

Now that we have got onto the subject of scale-engraving, it would be a good time to deal with the subject of John Bird's method for graduating astronomical quadrants, which I could only speculate about in an earlier letter *(It was No. 80, Ed.)*. I am now better informed on the subject, thanks to Mike Harding, of the Science Museum, to whom I am most grateful for his helpfulness and patience. I had better go back and start at the beginning. The principle on which Bird worked was indeed that of continued bisection. Where I went wrong was in thinking that he started from a right angle. He didn't. Instead, he must have started from the other end of the scale, by investigating what would be the most convenient smallest sub-division from which he could successively *double-up*. He found this to be 5 minutes of arc; that is, one twelfth of a degree. Three stages of doubling-up are equivalent to multiplying by eight. We then have:

5 x 8 = 40; x 8 = 320; 320 x 8 = 2560; after which, 2560 x 2 = 5120.

A right angle = 90deg., = 90 x 60 minutes, = 5400 minutes. 5120min. falls short of 5400min. by only 280 minutes, = 4deg. 40min., and 5120min. = 85deg. 20min.. Other possibilities would have been the minimum graduations of 3, 4, or 6 minutes; but if you like to work it out; repeated doubling-up would have brought these up to 3072, 4096 and 6144 minutes respectively, all of which offer no advantage. If he had started from 2, he would have arrived at the same figure as he did by starting at 4, i.e., 4096. It would have been pointless to try starting from anything bigger than 6 minutes, because 5 minutes is plenty big enough. On a quadrant with a radius of 8ft., this gives divisions 0.1396in. apart, that is, a little more than 1/8 inch.

I was surprised to find that Bird evidently did not start by setting out a right angle using the Theorem of Pythagoras. Instead, he first struck the arc by means of a beam compass, and then, without altering the setting, struck a second arc, using one end of the first as centre, to intersect it, so marking an angle of 60 degrees. In view of his predilection for bisection, one might expect that he would have bisected the 60deg. angle which he already had, set his compass to the resulting 30deg. and used it to go on the further distance to 90 degrees. He chose not to do so. The method he used was to construct, by bisection alone, what was called a 'scale of equal parts'. It was very accurate and was 8ft. long. Eight feet make 96in., and since 96 is not an integral power of 2, my supposition is, that he started with 64in., (64 being 2^6), and then extended the length of the scale by half to 96 inches. He was able to set his compass from his scale, using a Vernier and a magnifying glass, with an error of well under a thou., and his next step was to add a further 15deg. by striking an arc forward from his 60deg. point; the radius of the arc being arrived at by calculation. I assume that he used a trigonometrical table of sines. Having got that far, he repeated the process to add a further 10deg. 20min., so arriving at the 85deg. 20min. point. He was able to check the accuracy of his work by working backwards 4deg. 40min. from the 90 deg. point. The accuracy of the 85deg. 20min. point was, of course, absolutely crucial to the accuracy of the entire dividing process, and Bird carried out all possible cross-checks to confirm it. When he had satisfied himself on this point, he could proceed, by bisection, to fill in all the remaining 1023 points separated by 5min., checking, incidentally, the accuracy of the few points which he had already set out. When this had been done, there remained the final 4deg. 40min. to be dealt with. 4deg. 40min. = 280min., which requires 280/5, = 56 divisions. 56 is not a power of 2, but 64 is. My supposition is, therefore, that in order to proceed as before by bisection, Bird went back eight graduations to his 84deg. 40min. point, and then filled in by bisection the 63 intervening points between 84deg. 40min. and 90deg., the first eight of which he had determined once already.

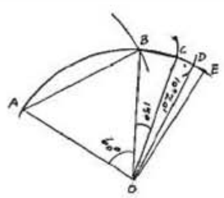


Fig 1. Setting out point D so that angle AOD = 85deg. 20min. AB = AO Radii BC and CD calculated

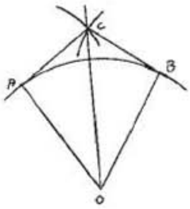


Fig 2. Construction for bisecting angle AOB: Radii AC + BC CO is bisector

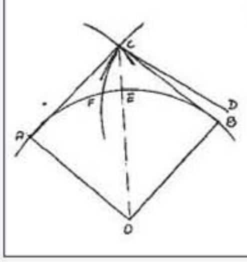


Fig 3. Possible source of error: CO bisects angle AOB and arc AB should be graduated at E. John Bird preferred to use dividers to transfer point C to F by striking arc CF from centre D. If D is badly located as shown the graduation will be at F whereas it should be at E

John Bird was a highly skilled and meticulous worker, and it is well worthwhile to take note of some of his principles and practices. His method of repeated bisection produced a large number of pairs of intersecting arcs, which formed a ring just outside the main arc of his quadrant. You might think that he placed a straightedge against the two points, the intersection of the two arcs, and the centre point of the big quadrant. He might then have incised a graduation across the arc of the quadrant. But that would not have been sufficiently accurate. Bird's maxim was *"A right line cannot be cut upon brass so accurately as to pass through two given points; (an arc of) a circle may be described, from any centre, to pass accurately through any given point."* His practice, therefore, was to make a tiny centre-prick, no more than a thou. across, where the two little arcs intersected. He could locate one point of his dividers in the bottom of this tiny crater, and then plant the other leg at a suitable spot, and use the first leg to scribe a short arc (which would form the graduation) across the arc of the quadrant. The fact that the graduation would be slightly curved does not appear to have concerned him. If needs be, he could increase the depth of cut by repeated light strokes. The cutting point of the dividers was brought to the shape of a slender three-sided pyramid, which on the one hand enabled it to incise freely, while on the other hand, it could penetrate to the very bottom of a centre-prick. You might wonder what precautions Bird took to make sure that the leg about which the dividers pivoted was planted in such a place that the scribed mark was not displaced sideways from its correct position (i.e., away from the point where the straight line between the centre-prick and the centre of the quadrant crossed its circumference), but that I do not know.

He was well aware of the inaccuracy which could be caused by thermal expansion, and took careful precautions against it. What I think is interesting is, that he contended that a skilled workman could work more precisely by touch than sight. He could, he said, locate by feel a tiny centre-prick which was too small to be seen with the naked eye. This, by the way, I can quite believe, because I have been told that the hole in a diesel engine injector nozzle is likewise too small to be seen. It occurs to me that all this precision in marking out the scale would be set at nought if the axle of the pointer was not located with equal exactitude at the centre of the quadrant. I don't doubt that Bird was well aware of this, but again, what precautions he took I do not know.

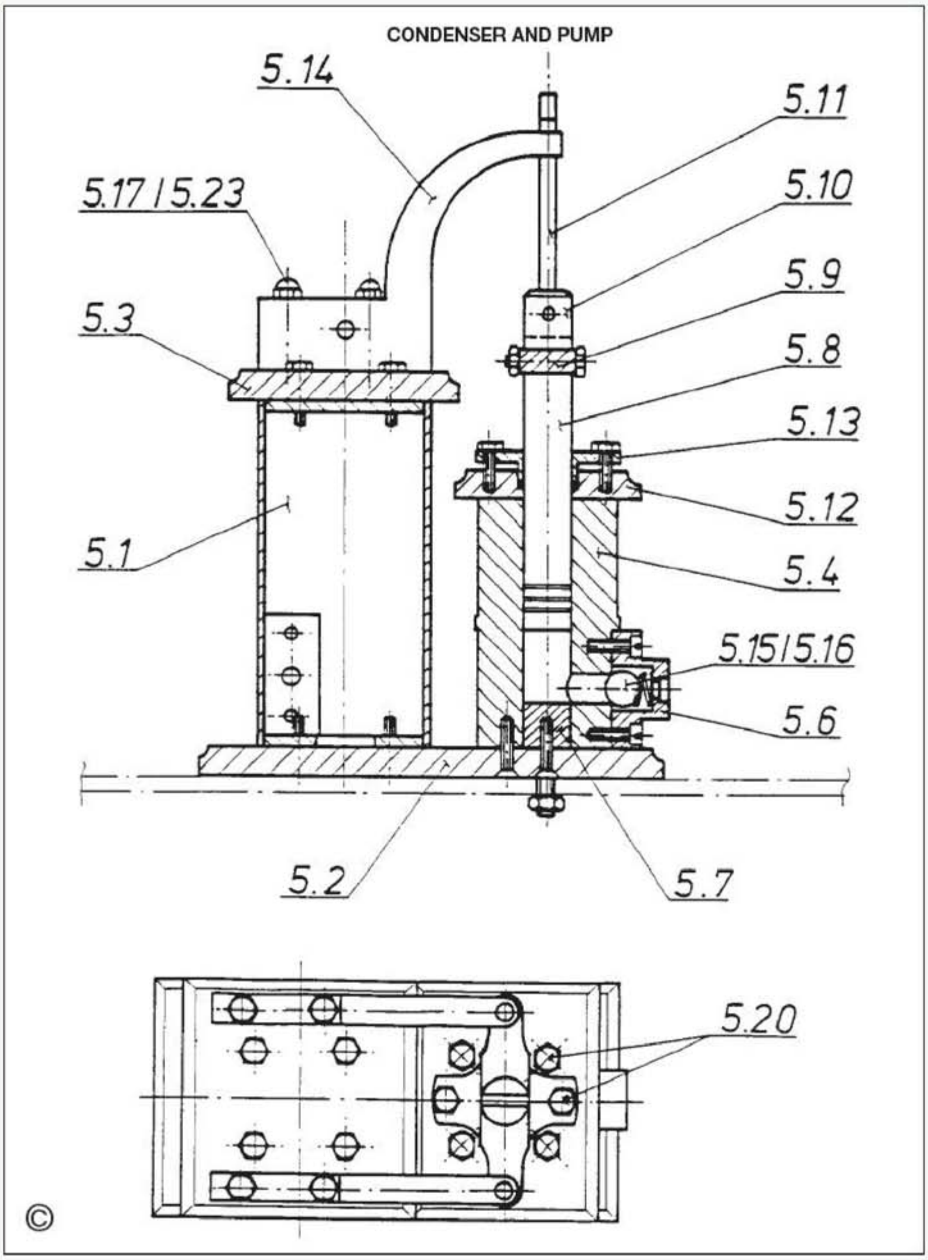
I have often admired the beautiful workmanship displayed in clocks and scientific instruments, and I hope that you agree with me, that it is a treat to learn something about one of the men of old who excelled in the craft of making them. Sir Marc Brunel knew what he was doing when he sent his son Isambard to Paris to learn something about it under Louis Breguet. Let me end with a quotation from L. T. C. Rolt's biography. *"He (Sir Marc) could not have found a finer or more critical nurse for his son's mechanical talents".*

Your affectionate Grandpa

THE GORGON STEAM SHIP ENGINE

Guenter Kallies
in Germany continues construction of his engine with the condenser and pump.

●*Part V continued from page 447 (M.E. 4271, 14 April 2006)*



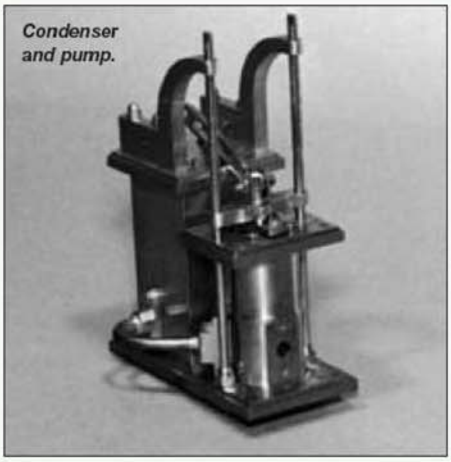
In front of each cylinder a condenser and pump unit is installed. The pump is operated by the main lever of the Evans linkage system. The condenser on the model version is just a hollow box without any internal equipment while the original one was a water-cooled tube system inside a housing. The steam coming from the cylinder outlet enters the box and condenses to water on the cold skin. This produces a lower pressure inside the box which will help to evacuate the steam from the cylinder and increase the power of the engine. With the pump, the condensed water will be removed and a constant vacuum can be maintained inside the condenser.

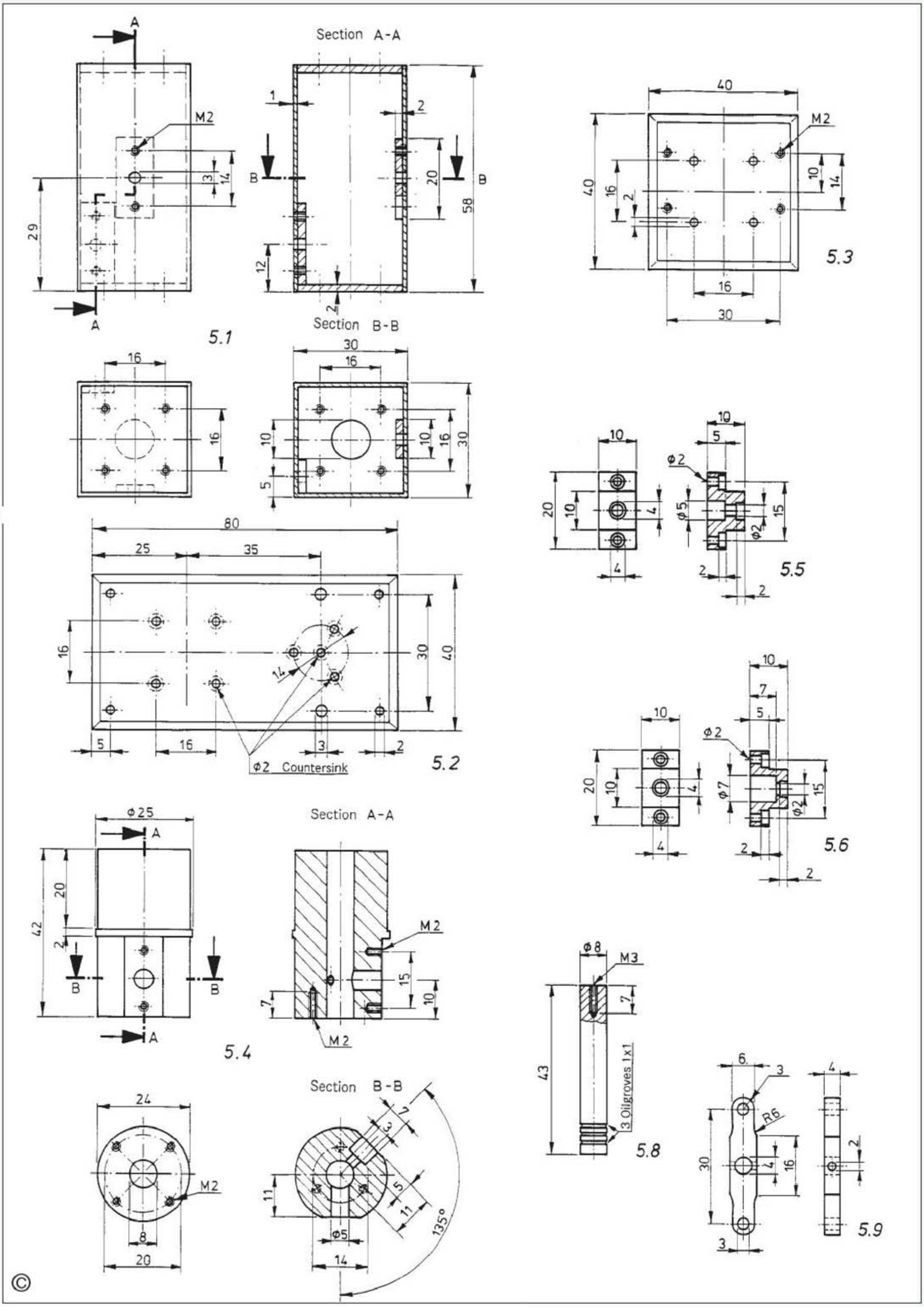
The Condenser-box (5.1) is made from various parts silver-soldered together. The main component is made from a hollow brass square tube to which all the other items are silver-soldered. The Ground-and Top-plates (5.2) (5.3) (5.12) are very similar to the ground-plates (2.2) and should be machined the same way. The Pump-housing (5.4) is made from round brass. Please note that one housing has to be made as mirror-image of the drawing in order to have the inlet-valve on the right position. All the other components in this group are again simple and do not need to be described in detail.

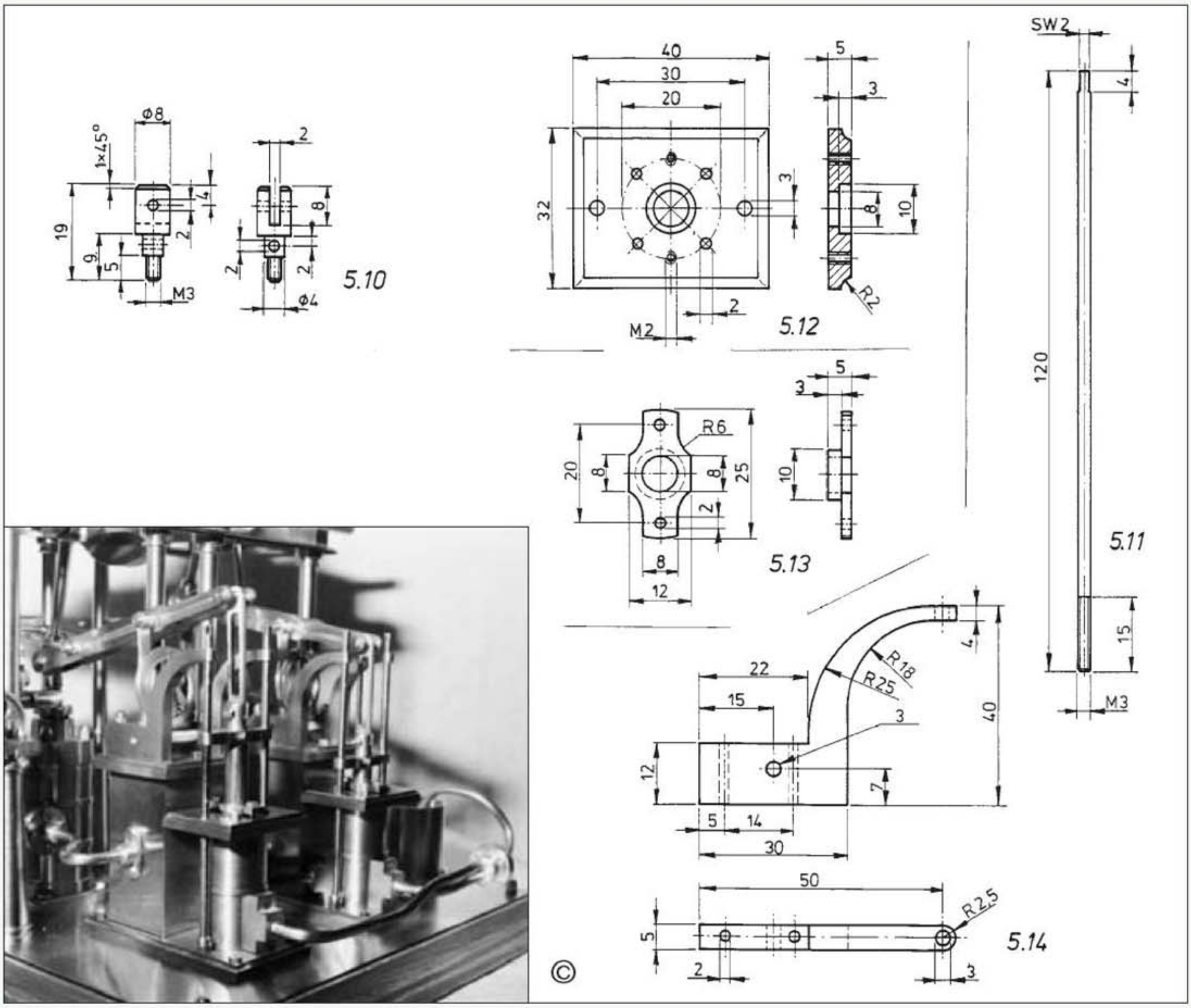
●*To be continued.*

Group No. 5: Condenser and Pump Parts list:

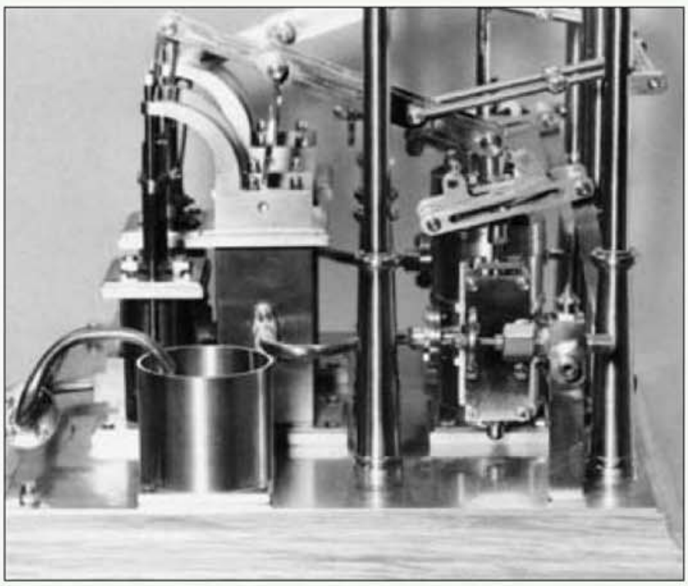
Item	Quantity	Name	Material	Dimension
5.1	2	Condenser-box	brass	60 x 30 x 30 x 1
5.2	2	Ground-plate	brass	80 x 40 x 5
5.3	2	Top-plate	brass	40 x 40 x 5
5.4	2	Pump-housing	brass	Ø25 x 45
5.5	2	Inlet-valve-housing	brass	20 x 10 x 10
5.6	2	Outlet-valve-housing	brass	20 x 10 x 10
5.7	2	Plug	brass	Ø8 x 8
5.8	2	Piston	stainless steel	Ø8 x 45
5.9	2	Yoke	brass	40 x 10 x 4
5.10	2	Piston-head	brass	Ø8 x 20
5.11	4	Guide-rod	stainless steel	Ø3 x 125
5.12	2	Top-plate	brass	40 x 35 x 5
5.13	2	Studded gland	brass	Ø25 x 10
5.14	4	Guide-rod-bracket	brass	60 x 40 x 5
5.15	4	Ball	stainless steel	Ø6
5.16	4	Spring	stainless steel	Ø5
5.17	8	Nut	brass	M2
5.18	4	Nut	brass	M3
5.19	10	Nut	brass	M2
5.20	30	Hexagon head screw	brass	M2 x 10
5.21	16	Countersunk head screw	brass	M2 x 10
5.22	8	Cheese head screw	brass	M2 x 10
5.23	8	Screwed rod	brass	M2 x 20


Condenser and pump.


Section A-A
Section B-B
M2
5.1
5.2
φ2 Countersink
5.3
5.4
Section A-A
Section B-B
M2
135°
5.5
5.6
φ2
φ5
φ7
5.8
φ8
M3
3 Oilgroves 1x1
5.9
R6
©



Above: Condenser and pump. Below left: Condenser, pump and cylinder connected by Evans Link System. Below right: The completed assembly in place.



CHANGING HINDSIGHT INTO FORESIGHT

Mick Appleyard
concludes his notes on lathe operation before discussing the milling machine.

● *Part IX continued from page 450 (M.E. 4271, 14 April 2006)*

To conclude the remarks on soft, blank end, Morse tapers started last time, one can also use these for mounting various cutters, however an arbor with a draw bar is, again, needed for this.

Screw cutting check

After you have set up your lathe to carry out screw cutting, and before you commence, make a quick check to ensure that the gear ratio is correct. The method that I use is to move the tool away from the work, start the lathe and engage the leadscrew and stop it after a couple of turns with the leadscrew still engaged. Now mark the top of the chuck with a piece of tape or a spot of Tippex and mark a pencil line down the right hand side of the saddle onto the lathe bed. Now turn on the lathe and count the turns of the chuck equal to $^{1}/_{2}$in. of travel (half the tpi to be cut) and switch the lathe off. Now measure from the pencil line to the saddle it should be $^{1}/_{2}$in. if all is correct.

Obtaining a good finish

Obtaining a good machined finish is a simple process, and is just a matter of having good quality materials, a sharp tool set on lathe centre and machining at the correct speed and feed for the material, together with ample cutting fluid.

1: All metals are designed and made for specific purposes. Not all materials will machine to a good finish, it is therefore essential to start off by using good quality, free cutting materials.

2: Have a good sharp tool with the correct top, side and front clearances. After the tool has been sharpened on the grindstone and a small radius ground on the tip, use a small, fine slip stone to finish off the radius to give a fine finish. I use high speed steel (HSS) tools for most of my work.

3: Tipped tools (throw away type) have the top, side and front clearances machined into the tool holder or moulded into the tip, which will give you the correct clearances every time. If you use tipped tools ensure that the tip grade and design is correct for the material being machined.

4: Sometimes after heavy machining (usually when cutting dry) you get a small piece of swarf sticking to the tip of the tool (built up edge), this will then act as the cutting edge on the next cut causing it to tear the work, if this is the case then either stone it off or re sharpen the tool. With a tipped tool, rotate it to a new point.

5: Set the tool on centre height using a tool height setting gauge. If it is set above centre it will rub on the work and may not cut. If it is set below centre, the work will try to climb over the tool causing chatter.

6: Set the lathe speed and feed correctly for the diameter and material being cut, if in doubt, lower the speed.

7: For fine finishing set the feed to 0.002 to 0.003in. per revolution of the lathe spindle depending on the shape of the finishing tool.

8: When taking the cut apply cutting fluid.

9: Make sure that there is no chatter when cutting. Eliminate by supporting long work with a centre and/or a steady and reducing the cutting speed.

10: The best indicator of the correct cutting speed is the colour of the material chip. As a rule of thumb, when using HSS tools, the chip should never turn brown or blue. Straw, coloured chips mean that you are on the maximum edge of the cutting speed. When using carbide tools the chip can range from straw to blue, but should never turn black. Dark purple will indicate that you are on the maximum edge of the cutting speed. Other general rules are, if you are roughing go slower and faster if finishing. For deep cuts go slower, light cuts go faster. If the work is rigid, go faster, and slower if less, rigid. If using coolant go faster.

Cutting diameters chart

Each time that you use the lathe do you check the material cutting speed against the lathe speed; if you are ignoring this then you will not get the best from your machine and tools. To make life easier, make up a chart for all the lathe speeds and the materials that you normally use and put the maximum, material machining diameter for each of the given speeds. Use the average cutting speed for each of the materials since the cutting speed will vary with material grade and hardness. For specific materials consult your material supplier. This chart can then be displayed in a prominent position by the lathe so that you can quickly refer to it.

To work out the cutting speed use the formula:
rpm = (cutting speed x 4)/work diameter.
Transposing this:
Cutting Speed = (rpm x work diameter)/4.
Transposing this:
Work diameter = (cutting speed x 4)/rpm.

Note: The cutting speed should be expressed in surface feet per minute and the work diameter in inches for these formulae to be correct. My chart for the Myford Super 7 is shown below.

Vertical milling machine maintenance

As with your lathe, in order to keep your milling machine giving consistent results, it is essential that it is kept in good order. Its also worth taking a little time just once every couple of years to run over the machine. Start off by cleaning it down

WORKSHOP WALL CHART

Maximum material turning diameter for HSS Tools, for a given speed

	Mild Steel	Stainless/Silver	Brass/Bronze	Cast Iron	Aluminum
Myford Sup.7	80 ft/min	50 ft/min	200 ft/min	80 ft/min	300 ft/min
Spindle Speed	Max dia inches	Max dia inches	Max dia inches	Max dia inches	Max dia inches
2150	5/32	3/32	3/8	5/32	9/16
1400	7/32	9/64	17/32	7/32	13/16
1020	5/16	3/16	25/32	5/16	1 1/8
700	7/16	9/32	1 1/8	7/16	1 3/4
615	1/2	5/16	1 5/16	1/2	2
425	3/4	7/16	1 7/8	3/4	2 13/16
290	1 1/8	11/16	2 3/4	1 1/8	4 1/8
200	1 5/32	1	4	1 5/32	6
130	2 1/2	1 17/32	6 1/8	2 1/2	9 1/4
90	3 1/2	2 3/16	8 7/8	3 1/2	Lathe Max Dia
80	4	2 1/2	10	4	Lathe Max Dia
55	5 3/4	3 5/8	Lathe Max Dia	5 3/4	Lathe Max Dia
40	8	5	Lathe Max Dia	8	Lathe Max Dia
25	Lathe Max Dia	8	Lathe Max Dia	Max Dia	Lathe Max Dia

A Material chip colour of Straw indicates that you are on the maximum edge of cutting speed.
Machine maximum swing is 10" in bed gap

When using Carbide tips where large amounts of stock is to be removed it will be better to take smaller cuts at higher feeds than deeper cuts at slower feeds. This will help to preserve the cutting tip.

Turning speeds for Carbide tip tools

Spindle Speed	Mild Steel	Stainless/ Silver	Brass/ Bronze	Cast Iron	Aluminium
Myford Sup.7	210 ft/min	135 ft/min	490 ft/min	285 ft/min	620 ft/min
Spindle Speed	Max dia inches	Max dia inches	Max dia inches	Max dia inches	Max dia inches
2150	3/8	1/4	7/8	1/2	1 1/8
1480	9/16	3/8	1 5/16	3/4	1 5/8
1020	13/16	1/2	1 7/8	1	2 7/16
700	1 1/4	3/4	2 3/4	1 1/2	3 1/2
615	1 3/8	7/8	3 1/8	1 3/4	4
425	2	1 1/4	4 9/16	2 1/2	5 3/4
290	2 7/8	1 7/8	6 3/4	3 5/8	8 1/2
200	4 1/4	2 3/4	9 3/4	5 1/4	Lathe Max Dia
130	6 7/16	4 1/8	Lathe Max Dia	8 1/8	Lathe Max Dia
90	9 5/16	6	Lathe Max Dia	Max Dia	Lathe Max Dia
80	10 1/2	6 3/4	Lathe Max Dia	Max Dia	Lathe Max Dia
55	Lathe Max Dia	9 3/4	Lathe Max Dia	Max Dia	Lathe Max Dia
40	Lathe Max Dia	Lathe Max Dia	Lathe Max Dia	Max Dia	Lathe Max Dia
25	Lathe Max Dia	Lathe Max Dia	Lathe Max Dia	Lathe Max Dia	Lathe Max Dia

A Material chip colour of Dark Purple indicates that you are on the maximum edge of cutting speed.
Machine maximum swing is 10" in bed gap

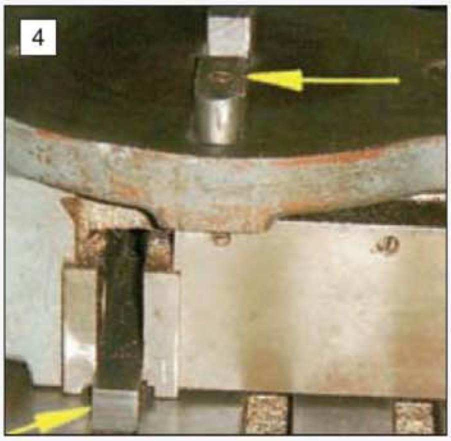
Material	HSS		Carbide	
	Roughing	Finishing	Roughing	Finishing
Low Carbon Steel	0.010 - 0.020	0.002 - 0.006	0.002 - 0.006	0.006 - 0.010
Med Carbon Steel	0.008 - 0.018	0.002 - 0.008	0.006 - 0.030	0.006 - 0.010
High Carbon Steel	0.008 - 0.015	0.002 - 0.008	0.008 - 0.030	0.006 - 0.010
Cast Iron	0.015 - 0.025	0.003 - 0.010	0.010 - 0.040	0.008 - 0.012
Brass / Bronze	0.015 - 0.025	0.003 - 0.010	0.010 - 0.040	0.008 - 0.012
Aluminium	0.015 - 0.030	0.003 - 0.012	0.015 - 0.045	0.008 - 0.012

Turning speeds for different material types and sizes - Myford Super 7

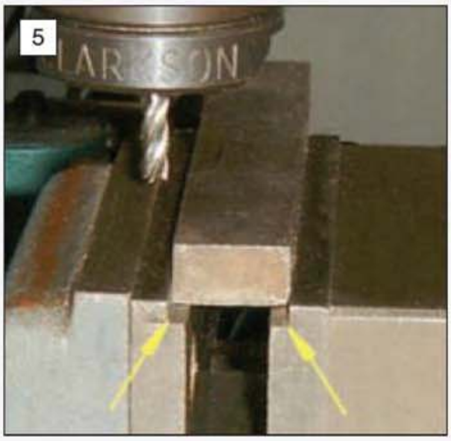
The permanently mounted dial gauge used to measure depth of cut on the milling machine.

The quill slot key being used to lock the spindle whilst changing a cutter.

The quill slot key in close-up. It needs to be a good fit in the quill slot.



Tenons fitted to the underside of the milling vice reduce the time taken to refit it.



The rebated jaws in use on the author's milling machine vice.

and oiling the slides and oiling points and applying a little grease to the feed screws. There are not a lot of items to check on this type of machine, with only two main areas. The first is the main slides. Wind the table to one end of its stroke and place a clock gauge off the main column onto the table. Now lock the table long travel (this will ensure that only the play in the cross travel is shown). Unlock the cross travel and zero the clock. Now try to twist the table and note any movement on the clock. Adjust the gib strip on the cross-slide to remove any free play. Now lock up the cross-slide and unlock the table long travel and repeat the test. Adjust the gib strip on the table long travel to remove any free play. Now check both the feed screws for backlash and adjust them as necessary.

The other check we need to make is on the main spindle. Remove the cutter from its chuck and fit the largest collet in the chuck. Now place a piece of bright mild steel in the collet with about 6in. protruding and lock up. Lock up the quill shaft, as we only want to check the backlash in the bearings, and slacken off the drive belts. Fit a clock gauge off the table onto the chuck and set to zero. Using the piece of steel in the chuck try to move the chuck and note any movement.

Milling machines usually have tapered roller bearings so if there is any free play this will also mean that there is end float. The bearings will have to be adjusted to remove this. With tapered roller bearings it is critical that you do not over tighten them as this will have the effect of pre-loading the bearings which could lead to early failure. Refer to the manufacturers instructions to make this adjustment. After adjustment rotate the spindle by hand to check it is free and repeat the test.

This process will only take about one an hour providing only minor adjustments need to be made. You will now be in a position to forget the milling machine for another couple of years or so.

Milling machine modifications

I have fitted a permanent dial gauge to the quill on my milling machine (**photo 1**). This is very useful when picking up the surface to be machined and applying a depth of cut. First clean the cutter of any swarf then with the spindle stationary lower the quill shaft until the cutter touches the work piece and set the dial gauge to zero. You can now accurately apply a depth of cut. The dial gauge is fitted to the headstock with a telescopic bar connected to the quill for the plunger to measure off. The gauge I use has a 1in. travel and is calibrated in 0.005in. divisions. I also have the facility to apply dial gauges to the longitudinal and cross travel slides for more accurate cut application. As an alternative one could fit a digital slide bar as detailed in the turning section.

Quill Lock

My milling machine has a No.3 Morse taper in which I have fitted a No.2 Morse taper Autolock chuck. In order to remove the cutter one has to have two spanners, one to hold the chuck the other to undo the collet. At times this can be very difficult. I have overcome this by making a key, which is a good fit in the quill slot for the drift, with the end of the key reduced to fit the slot in the number 3 Morse taper spindle. Its length is a little shorter than the drift slot.

Now, to remove the cutter, I fit the key into the quill and pass it into the Morse taper slot in the spindle (a little rotation of the spindle will be required here). This now locks the rotation of the spindle with the quill shaft. The cutter can now be removed using the one spanner and since the spindle is locked it makes undoing the collet very easy (**photos 2** and **3**).

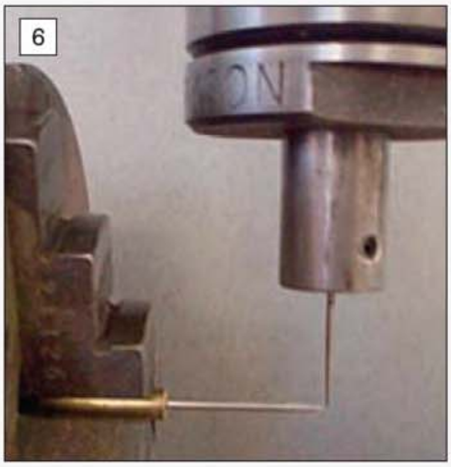
Modifications to the milling machine vice

Each time you remove and replace your vice from the machine table, do you have to re-clock it? If so drop everything and carry out this modification, it will save hundreds of hours. Find a piece of flat bar the same thickness as the T-slots in the milling machine table, width say about 1in. but this is not important. Cut to the same length as the vice jaws. Place the bar in the T-slot with say 1/2in. above the table. Turn your vice upside down and tighten up the jaws onto bar. Support and clamp the vice to the table. The jaws will now be parallel to the T-slot. Cut a slot in the bottom of the vice the same width as the T-slot say 1/4in. deep and in line with the securing holes. Make two short keys and secure one at each end of the slot with countersunk screw. Now fit the vice to the table and bolt down. Now each time you remove and replace the vice it will be parallel with no need to clock up the jaws (**photo 4**).

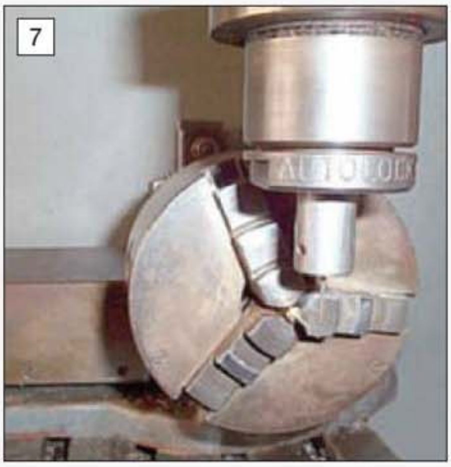
The second modification is to cut a 1/16 x 1/8in. deep rebate out of each vice jaw such that when a piece of bar is placed in the vice it lays parallel and horizontal. This can only be done if the jaws are soft. Tighten up the gib strip in the vice jaw and, with the vice bolted down, open the jaws say 1in. and place a piece of flat bar in the bottom of the vice and tighten up the jaws. (Check that the jaw does not lift when tightening with a dial gauge). Now machine the rebate in each jaw (**photo 5**).

Quick alignment of vertical milling machine cutter with horizontal or vertical chuck

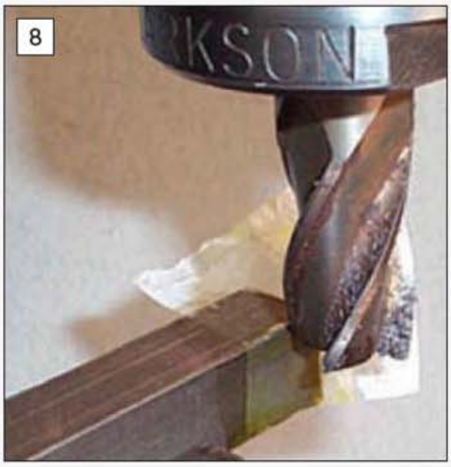
Much of the work we do in the milling machine does not require alignment accuracy better than 0.005 inch. The way I approach these set ups is



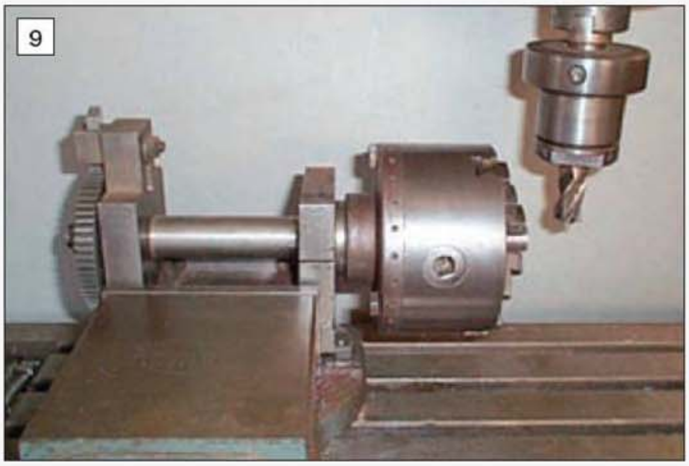
Using two mounted needles to line up the milling machine spindle to a horizontally mounted chuck.



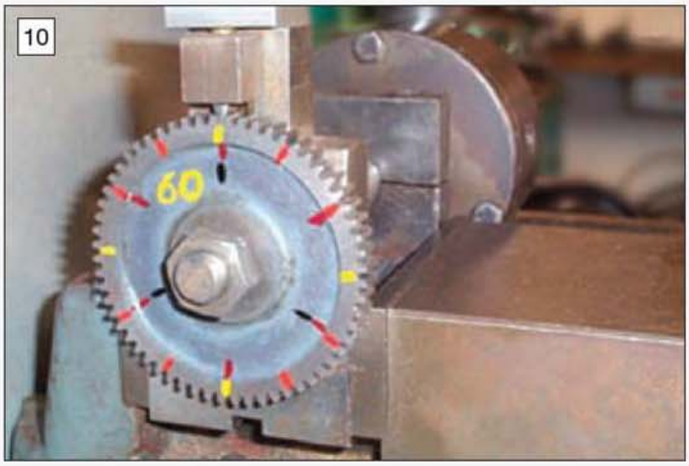
To achieve alignment the needles are best viewed from this direction.



Setting a milling cutter to a work surface using a piece of cigarette paper.



A simple, direct indexing dividing head is a useful adjunct to the milling machine in the amateur's workshop.



Indexing on the simple dividing head is achieved by the use of lathe change wheels. Here a 60 tooth wheel is in use.

with the aid of two needles. (I'm sure that if you raid your wife's needle box you will find a good selection). I have made a dummy screwed blank, which fits into one of my Autolock chuck collets. It has been drilled concentric to the outer diameter to take a needle, which is held in place with Loctite. Just a point on safety here, I place a wine bottle cork over the needle when not in use. For the dividing head chuck I have a similar arrangement, which is made from plain rod with a needle inserted into it. To set the alignment, just align both the needle points (**photo 6** and **7**).

Quick alignment of vertical milling machine cutter with horizontal or vertical work piece

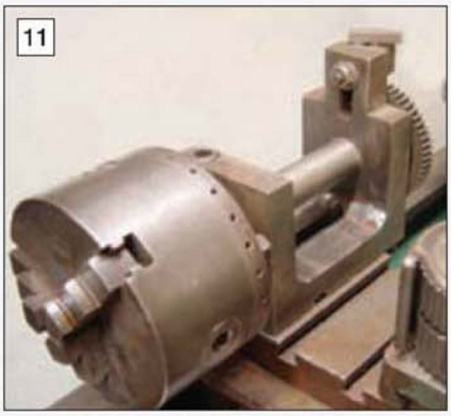
When we align the cutter with the work piece the normal practice is to move the side of the cutter towards the work until it just touches. This often leaves a small cut on the side of the work piece. To avoid this stick a piece of cigarette paper (which is approximately 0.002in. thick) using a little oil or cutting fluid. Now when we move the cutter towards the work piece the paper is cut or it moves. We know that the cutter will be less that 0.002in. from the work piece (**photo 8**).

Quartering a locomotive axle without a dividing head

First set the axle up in a V-block both parallel and level with both ends available for machining. Cut the first keyway (vertical) using a slot drill finding the centre in the normal manner. Now cut the keyway in the other end (horizontal) using a Woodruff key cutter finding the centre in the normal manner. You will now have an axle whose wheels will be exactly at 90 degrees. Make a fixture to cut the keyway in the wheels all in the same place.

Indexing using a dividing head

A dividing head is one of the most useful accessories you can have in the workshop. It does not need to be of the compound indexing type as 90% of the jobs in the home workshop can be done with a simple, direct indexing type. Arnold Throp detailed the simple dividing head, which I use, in *M.E.* 3600, 5 January 1979 (**photo 9**). Mine can also be held in the machine vice for quick and easy set-ups for those less critical items (**photo 10**). In addition it can be bolted onto the lathe cross slide for use on the lathe (**photo 11**).



If carefully designed the simple dividing head can also be used on the lathe cross-slide.

If you only use your dividing head very infrequently and have trouble remembering how to work out your indexing, then let's try to refresh your memory. I am going to divide the indexing up into three sections.

Section one

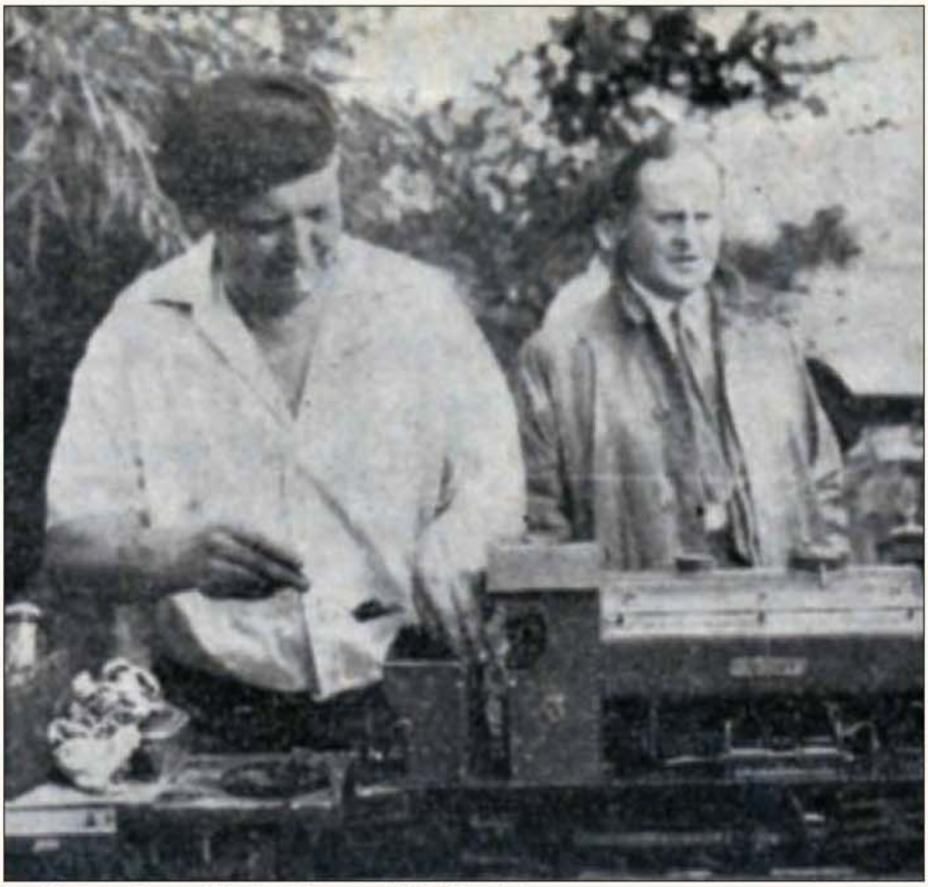
This is simplest direct indexing using a 40 or 60 tooth gear to carry out the indexing. Mine carries a 60-tooth gear wheel but could also be used with a 40-tooth wheel or any other. It relies on a spring-loaded detent plunger engaging between two teeth to index the divisions. This type of dividing head is only able to index a limited number of divisions and is used by simply counting the teeth between divisions, lifting the spring loaded detent plunger, rotating the shaft to its new position and re-engaging the plunger. The spindle can then be finally locked up. When I made mine, I mounted the main body (which I pre-fabricated by welding) on top of the lathe cross-slide, and machined the spindle at lathe centre height. This is extremely useful when drilling flanges, etc. in the lathe. Another advantage of this type of dividing head is that it can be held in the machine vice for quick set ups for less accurate work. For my part I use this dividing head for 90% of my work. You will also see that the 60-tooth wheel gives most of the common divisions required by the model engineer.

Divisions that can be indexed directly using the gearwheel stated:

40 teeth wheel 2, 4, 5, 8, 10, 20, 40.

60 teeth wheel 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60.

●*To be continued.*



Fred Cottam winner of the 1957 Harrow and Wembley trial.

A BRIEF HISTORY OF IMLEC

Chris Orchard
traces into the origins and development the popular IMLEC competition.

Efficiency; *"the ratio of useful work performed to the total energy expended"* [1] has probably been a goal of mankind from the very beginnings; pulling a plough with one oxen instead of two was well down the development line.

"We have passed through the Greenly era of pseudo-scientific design so successfully demolished by the empirical methods of LBSC. Now we have to understand why LBSC's methods give such results and to exploit them further if possible"

Jim Ewins, 7 July 1967. [2].

The need to keep costs under control, as the industrial revolution gathered pace, would have kept the search for efficiency to the forefront of the engineering mind, and the reduction in the amount of fuel burned for the output obtained must always have been important. Railways were certainly most concerned with their locomotive performances and the *Model Engineer* magazine in 1903, was linking railways and efficiency, with an article on the Manhattan Elevated Electric Railway [3]. A small note at the bottom of a page in 1905 mentions that the comparative efficiency of two model steam engines can be arrived at by *"measuring the amount of fuel and water consumed for the power generated in a given time",* [4] although this does refer to stationary engines and not railway locomotives.

A querist G. T. P., in 1907, was bemoaning the difficulties of getting a $^1/2$in. scale model locomotive to maintain 40psi; significantly the title of the query is *"model locomotive efficiency",* a phrase to be much used in subsequent years [5]. It would seem that a model locomotive that could achieve a circuit of a scenic railway was regarded as 'efficient', whereas one that could not, wasn't. Charles Lake, a prolific writer in the early *Model Engineer*, discussed the reasons for the apparent efficiency of the North London Railway 4-4-0s in 1909, an association between 'railway steam locomotive' and 'efficiency' [6].

In 1922, Henry Greenly wrote a letter to the *Model Engineer*, advocating solid fuel rather than liquid for firing model locomotives, and suggested a formula for calculating a value by which model locomotives could be compared [7]. Nothing to do with efficiency, just comparison. Mr. T. Watson, in the 10 July issue of 1924, suggested his own formula, requesting particularly LBSC's opinion, and Lieut.-Col. D. M. Stewart wrote from India offering yet another [8].

The 1930s saw much discussion among well-known figures such as C. M. Keiller, T. G. Marchant and H. Greenly on the subject of locomotive efficiency, with various means being advocated for achieving it. In 1936 G. S. Willoughby proposed that a proper test stand for testing model locomotive performance, and thus determining efficiency, should be built by the Society of Model and Experimental Engineers (SMEE), who would supervise the work of a few selected experts. A small fee could be charged for the use of these testing facilities, because a locomotive's value would be enhanced if a good certificate was obtained. It was felt that static testing would yield more accurate results than track testing [9].

Some correspondence resulted from this proposal [10], with a number of different ideas of a technical nature being propounded. Significant among these was Mr. R. H. Wilks who put his finger very firmly on the button by stating that efficiency is accepted as what it is if we get what we want at a reasonable cost; he was also way ahead of his time when he said efficiency would become increasingly important as world fuel supplies ran short, and future generations would look back in horror at the folly of our time [11].

In 1939 Henry Greenly reported Victor B. Harrison's experiments in testing Gauge 1 locomotives, finding efficiencies of around 20% of full size engines, that is about 2%, a figure typical of those to be achieved at future IMLEC competitions [12]. In 1943 LBSC spoke about efficiency but only in relation to building a true to scale $3^1/2$in. gauge Isle of Man locomotive, to work on tight curves in a restricted garden space [13].

The Stephenson Memorial Miniature Locomotive Association held its first meeting on 4 September 1948 at Roker Park in Sunderland [14]. As there had been insufficient time to arrange all the details for a proper competition, a rally was held under competition conditions; a comparative formula was devised and eight locomotives took part. It was agreed that the comparison was of locomotive and driver, some sympathy being extended to a competitor who had only one hour's previous driving experience; the one 5in. gauge locomotive taking part could not be fully loaded. More committee work would be done to determine if the formula used could be altered to place every competing locomotive on an equal basis, and thus determine the champion locomotive of the North East.

As with the static testing proposal, there were a number of responses to this competition in subsequent postbags [15], culminating in W. H. Nightingale's suggestion in April 1950 that any comparative formula should include the drawbar pull and the calorific value of the fuel used [16]. This correspondence in turn provoked G. W. Wildy into reporting the stationary tests carried out by the SMEE in 1948. Only two locomotives were tested, the results possibly being affected by the wheels slipping on the rollers. The indications from these tests were that miniature locomotives could achieve one third of the thermal efficiencies of their prototypes, with miniature boiler efficiencies approaching full size [17].

Under the heading 'Improvements and Innovations' (No. 14 - 'What Price Efficiency?'), 22 March 1951, '1121' humorously sums up the then current attitudes to locomotive testing, suggesting that what really should happen is that

2. John Drury, winner of the first IMLEC (M.E. Vol 135 page 865, 5 September 1969.)

each competitor be given half-a-pound of coal and a gallon of water and be told to *"see what you can do with that"* [18].

The cover picture of *Model Engineer* Issue 2951 for the 12 December 1957 is of two members preparing their locomotives for the Harrow and Wembley efficiency trials, surrounded by interested onlookers; the report appears on page 807 [19]. The first of these trials, the 'Arthur Pole Trials' had been held in 1954 and it can be presumed from the report that live loads were carried [20]. In 1956 the event was won by an Aveling Porter locomotive built by A. Tyler and fitted with a Franco Crosti boiler, and in 1957 by another well-known model engineering name, Fred Cottam. At least on this occasion the weight of coal used was measured to the nearest half ounce, a dead load was used and the competition was again comparative, no calculations of efficiency being made. As the secretary of the time remarked, *"the trials do not seek to establish any particular achievement, but a good time is had by all"* [21].

In 1959 a meeting was called at the *Model Engineer* offices to discuss the subject of Steam Locomotive Efficiency Trials. LBSC was consulted, a formula agreed upon and recommended for general acceptance at average track meetings [22]. (Even this formula didn't allow for the calorific value of the fuel). A small note on the same page indicated that the *Model Engineer* was considering the sponsorship of a national efficiency competition for passenger hauling steam locomotives of 3[1]/2in. and 5in. gauges. It was expected that clubs would hold trials early in the season and submit their two most efficient locomotives as entries.

In typical LBSC fashion, he claimed that although he had been consulted, his views had been ignored; the *M.E.* Editor replied by saying that his response had been negative. LBSC was clearly against efficiency trials, concocting the 'Bob and Bert' story of two friends who took part in a club trial and then fell out. But he was right in one respect, such tests would be of locomotive and driver; *"Aim for efficiency by all means but do it for your pleasure and don't parade it at the other fellow's expense. I should like to see all so-called 'efficiency trials' abolished, and the time spent in giving joy-rides to children"* [23].

Several clubs indicated their wish to adopt the proposed efficiency formula and others expressed interest in a national competition. *Model Engineer* was prepared to sponsor a contest with support from clubs, the proposal being for eliminating contests to be held on club tracks, with the winners to go forward to regional or national finals probably held in September. A handsome trophy and a cash prize of £25 was offered to the winning club [24].

Strangely, after all these meetings and discussions, another ten years were to pass before anything actually happened. On 7 March 1969, Martin Evans, the then Editor, announced that a locomotive efficiency competition to be known as The *Model Engineer* International Model Locomotive Efficiency Competition was to be held, the first one on the Illshaw Heath track of the Birmingham SME that coming July. A fine Silver Cup together with second and third prizes were to be donated by *Model Engineer*, and it was hoped that most of the major model engineering societies would enter. Some individual entries would also be welcome. A further announcement on 21 March confirmed that 20 locomotives of 3[1]/2in. and 5in. gauges would compete for the Martin Evans' Locomotive Challenge Cup and £25, a second prize of £10 and a third prize of two year's subscription to *M.E.* [25].

The Editorial run-up to the competition was intense, with a further ten announcements. Entries were invited from 16 recognised model engineering societies, three from individuals, the 20th place eventually being revealed as reserved for the home club [26].

Model Engineer Volume 135 Issue 3376 was published as a 'Special Issue', and started with editorial comment on the unfortunate derailment which had occurred. Competition entries had been received from Sutton Coldfield, Glasgow, Bradford, Chesterfield, Wolverhampton, Bristol, Brighouse, Cheltenham, Chichester, Chingford, Malden, Coventry, Colchester and Northampton, and of course the home club. A 17 page report by D. E. (Laurie) Lawrence was included with many photographs and details of the track and surroundings, and of course, the competitors and

WINNERS OVER THE AGES

No.	Year	Location	Winner
1	1969	Birmingham	John Drury
2	1970	Witney and WestOxford	LenLabram
3	1971	Southampton	W. A. Heyden
4	1972	Tyneside	Norman Spink
5	1973	Chingford	Pat Killian/Bill Longstaffe
6	1974	Bristol	Fred Winsall
7	1975	Tyneside	Laurie Joyce
8	1976	Kinver & West Midlands	Bill Perrett
9	1977	Chingford	Bill Perrett
10	1978	Guildford	Percy Wood
11	1979	Bristol	David Moriss
12	1980	Bedford	Percy Wood
13	1981	Bournemouth	Percy Wood
14	1982	Leyland	Roy Amsbury
15	1983	Guildford	Les Pritchard
16	1984	Bristol	Les Pritchard
17	1985	Urmston	Alan Crossfield
18	1986	Bournemouth	Alan Crossfield
19	1987	Birmingham	Kelvin Moonie
20	1988	Leeds	Lionel Flippance
21	1989	Leyland	Lionel Flippance
22	1990	Guildford	Lionel Flippance
23	1991	Bristol	Kevan Ayling
24	1992	Leeds	Dave Sutcliffe
25	1993	Leyland	John Heslop
26	1994	Gravesend	John Heslop
27	1995	Kinver & West Midlands	John Heslop
28	1996	Northampton	Alan Crossfield
29	1997	Llanelli	Len Steel
30	1998	Kinver & West Midlands	Kevan Ayling
31	1999	Northampton	Jim Elliott
32	2000	Leyland	Lionel Flippance
	2001	Cancelled	
33	2002	Leeds	Geoff Moore
34	2003	Bristol	John Ellis/Geoff Moore
35	2004	Kinver & West Midlands	Glynn Winsall
36	2005	Northampton	Ballan Baker

their locomotives [27]. Northampton was represented by Eric Hudson and his 0-6-0PT 'Speedy', a driver and locomotive that are still performing well to this day.

The Competition was won by John Drury of the host club with his 5in. gauge 'Royal Scot' locomotive, having achieved the lowest figure for the weight of coal used per drawbar horsepower per hour. There are no figures in the results table for the efficiencies achieved by the locomotives and no entrant from outside the United Kingdom, although if present political trends continue the entry from the Glasgow Society could be considered as 'International'.

Controversy followed the event, a number of correspondents to *M.E*, prominent among them Group Captain J. N. C. Law, questioning the accuracy of the results. It was pointed out that one boiler had evaporated some two and a half times the theoretically possible volume of water and that three boilers were over 100% efficient; the number of decimal places displayed in the results table was also questioned. The matter was eventually clarified by letters from Brian Hughes, the then Vice-President of the Birmingham society, explaining the quantities of water mentioned in the results table were those supplied, not necessarily evaporated. Others joined the fray, the Editor eventually having to close the correspondence [28].

Thirty five years of IMLEC

But the stage had been set for 35 years of miniature locomotive running competitions. A pattern emerged of *Model Engineer* arranging for a club to host the competition and advertising for entrants, and the competition taking place with subsequent reportage in the magazine. The competition venue changed from east to west, from north to south; the weather varied, the rules were adjusted, the date was usually in July but was flexible; some competitors retired, others derailed their locomotive bogies or their tenders; injectors failed, water pumps mysteriously decided not to work and the coal was not to the liking of some. Passenger coach bogie bearings seized, wheels came loose, and passengers were dropped off as a run proceeded, but never added. The merits and disadvantages of alloy or steel rails were discussed, some attributing differing efficiencies achieved from year to year to this factor.

Such a regular and popular event was certain to produce its own highlights; the first single wheeler to win, (W. A. Heyden's GWR Single Wheeler Dean 4-2-2 at Southampton in 1971), the weighing of passengers (at Tyneside in 1972), the first lady driver and winner, (Pat Killian driving her father's Bill Longstaffe's LNER B1 at Chingford in 1973), the special award for best 3$^1/_2$in. gauge engine, first suggested by the Editor in 1971, to Tom Arnott's LMS Class 5 4-6-0 at Chingford in 1973, the first time efficiencies appeared in the results table (1972 at Tyneside), and the first international entry (Jean Villette's 5in. gauge 4-4-0 from France at Chingford in 1973). Unfortunately, Jean experienced a boiler defect on his own engine, so rather than disappoint the first overseas entry, Martin Evans exceptionally agreed to him being loaned an engine for the competition, Phil Hains' 'Experimental No. 5' which he drove to fourth place [29].

In 1975 a 3$^1/_2$in. gauge locomotive took first place at the Tyneside Society's track, Laurie Joyce with his GWR 'King'. In 1976 Kinver saw a plethora of overseas visitors from Australia, Belgium and America with Jack Love from the Cape Town, South Africa society, the first international entry driving his own 5in. gauge South African Railways 4-6-0 locomotive (although built by Jimmy Scott in 1965) as opposed to a borrowed one. In 1977 Bill Perrett became the first person to win a second time, having won at Kinver the previous year [30].

Guildford in 1978 saw the appearance of the largest locomotive yet entered, Norman Lockwood's New York Central R.R. 4-6-4, whilst 1979 at Bristol was the first two-day event.

IMLEC of 1981 saw Percy Wood win for the third time and, in 1983, the first Shay type locomotive was entered. Leeds in 1988 saw the highest ever recorded efficiency (over 4%) by Lionel Flippance, who reckoned Leeds track was all uphill. The Editor subsequently admitted that the Bristol dynamometer car had been giving high readings, but that the first four places were not in doubt. At Guildford in 1990, Barbara Milton drove David Williams' Simplex as the Bristol Society's entry with all female passengers and 1991 saw the first axle weighing. Most regrettably Bev Fallows collapsed during his run on the Saturday at Leeds in 1992 and subsequently died that evening. The competition was first held at Northampton in 1996, and again following current political trends, IMLEC went international in 1997 being staged by the Llanelli society in Wales [31].

In 1998, a 'Superlec' was held at Birmingham, as a celebration of the centenary of *Model Engineer* and 30 years of the International Model Locomotive Efficiency Competition. Highly placed locomotives in previous competitions were invited to run against each other, not as a re-creation of the first competition, but as a fun day out. Lionel Flippance achieved the highest efficiency with his Britannia locomotive *George Eveniss* [32].

The year 2000 saw Jim Woods bring his 5in. gauge Isle of Man locomotive *Mona* all the way from Otago in New Zealand to achieve sixth place; Jim will be remembered for his cheerful approach to life and the competition and said he was *"here to have a good time rather than be a serious competitor"*. It was also the year when all locomotives were required to be fitted with spark arrestors [33].

Because of the restrictions imposed by the agricultural Foot and Mouth epidemic in 2001, the chosen society, Bristol, were unable to stage IMLEC that year, and an offer by the Guildford Society to run it in August rather than July was accepted; but only six entries were forthcoming and the *Model Engineer* Editor announced its cancellation in May. Guildford promptly changed the name to the 'Open Model Locomotive Efficiency Competition' and subsequently ran the event with 28 entrants! [34].

Technical aspects

Of course, the competition encouraged the continuation of the debate in the *M.E.* on how to improve the efficiencies of miniature steam

railway locomotives, started all those years previously. Various options were discussed in *Post Bag* by personalities such as Jim Ewins, D. E. Lawrence and H. A. Illingworth in the early 1970s, leading up to an erudite article by Professor Dennis Chaddock in 1986 in which he attempted to analyse the results of the 17th IMLEC trials with a table of results and two graphs. He concluded that much more information was required, such as track timing, cylinder dimensions, indicator diagrams, wheel diameters and grate areas, and particularly rates of water evaporation before more detailed analysis could be done. Probably with this in mind, the competitors in the 1990 competition were asked to provide their grate areas and/or total boiler heating surfaces [35].

In 1986 D. E. Lawrence also attempted to identify the parameters of design that lead to high efficiency in model locomotives and thus the ideal. He concluded that there were too many variables; varied build and maintenance standards, varying coal quality, varying driver enthusiasm, experience and driving techniques, the curving or otherwise nature of the competition track, alloy or steel rail, the flange profile of the passenger trucks, and of course the coal. The position of a competitor on the scoreboard could well be dependent on his judgement of load not on the efficiency of his locomotive; a poor guesser would find himself lower down the table [36].

In 1989 A. S. Garner, a statistician, wrote an interesting two-part article under the heading *"Incredible I.M.L.E.C."* in which he attempted to analyse a variety of results from the professional viewpoint. In 1974 R. A. Riddles, ex-Chief Mechanical Engineer to British Rail, on presenting the prizes at that year's IMLEC at Bristol, had said that a 5in. gauge eight coupled narrow firebox two cylinder locomotive with a high piston speed was his recommendation for a winning locomotive, [37] and A. S. Garner also concluded that such a locomotive should be driven as fast as possible pulling the highest reasonable load, and forget about the coal. Another article in the form of correspondence between Mr. Garner and Jim Ewins, the latter who had carried out much practical experimental work over an ▶

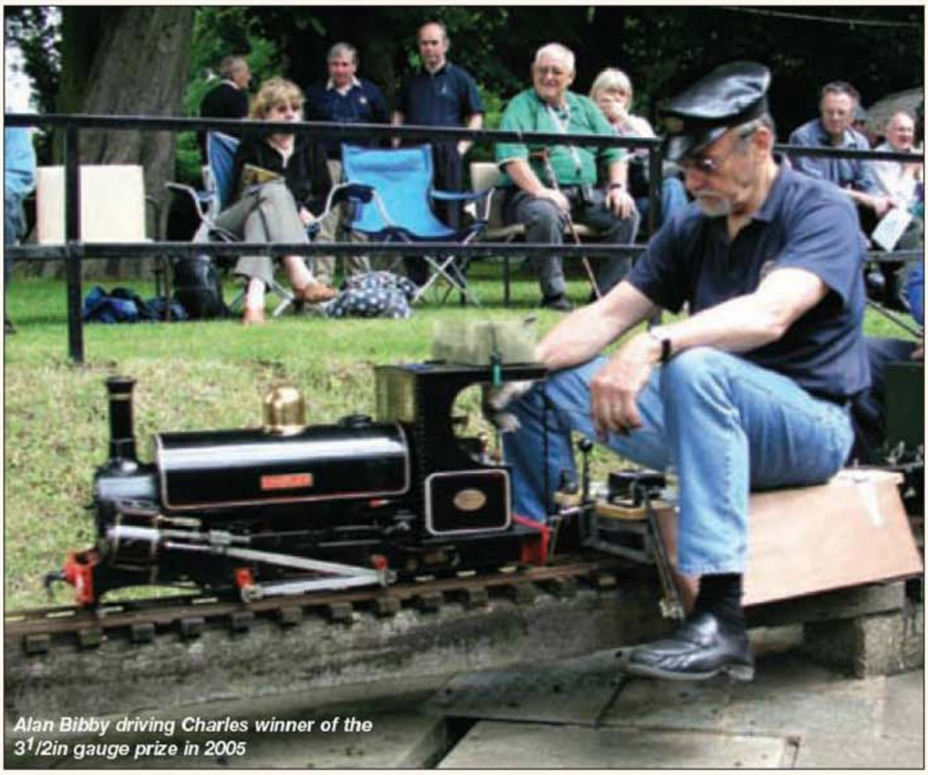
Competitors at IMLEC 2005 in Northampton

extended period, appeared in 1990 [38].

Dynamometer cars have inevitably played an important part in the search for and measurement of efficiency, and *Model Engineer* was reporting their use in railway terms as early as 1914. A 5in. gauge Dynamometer Truck won W. G. McCall a Silver Medal at the 1936 Model Engineer Exhibition, but it wasn't until October 1963 that a description of a car designed and built (by S. J. Hobson for the Harrow and Wembley SME) for miniature locomotives appeared. Apparently Charles Babbage, the founding father of the computer, spent one period of his busy life developing a full size dynamometer car [39].

In November 1969 Brian G. Hughes in a two-part article, described the Birmingham dynamometer car specifically built for the first IMLEC; a car built by the Rugby Society and used in their club trials proving useful in determining the range of conditions likely to be met. This latter car was described in *M.E.* by J. H. Daltry and H. A. Caldwell in March 1970. Eric Griffiths of the Bristol Society produced a dynamometer car which was used for the first IMLEC held at Bristol in 1974, and Don Cordall and the late Walter Bossons wrote a four part series on its refurbishment in 1992. Guildford made one for their event in 1983 (described in *M.E.* in May), with the Chingford car in reserve [40].

In 1984 A. F. Saunders suggested the competition would be more interesting if a dynamometer car could transmit data to a lineside computer for processing and display, and in January 1990 Andy Fremont began a four-part serial on the building of a digital dynamometer car for the Chelmsford society. David Tomkins described the design and construction of the Staines Society's car in a two-part series in 2001 under the title *"Measuring for Efficiency. Design for a Dynamometer Car"* [41].



Alan Bibby driving Charles winner of the $3^{1}/2$in gauge prize in 2005


Steve Eaton and Britannia, runner up last year

remark in *2000 "I'm here to have a good time rather than be a serious competitor"* [33], everyone taking part or involved in the organisation seems to have enjoyed themselves.

Summary

The early model engineer seemed to equate efficiency with actually meaning getting a locomotive to work, and this developed into devising means of comparison. Only later did people start to think of including the calorific value of the fuel used and thus to arrive at reasonably accurate figures for work in, work out; static testing was supplemented by track testing hauling dead loads which developed into track testing hauling live loads.

In view of the remarks earlier in this article, it is interesting to read in the second instalment of Martin Evans' reminiscences (2003) of the reason for the delayed start of IMLEC, the then editor Leslie Howard, feeling it necessary to put Martin's proposal for a competition to LBSC. It is tempting to speculate whether the latter's opposition to the idea was professional jealousy, or a fear that his designs would not be competitive [43].

So has it all been worthwhile? At least for the organising club it is a reason to tidy up the track site and get all those deferred jobs done and out of the way, and for each and every competitor the opportunity for half an hour of total track occupation. A reason for the success of IMLEC is that it is a gathering of like minds, the opportunity to meet friends, enjoy the company, and have a day out. IMLEC is a measure of the driver and the way they handle their locomotive; they get the cup at the end of the day, not the locomotive! For Martin Evans, the 'Father of IMLEC', there was no doubt; it had achieved his original ambition, the spreading of the gospel of miniature locomotive construction.

IMLEC in *Model Engineer*

As the competition changed and developed so did the style of its reporting in the *Model Engineer* magazine. D. E. (Laurie) Lawrence (*M.E.* editor 1980 to 1984) reported the first one at some length with each individual run being recorded in detail, a tradition he continued until 1989. He reported that some engines were given a discreet 'nudge' to get them started and some *Postbag* correspondents took issue with the accuracy of his reports. Laurie countered by describing his days at an IMLEC competition as a series of 'half-started conversations', and saying that he had done his best.

Later, details were given of hotels and other places to stay and of interest to visit in the vicinity of the competition venue, together with details of on site camping and caravanning facilities if these were available. As the years progressed, model exhibitions and an increasing trade presence became the norm and were reported. Limitations on space in 1987 prevented a run-by-run description and marketing skills were apparent in 1989 in the form of a free ticket for every 15 purchased. From 1990 to 1999 IMLEC was ably reported by Ted Jolliffe assisted by other *M.E.* staff, with gradually improving quality, layout and increasing numbers of colour pictures.

The first cover picture of an IMLEC locomotive was on the 5 November 1971 and was of Fred La Roche's 5in. gauge LMS 0-6-0 tank locomotive, which he drove to fourth place at Southampton that year. Percy Woods, the winner in 1978 had to wait until 20 September 1979 to see his winning *Maid of Kent* on the front cover, but from 1983 it became usual to see a front cover picture of the winner on the issue containing the report of that year's competition. In recent years it became the practice to report the previous year's event as an introduction to the current year's competition, that is the report of the 2002 event at Leeds did not appear until June 2003, and the 2003 event at Bristol was not reported until June 2004. Happily that state of affairs has now been corrected, an excellent report of the 2004 event at Kinver appearing in *M.E.* 4228, 20 August - 2 September, with a happy Glyn Winsall on the front cover.

A social gathering

Many of the reports of efficiency trials in the *Model Engineer*, whether at club or 'international' level mention the social and 'having fun' aspects of the competition. From the Harrow and Wembley Society secretary's comment in 1957, *"the trials do not seek to establish any particular achievement, but a good time is had by all"* [21], via Ted Martin's suggestion in 1970 after the second IMLEC at the Witney and West Oxford Society's track that *"the real reason for IMLEC is a gathering of like minds"* [42], to New Zealander Jim Wood's

References

[1] *Concise Oxford Dictionary.*
All the following are references to *Model Engineer* magazine (volume-page)
[2] 133-654
[3] 9-100
[4] 13-3
[5] 17-580
[6] 21-564
[7] 46-588
[8] 51-54-250
[9] 69-603, 70-117-214, 72-310-408, 74-62
[10] 74-141-191-264, 75-191
[11] 75-363
[12[80-325
[13] 89-136
[14] 99-510
[15] 102-371-490-618
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[18] 104-384
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[21] 115-787
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[23] 120-428-442
[24] 120-579
[25] 135-215-290
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[30] 141-808, 142-788, 143-706
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[39] 30-434,75-620, 129-152-381-430-470
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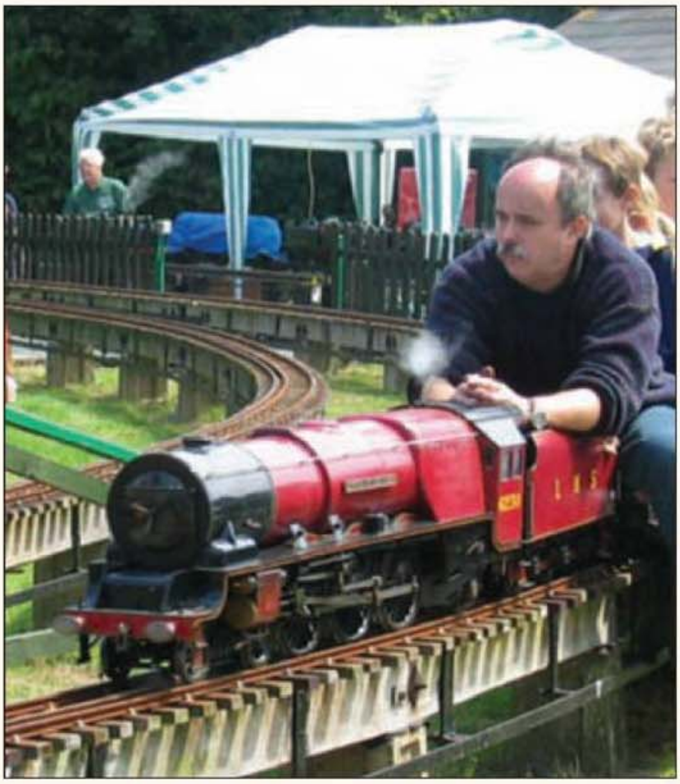
[43] 190-152

IMLEC AT FAREHAM



Brian Fisher
of the Fareham & District Society of Model Engineers previews this year's event on July 1 and 2.

This year the annual IMLEC is to be hosted by the Fareham & District Society Of Model Engineers (F&DSME) at their track at 'The Railway Field' Segensworth Road East, Titchfield near Fareham in Hampshire, and the Society extends a warm welcome to all competitors, supporters and spectators to this much-enjoyed event. Those who have attended on previous years will know that, although it is a serious competition, the social side is very important as well and we look forward to seeing 'old faces' and making new friends.

Although this will be the first time that the F&DSME has hosted IMLEC we are making every effort to ensure that it the competition runs smoothly and that everyone has an enjoyable weekend. The event will follow a format very similar to that of previous years but all competitors are requested to take note of the rules which have been designed to ensure a successful and safe event on the steeply graded site.

There are two tracks at Fareham, an elevated dual $3^1/2$ and 5in. gauge track of 1565ft. in length and a ground level $7^1/4$in. gauge track with a running length of 935 feet. The elevated track has a maximum gradient of 1 in 77, is equipped with steel flat-bottom rail and has a minimum bend radius of 45 feet. The tracks are situated within the society's own private ground which includes a large clubhouse with toilet facilities, including those for the disabled. During the event the clubhouse will be the catering centre from which food will be available during both days. There is to be a 'hog roast' available on the Saturday evening for which pre-booking is advisable.

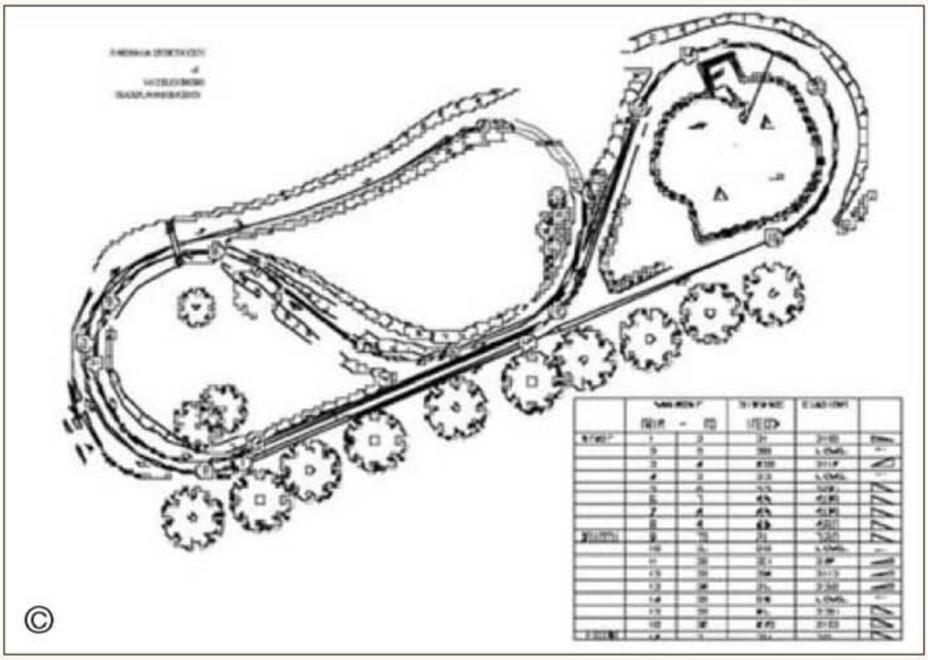
For the competitors, the track creates quite a challenge. Leaving the competition start point the track descends for a few yards at 1 in 193 before curving to the right and ascending at 1 in 107 before curving through the tunnel which is level. After leaving the tunnel the track, while still curving to the right, descends initially at 1 in 270 and then 1 in 129 followed by 1 in 210 before passing through the normal station which is almost level. After the exit from the station the next 300ft. of the line first descends at 1 in 210, curves to the left, levels and then straightens while climbing initially at 1 in 77 then 1 in 107 and followed by 1 in 210. The line again levels for a short distance before rounding the pond and descends at 1 in 350 then 1 in 270 with a final descent at 1 in 81 to the competition finish point.

The track is attractively landscaped, with many mature trees within and bordering the site and, weather permitting, seating and tables for picnicking and watching the event in comfort will be laid out. There will also be a small exhibition of member's models in the clubhouse. It is hoped that the adjacent $7^1/4$in. gauge track will be in operation during the weekend to add to the enjoyment of the visitors and provide a view of the proceedings from a different perspective.

We are currently in the process of inviting model engineering traders and several have booked their space in addition to our friends from the Southern Federation of Model Engineers. Owners and drivers of competing locomotives will be admitted free to the event but all other visitors will be admitted upon purchase of a detailed programme for which a charge of £5 will be made at the gate. At the time of writing this article there are already 24 competitors who have applied to take part in the competition and we are compiling a reserve list in case of cancellations.

More information on the event and maps of the location can be obtained from either of the following: Pete Reynolds (tel: 02392-268351) **Peter@PReynolds75.wanadoo.co.uk** or;
Mike Machin (tel: 01489-860113) **mike@freelancedesign.co.uk**

I would like to thank Ted Walley and Dave Wrenn of the F&DSME for their work on the surveying and preparation of site maps for this article.




The arrangement used for testing and setting up the radio control. The truck carried the battery pack and the red flag helped stop eye injuries.

BUILDING LADY ANNE FROM THE KIT *THE DIARY OF A BEGINNER*

Dick Mundy
from France, concludes this series on the trials and tribulations of a beginner.

●*Part IV continued from page 452(M.E. 4271, 13 April 2006)*

The threaded holes in the bracket were way out of alignment. The only answer was to open up the clearance hole to a No. 30 drill and then, suddenly, I was back in business again. It was quite noticeable that the internal radius on the bent up bracket supporting the gas tank was too great to allow the latter to sit down squarely onto the footplate. However, I left well alone although I was concerned it would flex a bit when I loaded the gas canister. I reminded myself I was making a steam engine and not a watch!

The replacement pre-bent gas pipe arrived some days later but unfortunately I had become side-tracked by a small matter of preparing our annual costs for our tax accountant. We had created a small holiday gite here on our property in France and it was important that every possible expense was set against income - it also told me that we are in the tourist business for the fun of it but we do meet some nice people every year! I am wandering again, but the bends of the pipe put in by Roundhouse seemed almost ideal for my Lady Anne. A slight turn clockwise of the gas burner and with a little tweak it was perfect, and then I replaced the cylinder lubricator. Now I could ditch my temporary bracket for the reversing lever and mount it properly on the foot plate. Although I had ordered, and indeed received, the radio control kit I wanted to try her out manually first and that could be less the bodywork at this stage while the painting goes on. Come on Mrs. Mundy, where was the butane?

In fitting the pressure gauge back in place I noticed that it was actually reading full scale, very strange, and I cannot now recall if it was the same when I originally fitted it and tried the aborted steam up, but I did not think it was. Surely even I would have noticed that before. In the time honoured tradition I try a few taps with the finger and thought maybe one of the screws on the back was for setting the zero - neither are, at least for me. Within an hour or so of sending another 'Help me' e-mail to Roundhouse I get a reply that a replacement is in the post - fantastic service; apparently they do get a few dodgy ones from time to time. I would have liked to try a steam up again, even without a working pressure gauge and with my butane/propane mix, but it was blowing a gale outside accompanied by nasty driving rain so I decided to stick to painting the bodywork. I am doing the painting in the middle of the hangar, well ventilated in there, fairly dry but out of the rain and direct wind. I also did some tests with the radio control bits, before fitting to the loco, in breaks between the painting sessions but as that immediately worked successfully I saw what I could fit to the chassis.

There were certain bits of the radio control that I could fit without interference with the manual control and those were fitted but it was still blowing a gale outside so I still did not think it was right to try a steam up. Now the painting was finished I placed the brass trim in place on the body and here came another mistake. The brass handrails were different lengths and of course, due to a certain well known law, I fitted the marginally longer ones to one side of the cab door only to find the remainder were shorter. This was annoying because it had taken me and my full size fingers some time to get the 8BA nuts on the inside threads of the stanchions, the majority of which seemed to be in inaccessible corners. Undoubtedly that same law again! Note here; the two longer handrails go onto the top of the tanks and the four shorter ones go either side of the cab doors, obvious when I thought about it.

However, after a change around all the handrails were in place and I fitted the brass spectacle rims and the dummy whistle. I wonder as I do this if I could get a real steam whistle? There is a third uncommitted channel on the radio control set and, with an extra solenoid and some sort of steam manifold fitted, would it be possible? I decided to make enquiries but avoided letting these thoughts interfere with the ongoing work. The next day I went to buy a small pot of gloss black paint to finish off the coal loads, and took the film in for developing on which I had been recording progress.

These photos were taken with an elderly Olympus SLR which is on its last legs. The cost of repair is extortionate so I am considering a change, which is embracing digital photography but, again,


Under test with the bodywork in place. The Southern coach was made by Tim Green of Winchester.

Lady Anne enjoying an outing on her home track on a warm sunny day and under full radio control.

I find to get performance equal to regular film one needs to go right up to professional level in digital cameras at professional prices. Not for me as the current mid-range SLR cameras are now very affordable. The only off putting thing is that I know as soon as I buy a new one it will be replaced by the latest model with improved performance - just like computers!

The coal loads looked quite good now they were painted gloss black, and the difference does show up against the matt black of the bodywork. I had a little trouble fitting the battery clip inside the cab roof which had been pre-drilled (different to what the book of words says). Although the heads of the countersunk screws provided sit down fairly flat on the outside of the cab roof, the nuts on the inside project so far in to the battery compartment that the two outside cells would not fit in nicely as they fouled the nuts. I solved the problem by slightly countersinking with a No.24 drill the inside of the battery clip and then screwing from the inside to outside, and filing down the projecting screw threads flush with the nuts. One of the nuts was still visible after the dummy roof vent/aerial plate was fitted, but I thought a dob of black paint would hide it.

My projecting nut under the dummy roof vent caused another problem as it projected out too far and the 'sticky fixers' provided to give insulation are not thick enough. When I went to collect my film the next day I sought out some of the thicker ones that I had seen used before for mounting exhibition displays. In default I could have used a piggy back approach to provide the gap. It might also pay to interpose a sheet of flexible insulation material - belts and braces again.

This was retrospective. It was a relatively dry morning with some promise so I donned outdoor boots against the mud and went all round one of my tracks clearing it of winter detritus and recent storm damage. All the points would need a good service once the weather really cleared up - after all it was still only January. But after an hour or two I had brushed off the track so it was reasonably clear, I could get a good run round and, lo and behold, the sun came out. I decided the time was ripe for another steam trial which could now be supported by straight butane which my wife had brought back from England. It was interesting to see my bottle of 'Taymar' butane gas RF 80 had the Camping Gaz symbol on it, which was obviously a French product so why can I not buy it here? Worth some investigation on the web, perhaps.

Anyway, I took my Lady Anne up onto the track and placed her on a high bit so I did not have to bend down too much. Oiled around (again!), added butane into the tank which took only a minimum of time before it overflowed. I guess there was a lot of gas left in there from my earlier abortive trial. I then filled the boiler. Here, I should add, that I am currently using de-ionised water as it is all I have at the moment. In future I will collect rainwater and filter it for use in the boiler. Although de-ionised water is not recommended I do not know why and some explanation is needed.

I tried to light the gas with as little success as I had had previously. I went through a logical progress of investigation as clearly there was a lack of gas in the important area, i.e. the burner. I disconnected the union at the tank, turned the gas ON and there was a distinct hiss (and smell - I'm sniffing again!). It was all okay there. After re-connecting that end I checked at the burner end of the gas pipe and again it was okay. I took out the gas jet fitting and found I could blow through it but close investigation revealed some bits of rubbish in the inlet cavity which I removed. It is possible, of course, to see through the gas jet if you hold it up to the light, which I did, and it did not seem round: so to hell with it, I had a spare (provided by Roundhouse in the kit) so I fitted the spare. I replaced the gas jet in the fitting then replaced it facing outwards, turned the gas on again and sure enough there was the distinctive hiss. I was beginning by then to recognise the sounds and did not need to sniff. I refitted the gas jet in its enclosure within the burner and tried again with a match at the funnel. That time it fired, and I could hear the burner going even in my old age induced, deaf state.

Given a few minutes I found I could turn up the gas and within ten minutes steam was coming out from the safety valve. At this juncture I should add that I was steaming up without a working pressure gauge, as the replacement had not arrived, so I really had no idea what was happening steam wise. I put her in to forward gear, I opened the regulator a little (I confess to being somewhat nervous at that point in time) and nothing happened except a lot of spitting and puffing. I opened the regulator a bit more and then suddenly she wanted to move, a bit hesitantly but certainly wanting to stretch her legs, and with another small forward movement of the regulator handle she was off! I ran alongside the track and was able to adjust the regulator sufficiently to achieve a constant, reasonable, forward speed and once my fear/nervousness had disappeared I let her run - fantastic! I managed to stop her easily, put her into neutral then into reverse opened the regulator a bit again and she went back the way she had come. I can tell you, I was well pleased. My Lady Anne ran for a good 20 minutes, forwards and backwards, until finally coming to a stop on the far, most inaccessible, corner of the track. I did not really mind and forgave her in that instance but I may well not be so forgiving in the future. I hope she understands.

Bringing her back indoors I found next to no water left in her boiler and she got a good wipe down. The next day I decided this lovely lady would have her radio control fitted and we would see if she then submitted to my commands.

Starting with the reversing servo, I removed her manual reversing lever so that I could replace it with one of the two servos. The mounting plate of this servo needed a little modification. I had to cut out the ends of the two fixing holes and make them into open ended slots to enable it to fit onto the mounting pillars. But because the fixing seemed a trifle fragile (after all, it is a steam locomotive and not a precision clock!) I placed brass washers both above and below the plastic to spread the load a little.

I moved on to the regulator servo and this required opening up the fixing holes with a file to ensure it could be screwed in place, which is a real fiddle needing another pair of fingers really but now it was in place. I stuck the receiver in place but then realised it must not sit down onto the footplate as there is then no place to store the excess wires. So with difficulty and careful application of a knife blade, I lift off the 'sticky fixers' and moved the receiver up by about 8mm. Now I had plenty of space to stuff in the wires and it made the wire clamp more accessible. This meant I could lay the wires away from the boiler but I used a spare 'sticky fixer' to hold the wires well clear of the mechanism of the reversing servo.

Now it was time to set up the radio controls. The reversing connection went on easily except for the star-lock washer, which required levering onto the end of the rod with a pair of small pliers and a screwdriver jamming the top down. In accessible places the trick to fit star-locks is to use a hollow punch with light taps of a hammer. The final adjustment was a doddle - those Quicklink fittings are marvelous.

Problems, problems of my own making. I had installed the regulator servo the wrong way round and getting it right has taken a good hour plus and now I find that in sorting it I have abraded the insulation on the connector wires and black and red are shorting. This meant cutting the nice tidy harness and rejoining each of the wires and then insulating with heat shrink sleeving, however it is back together again and all working. I could now fit the servo horn in the right attitude. First time round, it was not until I reached this point that I realised my bad mistake.

Following the instructions, suddenly it was all right. Tests with the radio controller all checked out so it is outside again for full testing. Lighting the gas is difficult and two matches later I noticed the gas valve was venting into thin air. I had overlooked the re-connection after the earlier business of turning round the servo when I had removed the gas tank when re-routing the wires! Once fixed she lit up like a dream and with only very slight alteration to the regulator travel after raising steam, I had perfect control all round my track from the radio transmitter. This was so fascinating I suddenly realised it was getting dark when suddenly the gas finally ran out and, as before, my Lady Anne came to a stop in the remotest corner of the track. She must be taught to stop this naughty habit or goodness knows what she might get up to next! The photo shows the trailing truck carrying the batteries and the extended wire aerial as I still have not been to the shops and do not have those 'sticky fixers' for the plate aerial on the cab roof.

I was now only a matter of fixing the body in place, replacing the buffer beams and seeing if I can put LGB type couplings on them, and fixing the plate aerial of course. Maybe a bit of touch up paint was necessary. Then I would have a photo session before doing some real tests with weighted loads on the flat and up my 5% gradient to see if she really would behave as a lady should.

I then tripled up the 'sticky fixers' and the cab roof ventilator/aerial plate was fitted in place with no shorts. But when I came to placing the body in position I could see that the left hand side did not sit down properly, the inside of the side tank was up against the top of the reversing servo. Recalling I had added washers under the servo mounting plate accounted for the problem as it had raised the servo just out of tolerance so these were removed. The body now sat down nicely and I screwed it in place. As I did it I noticed that my paint had already blistered alongside the brass boiler band adjacent to the smoke box. Clearly the paint I had used was not up to the high temperature of the boiler. Never mind, she can wait for her first service for that to be attended to; perhaps a full repaint might be in order then.

I fitted the cab roof but made a change to the method of fixing the screw hinges by using 8BA x 0.5in. hexagon head screws with two nuts on each screw inside which are locked together. There is now no chance of the hinge screw coming adrift. But now I found that the battery clip supplied was much too thick and the cab roof could be closed. I found another battery clip in my electrical 'bin' which was much thinner and fitted this instead, and although I could now close the roof with a bit of fiddling, the insulation became torn as it is pushed past the top clip of the spectacle rim. The only solution was to solder directly to the battery terminals – after all, how often will I need to take it apart? With a couple more 'sticky fixers' the wires were kept well away from the hot spots, a bit of tape to mask the bare battery terminals (although they seem well clear of the metalwork) and, although this was very much a 'bodge', a quick test showed all was working again. Unless the cab roof is very carefully positioned into the closed position there is also an interference fit between the battery pack and the top of the gas regulator. It seemed to me that a better place for the batteries would be in a 'pocket' created within the cab against its back wall. I might arrange that during her ladyship's first service together with a good repaint, her paint work was already chipped and needed immediate touching in before her outshopping photos.

I now refitted her buffer beams. The front one I have left as standard but to the rear one I added an LGB type coupler and raised the centre buffer so that it now sits at the top of the beam and is much more in line with that on an LGB wagon. Raising the Ron M. Grant buffer means removing the threaded spigot on the back, then drilling and tapping 6BA into the stub of brass left in the buffer. Finally it was fixed with a screw from the back of the beam through a new clearance hole drilled 6mm from the top on the centre line. The sprung loaded, dropped end on the inside of the hook (the bit that is used for auto uncoupling) had to be cut off as it was marginally lower than standard LGB and would certainly foul points' frogs if left as was.

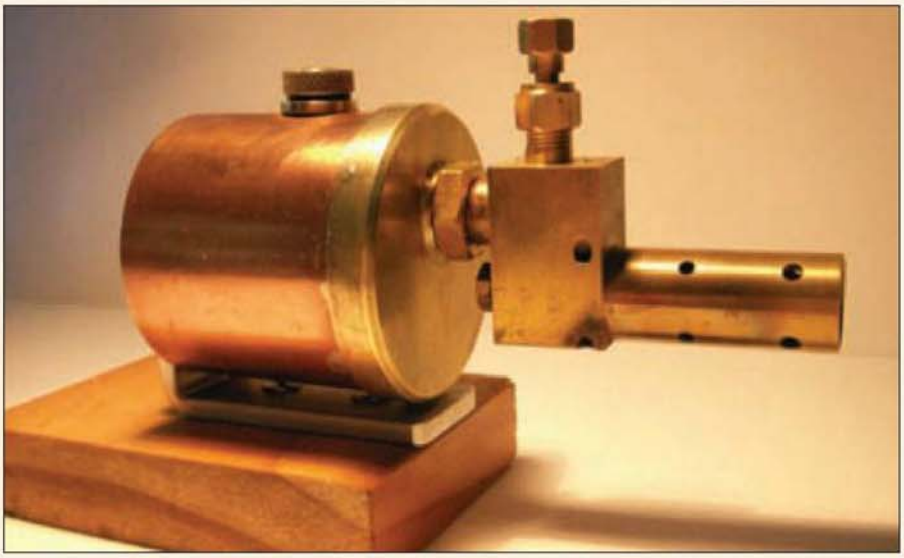
The final photographs were now taken and I noticed, when her ladyship was on the track, a slight maladjustment of her reversing link probably due to my removing the unnecessary washers earlier. It looked as though I could get to the Quicklink connector for the adjustment without having to remove the body and therefore I would not have to unsolder the battery connections already.

In retrospect, the build was now finished. Would I do it again? The answer is certainly "*yes*" and probably will. Either a different model or I might make up my own body on the same chassis/boiler assembly. It has been great fun and educational, but I would I buy the complete set of parts straight away. I would also try to make a better job of the paint work from the word go, improve the battery positioning if possible, use hexagon head bolts in all visible places instead of the slotted cheese head type and spend more time building and less writing. It has taken me some nine weeks from start to finish. Rather longer than Oliver Clay achieved!

IN THE NEXT ISSUE

- **New series on machine tools for the model engineer**
- **New construction series on the Model Stuart Drilling Machine**
- **New meths burner for small engines**
- **The products of Tangyes of Birmingham**
- **Boilers by Peter Rich**

Plus all your regular favourites



ON SALE 26 MAY 2006

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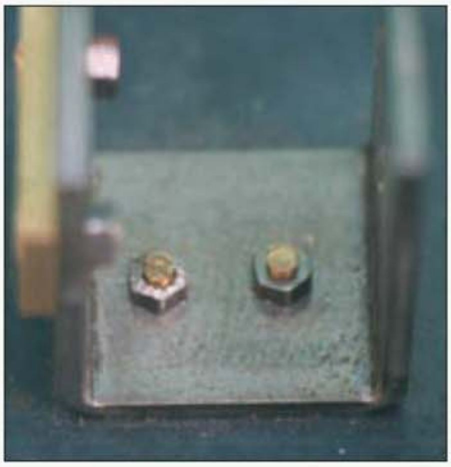
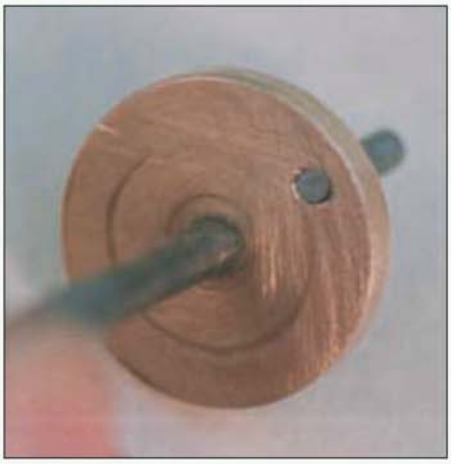


The fabricated engine support is held onto the base plate by two 6BA. screws fitted from below.

The 'Popular' flywheel should be skimmed to finish the surface. Size is relatively unimportant.



The crankshaft and crank pin are a force fit into the crank disc then rivetted and filed flush.

BOWMAN

Marcus Rooks

concludes his short series on the building of this neat engine.

●*Part III continued from page 455 (M.E. 4271, 13 April 2006)*

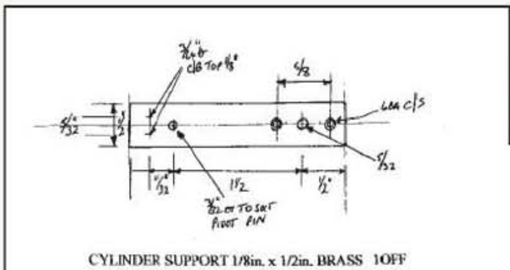
The horizontal support is made from a piece of 1/8in. x 1/2in. brass. You can either use a commercial section or do as I did and cut it from a piece of scrap sheet. At this stage do not mark the steam ports, drill the other holes as indicated. Next push a piece of 5/32in steel into the gear frame and slip the support over it and clamp in the horizontal position. The fixing holes can then be drilled directly from the support onto the gear frame. Countersink the holes in the support and it can be attached with two 6BA countersunk screws.

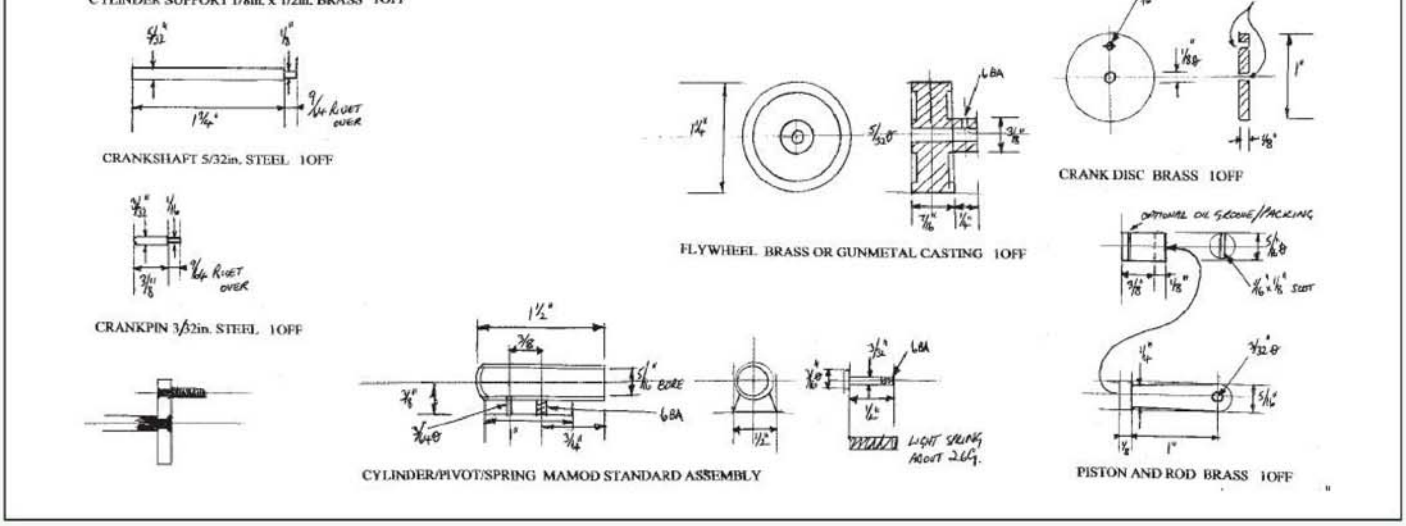
I would strongly advise using a Mamod standard cylinder. This is very convenient and is accurately aligned, however, building up from scratch would not be too difficult for the experienced builder. We will however be making a new piston and rod.

The piston is turned down from 3/8in. dia. brass rod until it is a nice sliding fit in the cylinder. At this stage remove from the chuck with a nice long holding piece. The 1/16in. slot can be carefully cut with a hacksaw or better still using a slitting saw. Cheap slitting saws are available from most of our suppliers and are ideal for such jobs, producing a nice accurately cut slot. I clamped the embryo piston in the tool post with the saw in the chuck. The piston rod is made from 16 gauge brass sheet and is a simple drilling and profiling job, make sure that the rod is a nice fit in the piston. When you are satisfied, separate the piston from the chucking piece and face off to 1/2in. long. The rod is then soft soldered into the piston.

The crank disc is another simple turning job. If you are confident about your machining capabilities the facing tool can be used with the cross feed dial to accurately mark the 3/8in. throw. Drill through 1/8in. dia. and part off a slice 1/8in thick. Make a centre pop on the throw and transfer to the drilling machine and drill the 1/16in. hole, countersink these holes on opposite sides. The crank pin is a simple turning from 3/32in. dia. steel; turn down one end for a tight fit in the disc for a little over 1/8 inch. Tap this in place and lightly rivet over and file flush. The crankshaft is treated in a similar fashion, pushing in place and lightly rivetting over from the opposite side. Make sure that the shaft runs freely and the disc is square.

The next step is to mark and drill the steam holes. You can mark and drill as per the drawings, but I think a better method is to mark in situ. "*How is that done*?" I can hear you ask. Very simply, I can reply, as I used the same method with *Dreibeiner*. Make a small pin with a sharpened end to fit in the cylinder steam port. Assemble and use light hand pressure to hold the cylinder in place whilst the crank disc is rotated. You will find that the pin scribes a nice arc on the port face and it is an easy job to pop mark the two extremities and drill them 3/64in. diameter. On the reverse side counter bore the top hole 1/8in. x 1/16in. deep to accept the main steam line. If you use the lower hole the engine will rotate in the opposite direction.





Finished cylinder components. The cylinder and pivot pin are Mamod items.

The completed power unit bolted to the base plate and awaiting final plumbing.

The steam pipe in place for soldering. Direction of rotation can be reversed by using the other port.

Flywheel

The next item on the list is the flywheel; British engines used solid heavy brass flywheels. You can either machine from a brass blank or use a gunmetal casting. I used the Reeves Popular flywheel casting. All it needs are the surfaces to be machined smooth and it will be about the right size, there is no need to be fussy. It is drilled 5/32in. dia. to match the crankshaft and cross-drilled for a 6BA set screw.

The pulley can be either machined from solid or, once again as I did, use a Meccano commercial item. The whole shebang can be assembled with a brass washer between the crank disc and frame, flooded with oil and spun around a few times to run it in. We are on the home run now and the adrenaline should begin to flow!

Finishing

The engine and boiler are connected by 1/8in. dia. copper pipe. With the engine and boiler in place, juggle the pipe around until it flows nicely into the recess on the back of the engine support; do not solder until every thing is finished.

When all the bits and pieces have been assembled and checked, strip down, clean and give a nice finish with fine emery cloth and wire wool. The boiler should only be cleaned with wire wool and detergent before polishing with the likes of Brasso.

British engines were not noted for their colourful finish, many, such as Mersey Models and Wormar had virtually no colour at all. When they were painted, standard workshop colours were used, red, green and black. You can choose either to leave in a metallic state or paint. I chose the former but if you want to paint then I would suggest green for the base, red for the inner recesses of the flywheel and black for the frame, the rest should be polished.

The final stage is to reassemble, a touch of heat and solder will attach the steam line to the engine and we are in a position to test our little engine. Flood the engine with light oil and spin around as much as possible to free up the movement. Fill the boiler up to the level plug with hot water and half fill the burner with meths., trimming the wicks until they are about 1/4in. long. Stand back for a few minutes until a mixture of steam and water comes out of the ports then spin the flywheel and the engine should be away. As it runs in so it should speed up until a satisfying blur is all that can be seen. By filling the burner only half full the meths should run out before the water so the joints should not be put at risk.

After running, empty the boiler and burner and I would suggest leaving the level plug out so as to allow any trapped water to evaporate. Finally clean down with an oily rag and put somewhere prominently on display.

I think that it should be pointed out that Bowman is based on a 70 year old design and as such does not comply with modern safety regulations if intended for commercial use or by children. To comply with regulations the following simple modifications need to be done: -

1: No flames are allowed to escape from the top of the firebox. This is achieved by altering the width of the firebox.

2: Use solid fuel tablets.

3: Use a water gauge, such as the Mamod type rather than a level plug.

All are quite easy modifications but then it would not really be a 1930s steam engine.

I hope that you have enjoyed making Bowman which should be a nice weekend project and bring back the good old days of British steam toy making.

FOR YOUR BOOKSHELF

TOOL AND CUTTER SHARPENING

This book is number 38 in the Workshop Practice Series and is written by Harold Hall, who is the author of a number of other works in this popular, competitively priced series. Following the introductory chapter, chapter two deals with drill sharpening and the use of the inexpensive drill sharpening jigs sold for the purpose. Traditional drill geometry is explained, as are the advantages of the 4-facet sharpening method favoured by industry and many amateurs. Chapter three explains to the reader how the making of more sophisticated grinding rests than those supplied by the grinding machine makers can increase the scope of the off-hand grinder enormously and enable work normally associated only with industrial tool and cutter grinders to be done. The importance of grinding wheel dressing and safe working are also covered. Chapter four deals with the grinding of lathe tools and emphasises the importance of the various cutting angles and the need for sharp tools in terms of finish and accuracy.

Chapter five is concerned with the grinding of end mills and slot drills using simple methods to index and guide the tool and in chapter six these methods are extended to other types of milling cutter. Chapter eight is a short chapter on grinding workshop items like screwdrivers and scrapers whilst chapter nine deals with the commonly used woodworking tools. The remaining chapters are concerned with making the slide rest and other accessories in order to carry out the techniques described in the book. All the chapters are well illustrated and have useful, clear drawings where appropriate.

Any complaints? Well, something like three chapters are used to describe the grinding rest used by the author but this has already been covered in some detail in Workshop Practice Series No.35 *Milling, A Complete Course* (reviewed in *M.E.* 4236, 10 December 2004). The reader of the first few chapters of this book could come away with the distinct impression that it is perfectly in order to grind on the side of a disc-type grinding wheel. Now, I know this is something that we all do from time to time but it is bad practice and is to be avoided where possible. The correct approach, where a nominally flat surface is required, is to use a cup or saucer shaped wheel and this is explained in the final chapter of the book but perhaps too late to prevent the beginner drifting into bad habits. Finally, the chapter on the sharpening of woodworking tools does not place enough emphasis (although it is mentioned) that sharpening such on a dry aluminium oxide wheel might well lead to the steel becoming hot and losing its hardness. For this reason a 'wetstone' is almost essential for sharpening the woodworker's edge tools, which are made of high carbon, tool steel. This, of course, is not a problem with high speed steel metal cutting tools.

It is all too easy for the amateur to become convinced he must have a tool and cutter grinder if he is to carry out tool sharpening effectively. This book explains how much can be achieved with the minimum of equipment.

Tool and Cutter Sharpening, Workshop Practice Series 38 (ISBN 1-85486-241-3) is written by Harold Hall and published in paperback by Special Interest Model Books (www.specialinterestmodelbooks.co.uk). £6-95.

KEITH'S COLUMN

Keith Wilson addresses the important issue of locomotive lubrication.

●*Part XX continued from page 463 (M.E. 4271, 13 April 2006)*

LILLIAN
A NARROW GAUGE LOCOMOTIVE
for 7¹/4in. gauge

As most steam engine drivers will know, cylinder lubrication is very important. Some of the very early American (and English ones) were known as 'muzzle-loaders' because at some places on long journeys the fireman (usually) had to pass along the running plates to put a lump of tallow into a two-stage valve, with a funnel on top.

When running, the top tap was normally closed and the lower one open. The lower was closed and the top one opened so that the lump of tallow could be popped in, the top tap was then closed. With the opening of the lower tap, the tallow would melt and flow into the steam chest, thence into the cylinders.

One can imagine what the Health and Safety Executive would make of this operation. It worked, but was not the best system possible.

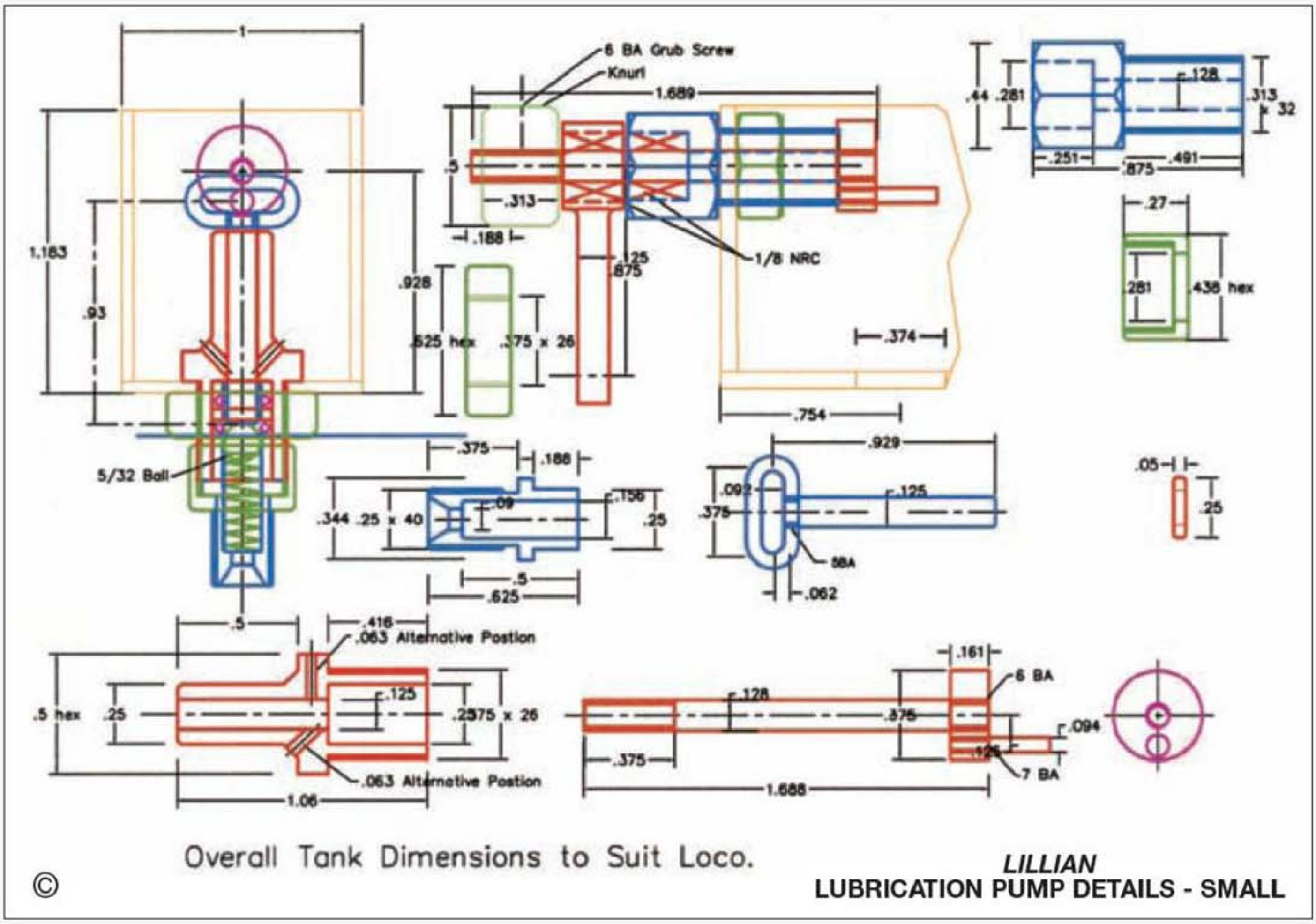
Later came various systems for doing this process automatically. One was a long tube of grease, with a plunger pushed along by a thread (the screwed variety, not the sewing type!). This worked, but it took such a while to rewind the plunger and refill the tube, and became outdated.

> *Wilson's Words of Wisdom:*
>
> *The most fiercely defended right is the right to remain ignorant.*

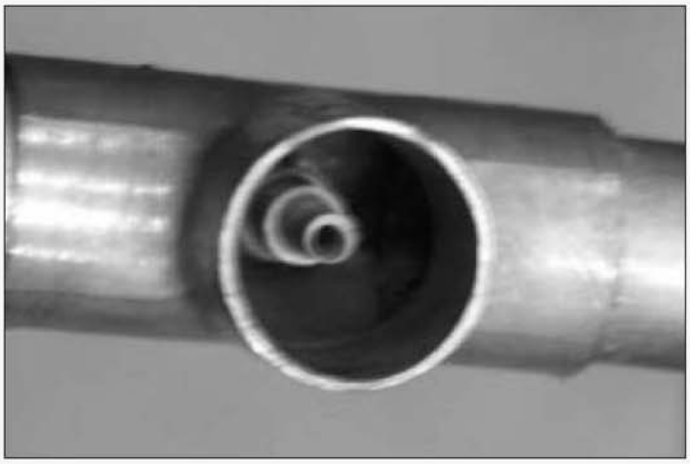
Dear old Curly designed and developed an oscillating-cylinder lubricator pump driven by a ratchet system, and until invented/ designed/ thought up by Jim Ewins (see below) was not, as far as I am aware, improved on. It was reliable if made properly, but had one or two tiny traps. For, it must be appreciated that the non-return valves had to be absolutely tight, even a 1% leakage could ruin the system. For the force tending to blow back is high and fairly constant, whereas the pump forwards is intermittent. It therefore follows that even a tiny leak will mean that during this operation oil can creep back under steam pressure.

Unless this creep-back effect is considerably less than the 'forward' effect, the system will fail. Now I know full well that the oscillating-cylinder has the additional non-return effect from the flat faces between cylinder and stand, but this can fail due to the 'bridging' effect of the ports in the two 'dead- centre' positions. Great care is required to avoid this effect, caused by minor misplacement of the ports or minor discrepancies in their diameters. In theory at least it is easy to make a perfect, non-return valve (NRV); however in practice it is not so easy.

As far as I know, the most reliable NRV is the 'Schraeder' valve as used in car tyres and these can be obtained at no cost from a tyre replacement depot. Just ask the chap on the floor. The thread on this beast is very close to 0.196in. x 36, but is almost certainly a metric size, M5 x 0.07mm pitch seems to be right. I do not know exactly the 'official' sizes, but the well-known firm of Halfords sell a little 'box of tricks' composing tap, die, and key for the valve insertion. The outside thread of the



The wheels in position on the chassis. Note that the wheels have set themselves being mounted on needle roller bearings.



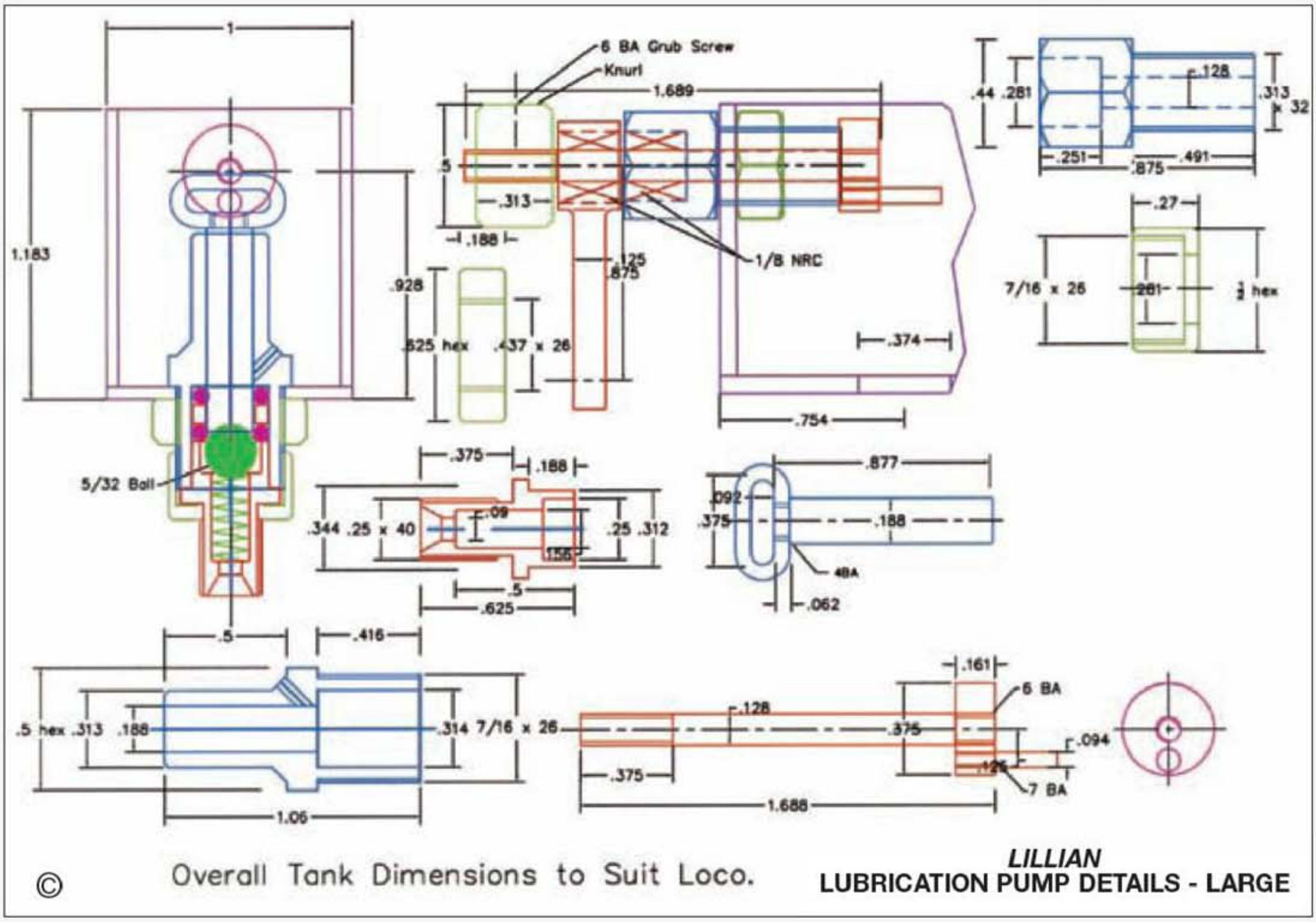
A view down the steam supply pipe to the cylinders. Note the oil entry jet visible through the aperture.

complete valve is near as makes no odds to 5/16in. x 32.

I am not sure which was invented first, the mechanical lubricator or the hydrostatic one. The hydrostatic is the simplest one, but there are pros and cons for both. The hydrostatic one needs to be emptied before re-filling, whereas the mechanical pump type can be replenished by merely pouring fresh oil into it. In full size, the amount of oil carried in either type can be adequate for a day's working. But due partly to the old 'square-cube' law and partly to the fact the our locomotives run much oilier than full-size, this is just about impossible for us; although I did once design a system that had an extra reservoir 'down below' so that ordinary convection would keep the top reservoir topped up for longer runs. However, this system would still need 'blowing down' in order to refill. I never actually made one so I cannot vouch as to its efficacy. The real solution is (as usually happens) blindingly obvious once it has been pointed out. Larry Barker spotted it some time ago, and it works very well, combining the advantages of both types. It provides for instant re-filling and visible evidence of oiling.A small pump, running faster than our normal mechanical lubricators, feeds back into its own reservoir through a little spring-loaded valve; the pressure thereof being set to a bit over boiler pressure. It follows that there is a constant supply of oil comfortingly over boiler-pressure available. This feeds back into the cab and to the lower end of a sight-feed set-up. From the top of this set-up a pipe(s) feeds forwards into the steam chest(s); hence the oil gets put just where (and when) it is needed at the control of the driver.

If the feed is into two steam chests, (outside cylinder locomotives) it is most important that the pipes 'after' the necessary fork are as identical as possible. No extra non-return valve, for there is no-way that they can be set absolutely identical, and the pipes must be same length and diameter. In the case of our *Lillian*, the feed can be into the 'T' in the centre of the steam pipe between the two cylinders, of course it should be dead opposite the main steam pipe. Also, if possible the feed should be aimed at the centre of the steam pipe (diameter-wise) because the oil tends to emulsify.

●*To be continued.*



CLUB CHAT

With Malcolm Stride

UK News

Mike Leahy from the **Southern Federation** has sent me a comment regarding insurance following my recent mention of the subject (*Club Chat, M.E.* 4269, 17 March 2006). I quote Mike's clarification of the situation regarding cover: *"Any club insured under the Southern Federation scheme is covered for any activity at their track site at any time irrespective of whether it is a public day or not, providing it is being undertaken by a club member or a visitor who has signed into the day book. So a ride given by a club member to Joe Public would be covered under the Public Liability section of the policy."* The important point regarding visitors is that they should have signed the daybook to ensure cover. Mike also comments that policies other than that from the federations should offer the same cover. I suggest those clubs with different policies ensure that this is so. I express my thanks to Mike for clarifying the situation.

One other point to make is related to child protection and photographs. I spend quite a lot of time browsing through club websites for this column and have noticed that several contain photographs of young children obviously enjoying themselves on trains and other activities. It is a sad fact these days that publishing photographs of children enjoying such things is fraught with potential problems and I would urge clubs to be cautious when doing this and if they do to ensure they have written permission from parents.

This also applies to newsletters and clubs that have submitted photographs for this column may have noticed that if we publish pictures in this magazine we do not include those with children or we 'crop' the children out of the picture before publication. This is unfortunate but necessary in this day and age.

Basingstoke DMES is discussing future options with the local council regarding the continuing lease on its Viables track site and during these discussions the council intimated that grants were available for projects that involve education or young people. Other clubs may like to investigate the situation in their own areas.

We would be pleased to publish details of any national schemes that could help clubs. The society has started a regular 'Bits & Pieces' evening at which members can discuss each other's efforts and hopefully solve problems. To encourage participation of the members, points will be awarded for the best/most entertaining/most informative presentation each time with a trophy for the member with most points at the end of the year. The society website is being revamped at **www.basingstoke-dmes.co.uk** The society gala weekend is on August 19-20 this year so those who like to plan ahead can put the dates in their diaries now.

In common with many societies, **Bedford MES** is situated in an area with hard water supplies resulting in boilers becoming clogged with scale which can drastically reduce service life. The society is proposing to install a water softening facility to provide a treated supply for the locomotives. Progress is being made on the Winterfields site track alterations and the decision was made to remove some of the old track while the realignment was being done because working round the track was slowing progress. Investigations are also taking place into the possibility of establishing a garden gauge layout on the site. This is as a result of the local 16mm narrow gauge society losing its base in Bedford.

We have reported previously on the efforts being made at **Bradford MES** with the installation of new carriage sheds. These are lengths of large diameter concrete pipe and are now installed with screened vents to allow air to circulate through and out of the chimneys at the top. The work was made more difficult by the muddy conditions during the winter months. Member Keith Parkinson has made a dramatic change from $7^1/4$in. gauge to garden gauge with his latest model. This is a model of a Greenwood and Batty works locomotive and has the gauge adjustable between gauge 0 and gauge 1 thus keeping all options open for Keith. The new locomotive will certainly be much kinder on his back! Investigations continue into the way forward for the proposed boating pond at Northcliffe. It is a sign of the times that approaches to retired engineers for help have generated no takers due to insurance implications.

Bromsgrove SME is holding two open days this year, the first is on May 20 and the second on August 12. Those requiring further details should contact Brian Mould on 0121-4535733 (after 6pm). Coincidently, at the last open day the new Gauge 1 track was opened with a model of a Midland railway Lickey Banker, which is the same prototype, although in 5in. gauge, that opened the raised track some 20 years ago and all within three miles of the real Lickey Bank.

Trevor Jenkins of **Cardiff MES** has taken on the task of writing a history of the society in time for the 60th anniversary in 2008. The history will be published in book form and the society is looking for archive photographs of its activities.

CLUB DIARY

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

MAY

12	**North London SME.** *AGM.* Contact David Harris: 01707-326518.
13/14	**Chesterfield MES.** *Rally & Open Weekend.* Contact Mike Rhodes: 01623-648676.
13/14	***Merstham Model Steam Show*** at St. Nicholas School, Taynton Drive, Merstham, Surrey RH1 3PU. Adults £6, Senior Citizens £5, Children £4. Enquiries: 01737-760400.
13/14	**Romney, Hythe & Dymchurch Railway.** *Steam and Diesel Gala.* Information: 01797-362353.
13	**South Lakeland MES.** *Open Day.* Contact Adrian Dixon: 01229-869915.
13	**York City & DSME.** *Alan Hopwood: Repair and Adjustment of Exacta cameras.* Contact Pat Martindale: 01262-676291.
14	**Basingstoke DMES.** *Shunting Competition.* Contact G. Harding: 01256-844861.
14	**Bristol SMEE.** *Public Running.* Contact Trevor Chambers: 0145-441-5085.
14	**Canterbury DMES (UK).** *Public Running.* Contact Mrs P. Barker: 01227-273357.
14	**Edinburgh SME.** *Newliston House Open Day and Club Track Running.* Contact Robert McLucke: 01506-655270.
14	**Harlington LS.** *Public Running.* Contact Peter Tarrant: 01895-851168.
14	**High Wycombe MEC.** *Club Running afternoon.* Contact Eric Stevens: 01494-438761.
14	**Leeds SMEE.** *Running Day.* Contact Colin Abrey: 01132-649630.
14	**Leighton Buzzard NG Rly.** *Teddy Bears' Outing.* Enquiries: 01525-373888.
14	**Saffron Walden DSME.** *Running Day (public running after 2pm).* Contact Jack Setterfield: 01843-596822.
14	**St. Albans DMES.** *Puffing Field Morning.* Contact Roy Verden: 01923-220590.
14	**Worthing DSME.** *Public Running.* Contact Bob Phillips: 01903-243018.
15	**Peterborough SME.** *Keith Hale: Soldering & Brazing.* Contact Ted Smith: 01775-640719.
16	**Chesterfield MES.** *Paul Pratt: South American Railways.* Contact Mike Rhodes: 01623-648676.
16	**Erewash Valley MES.** *David Chapman: Slide Show.* Contact Jim Matthews: 01332-705259.
16	**Northampton SME.** *Running Night.* Contact Pete Jarman: 01234-708501 (eve).
16	**North Cornwall MES.** *Meeting & Pre-season Steam-Up Evening.* Contact Geoff Wright: 01566-86032.
16	**Nottingham SMEE.** *Tim Coles: GT3 Gas Turbine Locomotive.* Contact Graham Davenport: 0115-8496703.
16	**South Durham SME.** *Afternoon Steam-Up.* Contact B. Owens: 01325-721503.
17	**Bristol SMEE.** *Meeting.* Contact Trevor Chambers: 0145-441-5085.
17	**Guildford MES.** *Last Bits & Pieces.* Contact Dave Longhurst: 01428-605424.
17	**Leeds SMEE.** *Meeting.* Contact Colin Abrey: 01132-649630.
17	**Maidstone MES (UK).** *Members' Playtime Run.* Contact Martin Parham: 01622-630298.
17	**MELSA.** *Meeting.* Contact Graham Chadbone: 07-4121-4341.
18	**Isle of Wight MES.** *Barbecue.* Contact Les Morgan: 01983-875118.
19	**Canvey R&MEC.** *D. Chandler: Computers I have known.* Contact Brian Baker: 01702-512752.
19	**North London SME.** *Ralph Copnall: The British-Owned Railways of Argentina.* Contact David Harris: 01707-326518.
19	**Rochdale SMEE.** *Meeting.* Contact Mike Foster: 01706-360849.
19	**Romford MEC.** *Rusty Titford: Painting and Lining.* Contact Colin Hunt: 01708-709302.
20/21	**Bristol SMEE.** *Southern Federation Spring Rally.* Contact Trevor Chambers: 0145-441-5085.
20	**Bromsgrove SME.** *Open Day.* Contact Brian Mould: 0121-453-5733.
20	**Canvey R&MEC.** *Members' Running Day.* Contact Brian Baker: 01702-512752.
20	**Chesterfield MES.** *Public Running Day.* Contact Mike Rhodes: 01623-648676.
20	**Romford MEC.** *St. Francis Hospice Track Run.* Contact Colin Hunt: 01708-709302.
20/21	**Tyneside SMEE.** *TSMEE Spring Rally.* Contact Ian Spencer, 0191-2843438.

The Editor of the **Plymouth Miniature Steam** newsletter had a problem with the spring issue, either having to keep the editorial to a single page, or stretch it to fill five. I can report that he kept it to a single page with the rest being a varied series of articles including the new boiler test code which I think has been discussed in almost every newsletter I have received recently. One of the articles is a continuation of the description of the restoration of a Kelly mine drill forging machine by Dave Witheridge. Can I suggest to Dave that I suspect many readers of this magazine would be interested in this topic if he would like to submit the words and drawings?

Geoff Hennell, Chairman and Editor of *Kingpin*, the **Nottingham SMEE** newsletter has written about his experiences of moving house (and workshop) which involved a well-known removal firm, a 60ft. long articulated lorry with a three ton forklift truck and a ten ton crane on its bed, a 3 1/2ton van, the house moving van and finally a small van. As he says, contingency fever had set in. The new house was only 800 yards away but Geoff's equipment took two days and went via Chesterfield for transfer to a more sensibly sized wagon but happily the move was completed without major disaster and we wish Geoff well in his new house. The society has received all the necessary permissions for the erection of canopies over the station platform and steaming bays and is now waiting for quotations for the steelwork. A useful tip in the newsletter is from 'Sapper' who suggests using a piece of split tube to hold square material in the 3-jaw chuck for turning. Quicker than setting up the 4-jaw. The newsletter also carries the news that Chris Heapy's very useful website has closed down but suggests another at **www.homeworkshop.org.uk** for those wishing to buy or sell model engineering items.

Work has been taking place over the winter at **Saffron Walden DSME** with the tracks into the container laid, the articulated passenger trolleys completed and the club locomotive mechanics completed. Large amounts of soil have also been moved to provide extra ground clearance under the raised track. Important plans are in place to upgrade the power supply into the club hut so that the kettle and fan heater can both be on at the same time and to stop the water supply freezing.

At the February meeting of the **Stamford MES**, Norman Smedley gave a slide presentation on the subject of Foden Lorries. This year is the 150th anniversary of Foden's founding in 1866 when the original company, Hancock and Foden, became Foden following the death of William Hancock.

World News

Australia

Brian Strevens from the **Steam Locomotive Society of Victoria** fancied a change and the chance to put the contents of the scrap bin to use by making a radio-controlled catamaran, *The Downpipe Catamaran*, from recycled materials. So, with two short lengths of storm water drainpipe, left over from the new gutters on the garage, plugged at one end with a Perspex disc and with the other flattened to make a toothpaste tube shape he generated two hulls. The pipes were joined by two crossbeams which were made from sheet metal; leftovers from a swarf guard for the Myford cut, bent and rolled on the Chinese multi-purpose machine. The mast and boom are from curtain track tube. The sails are made from waterproof material intended for an anorak. The steering gear was made from galvanised steel sheet. Most of the other bits are stainless steel welding wire. The expensive bit, the radio control, was purchased. The vessel was conceived, constructed and in use in about three weeks. The catamaran has proved to be a source of fun for both Brian and his grandchildren. Any more examples of such economy will be welcome.

Canada

British Columbia SME is to carry out some remedial work to improve the drainage on the grassy area of the site. The problem is caused by the clay used to build up the ground when the area was landscaped in 1992. Because it is only covered by a thin layer of topsoil the clay does not allow the water to soak away. Some track alterations are also to be carried out. A picture of a low temperature Stirling engine carries the caption *"A truly political machine, the Stirling engine runs on hot air and performs no useful work."* I can't think what they mean! Tom Pruden was awarded the society 'Man of the Year' award at the Christmas party.

New Zealand

Brian Wheeler, a member of the **Hutt Valley MES** reported that at the Canmod meeting he had water pump trouble due to a stainless steel ball that turned out not to be very stainless! I am sure many readers will sympathise with Brian. In spite of this he had some good runs and at McLean's Island he had his speedometer reading 33kph on the open stretches of track.

Another society making good progress with its work programme is **Maidstone MES**. The society has also decided to get help with the heavier work and to raise money to contract out work not practical for the society to undertake. At the February meeting, Paul Walker showed some components of a small gyroscope that he is constructing.

21 **Basingstoke DMES.** *Visitors' Open Day.* Contact Guy Harding: 01256-844861.
21 **Birmingham SME.** *Family Picnic Day.* Contact John Walker: 01789-266065.
21 **Edinburgh SME.** *Newliston House Open Day, Locomotives Running.* Contact Robert McLucke: 01506-655270.
21 **Plymouth MSLS.** *Public Running.* Contact John Brooker: 01752-671722.
21 **Rugby MES.** *Public Running.* Contact David Eadon: 01788-576956.
21 **York City & DSME.** *Running Day.* Contact Pat Martindale: 01262-676291.
22 **Bedford MES.** *The Bubbly Bottle Challenge.* Contact Ted Jolliffe: 01234-327791.
23 **Basingstoke DMES.** *Stationary Engines.* Contact Guy Harding: 01256-844861.
23 **Hornsby ME.** *Social Night.* Contact Ted Gray: 9484-7583.
24 **Hull DSME.** *Tony Finn: Quiz.* Contact Tony Finn: 01482-898434.
25 **Leyland SME.** *How do you make your nameplates?* Contact A. P. Bibby: 01254-812049.
25 **Worthing DSME.** *Tony Pratt: The Wey & Arun Canal.* Contact Bob Phillips: 01903-243018.
25 **Worthing DSME.** *Public Running.* Contact Bob Phillips: 01903-243018.
27/28 **Bedford MES.** *Club Running, Exhibition, AGM & Miniature Traction Engine Rally.* Contact Ted Jolliffe: 01234-327791.
27 **Brighton & Hove SMLE.** *Track Day.* Contact Mick Funnell: 01323-892042.
27 **Hornsby ME.** *Family Day/Boiler Inspections.* Contact Ted Gray: 9484-7583.
27 **New Jersey Live Steamers, Inc.** *Special Work Day.* Contact Karl Pickles: 718-494-7263.
27 **York City & DSME.** *Best work of the year.* Contact Pat Martindale: 01262-676291.
28 **Amnerfield Miniature Railway.** *Public Running.* Contact David Jerome: 0118-9700274.
28/29 **Bristol SMEE.** *Public Running.* Contact Trevor Chambers: 0145-441-5085.
28/29 **Cardiff MES.** *Spring Bank Holiday Open Days.* Contact Don Norman: 01656-784530.
28 **Chichester DSME.** *Steam on Sunday.* Contact Brian Bird: 01243-536468.
28/29 **Claymills Pumping Engines.** *Open Days.* Contact B. Eastough: 01283-812501.
28 **Edinburgh SME.** *Newliston House Open Day & Public Running.* Contact Robert McLucke: 01506-655270.
28 **Harlington LS.** *Charity Open Day.* Contact Peter Tarrant: 01895-851168.
28 **High Wycombe MEC.** *Public Running.* Contact Eric Stevens: 01494-438761.
28 **MELSA.** *Sunday in the Park.* Contact Graham Chadbone: 07-4121-4341.
28 **North Cornwall MES.** *Sunday Steam-Up.* Contact Geoff Wright: 01566-86032.
28/29 **Northern Mill Engine Society.** *Open Days.* Contact John Phillip: 01257-265003.
28/29 **Papplewick Pumping Station.** *Steaming Days.* Enquiries: 0115-963-2938.
28 **Taunton ME.** *Public Running.* Contact Don Martin: 01460-63162.
29 **Brighton & Hove SMLE.** *Lions Day.* Contact Mick Funnell: 01323-892042.
29 **New Jersey Live Steamers, Inc.** *Memorial Day Run.* Contact Karl Pickles: 718-494-7263.
28 **North London SME.** *Members' Running Day.* Contact David Harris: 01707-326518.
29 **Stockholes Farm MR.** *Bank Holiday Running.* Contact Ivan Smith: 01427-872723.
29 **Surrey SME.** *Public Running.* Contact John Cook: 020-8397-3932.
30 **Guild of Model Wheelwrights.** *Bath & West Show, Nr. Shepton Mallet.* Contact Biddy Hepper: 01492-623274.

JUNE

1-3 **Guild of Model Wheelwrights.** *Bath & West Show, Nr. Shepton Mallet.* Contact Biddy Hepper: 01492-623274.
1 **South Lakeland MES.** *Meeting.* Contact Adrian Dixon: 01229-869915.
1 **Sutton MEC.** *Bits & Pieces.* Contact Bob Wood: 0208-641-6258.
2 **Canvey R&MEC.** *Steam-Up with food.* Contact Brian Baker: 01702-512752.
2 **Maidstone MES (UK).** *Evening Run & Jacket Spuds.* Contact Martin Parham: 01622-630298.
2-4 **New Jersey Live Steamers, Inc.** *Spring Meet.* Contact Karl Pickles: 718-494-7263.
2 **North London SME.** *Malcolm Stride: Brush Electrical Engineering Co. Ltd.* Contact David Harris: 01707-326518.
2 **North Norfolk MEC.** *Track Evening.* Contact Gordon Ford: 01263-512350.
2 **Portsmouth MES.** *Meeting.* Contact John Warren: 023-9259-5354.
2 **Rochdale SMEE.** *Quiz Night.* Contact Mike Foster: 01706-360849.
2 **Romford MEC.** *Competition Night.* Contact Colin Hunt: 01708-709302.
3/4 **Aylesbury (Vale of) MES.** *Annual Miniature Traction Engine Rally.* Contact Andy Rapley: 01296-420750.
3/4 **Dockland & E. London MES.** *Public Running.* Contact P. M. Jonas: 01708-228510.
3 **Isle of Wight MES.** *Track & Pond.* Contact Les Morgan: 01983-875118.
3 **Romford MEC.** *Trackside Afternoon.* Contact Colin Hunt: 01708-709302.
3 **Sunderland (City of) MES.** *Meeting.* Contact Albert Stephenson: 01429-299649.
3 **York City & DSME.** *Summer Meeting.* Contact Pat Martindale: 01262-676291.
4 **Basingstoke DMES.** *Public Running.* Contact Guy Harding: 01256-844861.
4 **Leyland SME.** *Charity Day.* Contact A. P. Bibby: 01254-812049.
4 **Northampton SME.** *Public Running.* Contact Pete Jarman: 01234-708501 (eve).
4 **Plymouth MSLS.** *Public Running.* Contact John Brooker: 01752-671722.
4 **South Durham SME.** *Running Day.* Contact B. Owens: 01325-721503.
5 **Peterborough SME.** *Bits & Pieces.* Contact Ted Smith: 01775-640719.

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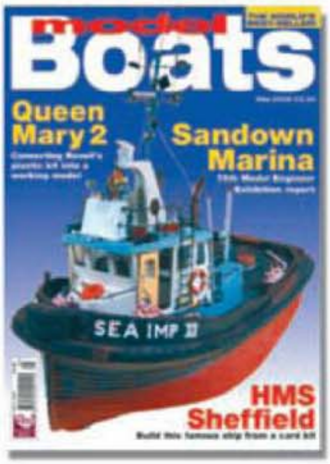

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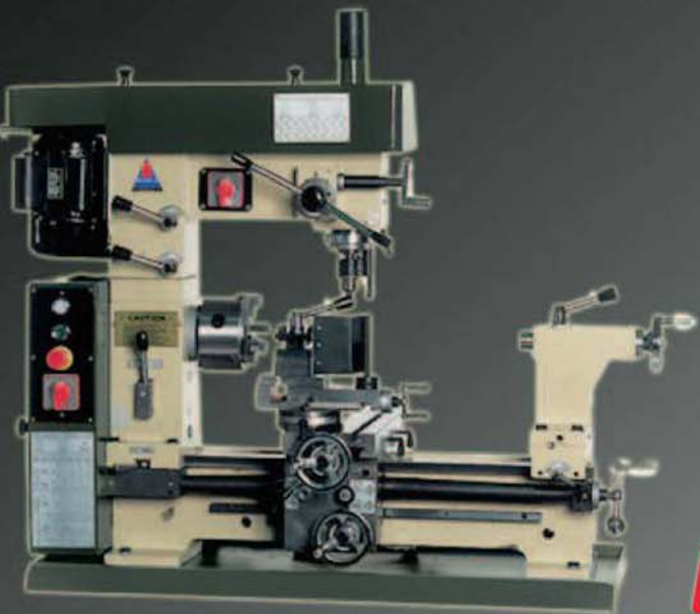

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