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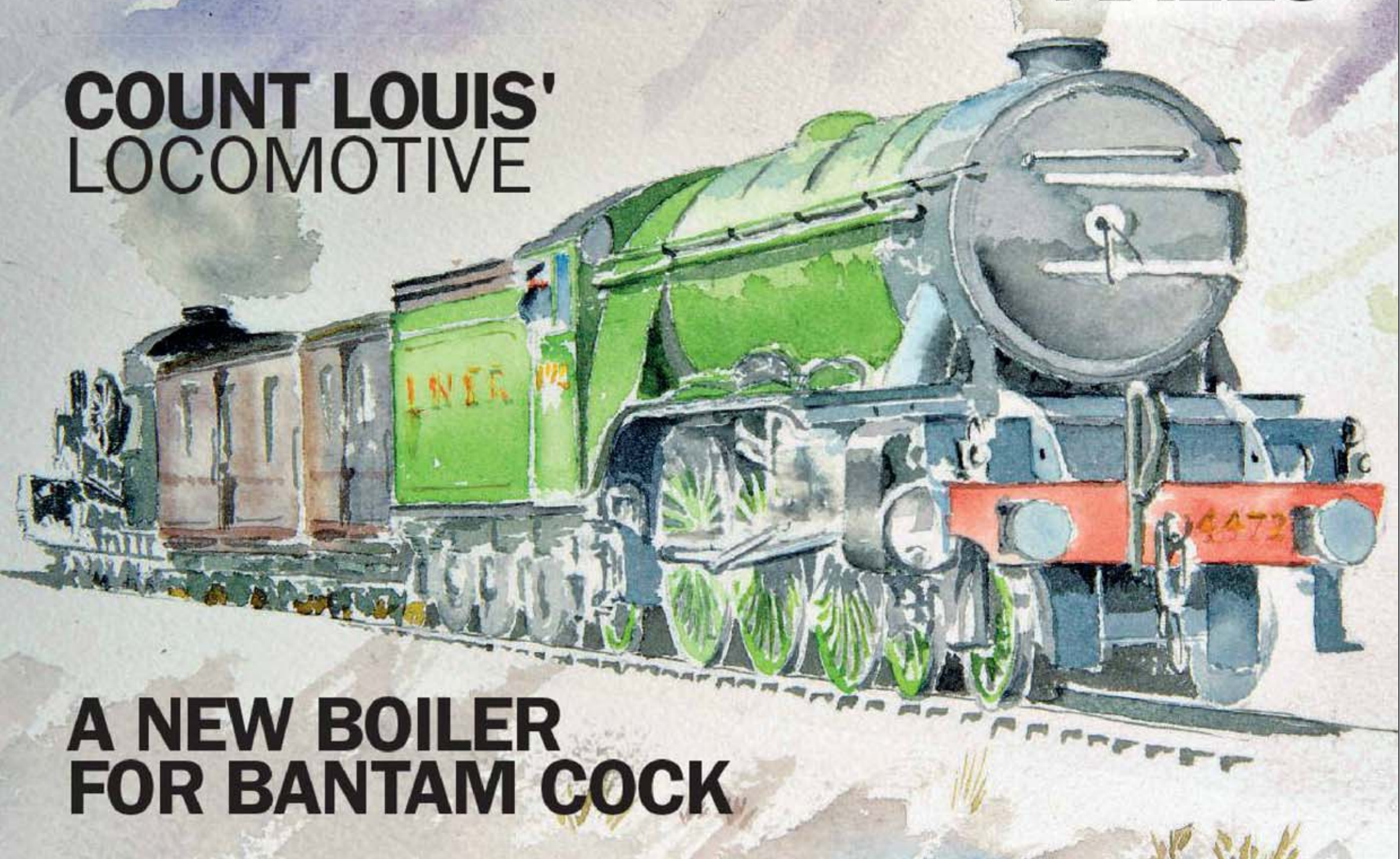

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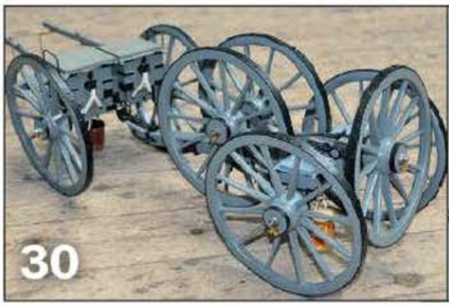

IN THIS ISSUE

Vol. 212 No. 4472 27 Dec - 9 Jan 2014

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Locomotive No. 4472 for Issue No. 4472. See Smoke Rings and the article on page 33. Illustration by the Editor.

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SMOKE RINGS

In this issue ...

Neil Wyatt completes his series on the making of Norden. This has been a pleasure to publish and will, I hope, have inspired readers to have a go at something that might be a little bit freelance but, at the same time, typical of its age and type. Neil successfully pitches his writing to appeal to a wide range of model engineers from those just starting out to those with many happy years' production under their belts and I look forward to similar projects coming to these pages in the future.

We also have the annual feature, 'Out and About' from Martin Wallis. This is another 'regular' I know readers enjoy, especially all you traction engine men! Speaking of which ... coming up next time we start a short series on a scaled up 'Minnie' which, I have to say, does seem to work surprisingly well.

On the cover ...

I recently had a telephone call from a gentleman, Mr. Fred Lane, a former Chairman of the Nottingham SMEE. Mr. Lane, a long time subscriber to *Model Engineer*, informed me that he was born in 1923 and asked whether I had noted that Issue number 4472 - a significant number - was fast approaching. The issue number and the year are connected, of course; 4472 being the original number of LNER A1, *Flying Scotsman* and 1923 being the year of birth shared by Mr. Lane and the famous locomotive.

I had noticed the significance of the Christmas week issue number and thought I would find a good photograph of the locomotive itself, preferably with a wintry theme. This proved to be rather more difficult than I had hoped (impossible, in fact!). Not to be beaten, I thought I would try to create something and so, dear reader, you now know the extent of my own skills with watercolours. The painting is by no means a prize-winner (and done in a hurry, of course!) but I have tried to portray a Christmas-time working; the date must be late December, perhaps 1937, as the Pacific is in its original form, classified as A1, right hand drive and coupled to a coal rail tender. Having achieved greatness only three years earlier, it is today booked for a lowly rerailing job somewhere in the snowy East of England. On page 33 we have a report on the origins of its preservation.

I am grateful to Mr. Lane for his interest and Yvette, Stewart and I wish him, and all readers, much happiness for the rest of the Christmas Season and send everyone our very best wishes for the New Year.

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This well known supplier has moved to new and more suitable premises. They now have a ground floor site which allows them to have their warehouse and workshop in the same building, and which can accommodate larger traction engines and locomotives. Visitors to the new premises are strictly by appointment only but this simply means please ring up first and arrange a time that is convenient. If you are in the vicinity, do go along for a mug of tea and a chat. The new address is:

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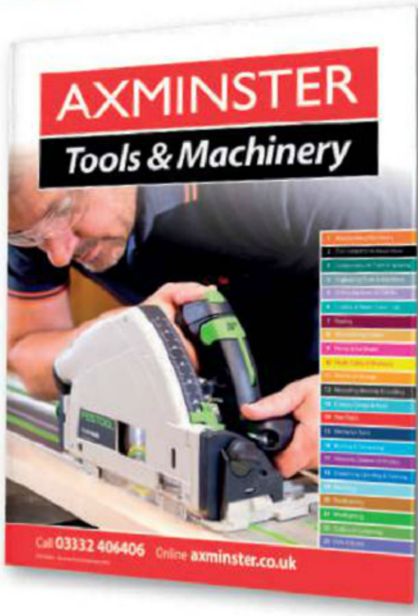

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MEET THE EDITORIAL TEAM

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Editor

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Norden

A Nineteenth Century Mill Engine to 1:12 Scale

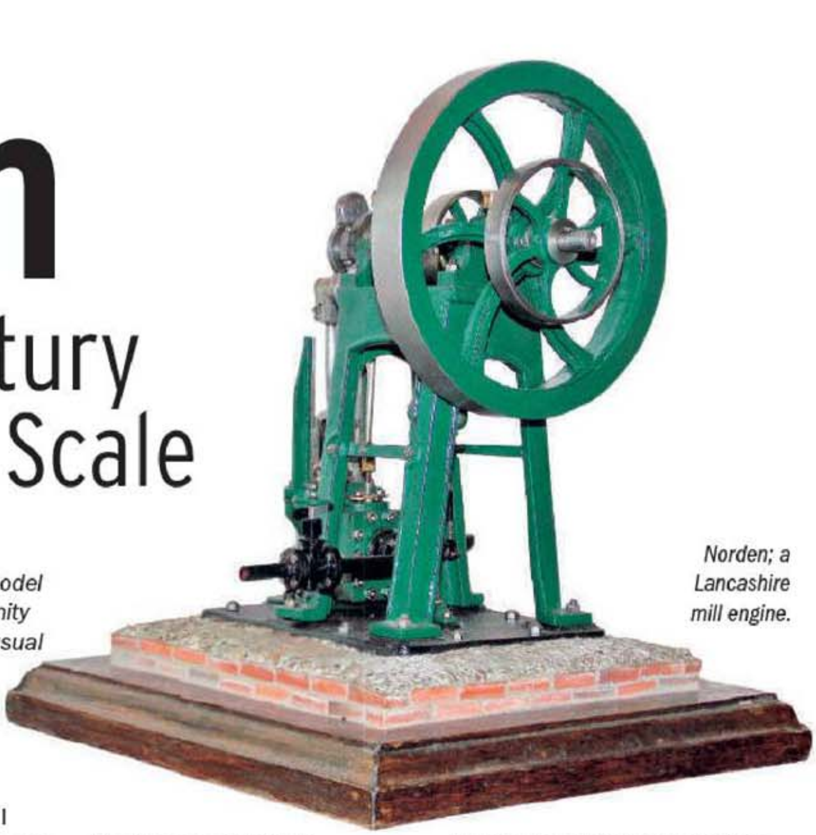
NEIL WYATT

Neil Wyatt completes his mill engine.

PART 11

Continued from 817 (M.E. 4470, 29 November 2013)

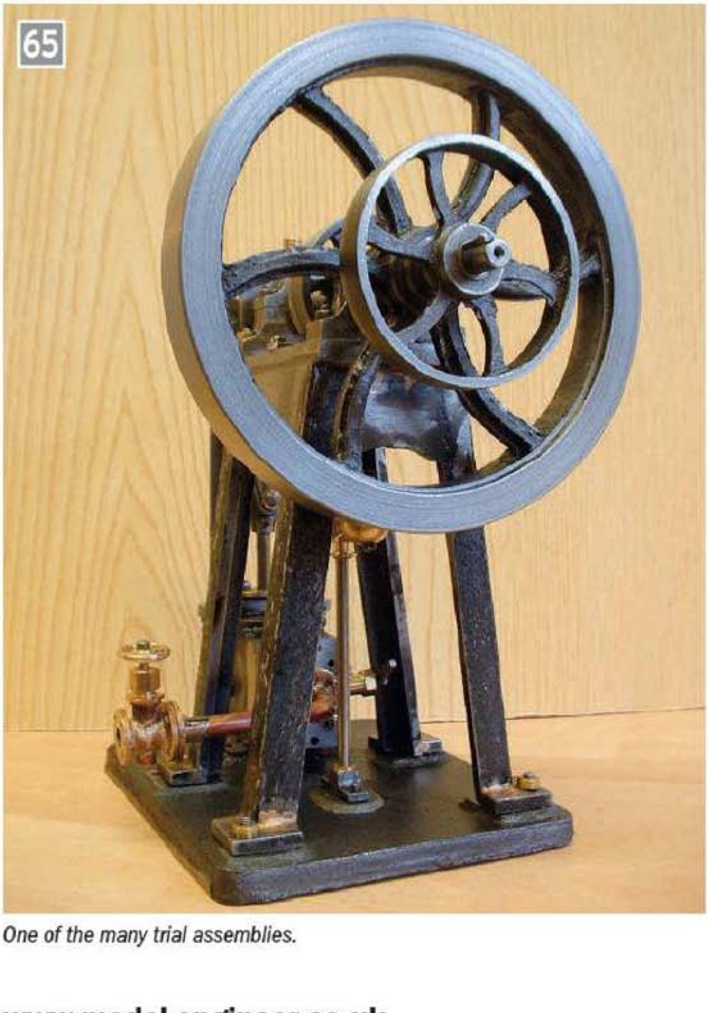
One of the attractions of model engineering is the opportunity to make a model of an unusual prototype, perhaps something that no-one has tackled before.



Norden; a Lancashire mill engine.

Finishing touches

Before painting the model I made many trial assemblies to make sure everything worked and fitted properly (**photo 65**). I won't go into great detail about how I painted the model. I used acrylic-based sprays, using a brown primer on the bare metal and finishing with deep green and black. These colours are modest and practical and well suited to a working engine. I made a small 'spray booth' from a cardboard box and tried to use many light coats (the table had over thirteen coats of green paint on it). The two biggest problems were how to spray parts all round in one go - I should have used some sort of turntable - and poor finish such as 'orange peel' or a matt finish. I understand that these problems may be caused by spraying either too close or in damp conditions respectively. The smallest parts, such as the governor were brush painted.



One of the many trial assemblies.

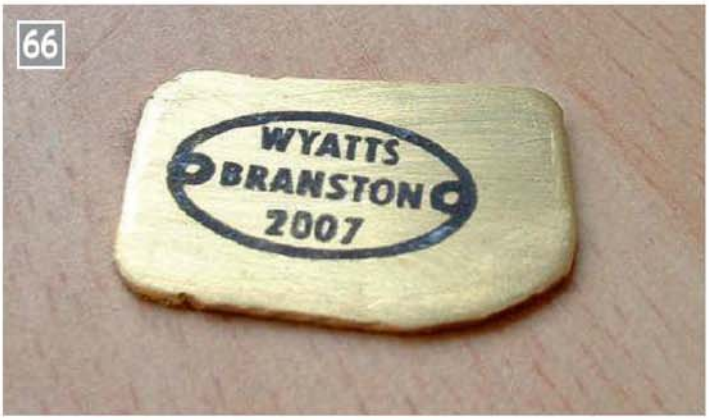
This is not a Gold Medal finish, though it may be better than that on the original engine! In many of the photos a layer of oil doesn't help show off the finish either, but I'm more interested in watching the wheels go round than watching the paint dry! Still I learned a few things and hopefully my painting skills are slowly improving.

Mr. Lees does not say anything about the makers of the engine, or their maker's plate, but as the maker of the model I claimed the right to mount my own plate on the engine.

Designs for the plate were produced in Corel Draw. A complex design with curved text was rejected as appearing too fussy, and three words in a simple ellipse were chosen to give maker's name, place and date. Two circles for mounting bosses were added just inside each end of the ellipse. The hardest task was choosing a suitable font; historically most plates used bold, tall sans-serif fonts. I don't recall which font I chose but it was about as simple and clean as you can get.

For printed circuits, I use photo-sensitive boards that are exposed to ultra-violet light using a positive mask. The resist is developed using sodium hydroxide. It is possible to obtain spray-on photo resist for making your own boards and this can be successfully used on brass. I have since had good results this way but at the time I did not have any spray-on photo-resist. Instead I followed another procedure that has been described in *M.E.* for making printed circuit boards.

This requires printing a mirror image version of the design on a laser printer – or photocopying a master copy. This is then ironed on to a piece of 16 gauge brass with a very hot iron. Though it sounds simple, this process took three attempts. Vital to success was the use of masking tape to stop the paper slipping. I pre-heated the brass, stuck down the paper, then left the iron (on 'linen' setting) in >>



The nameplates before etching.

place until the paper started to brown. Rather than peeling off the paper, I soaked it in water and gently rubbed it off to leave a positive area of 'resist' behind (**photo 66**).

The back, edges and unused areas of the brass were painted over and the plate etched in ferric chloride (as supplied for etching printed circuit boards). The solution was getting a little tired and it took over three hours to get a good depth of etch; fresh solution would have been a lot quicker. A little heat would have helped as well. After filing the plate to size the background was filled with black enamel. When dry the raised letters were polished clean and the plate drilled then lacquered.

I made two false 'rivets' by mounting 12BA hex screws in a mini-drill chuck and rounding the heads against an abrasive sheet. To fix the plate, these were glued into blind holes with cyanoacrylate.

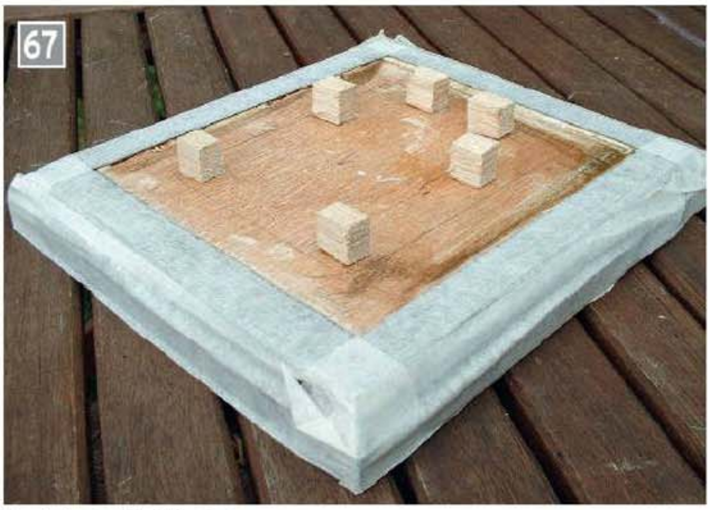
The bedplate of the original engine is, in its turn, 'bolted to a slab of concrete'. I decided to make a scale slab within a low retaining wall and mount this on a wooden base. The wooden base is similar to a picture frame, made from four pieces of beech. These were scavenged from old kitchen units and profiled using a router. The top was recessed to take a slightly inset rectangle of plywood. The beech looked rather 'contemporary' so I stained it a more antique looking dark oak with wood dye, then varnished it.

The (unstained and unvarnished) plywood was drilled for the six mounting 'studs' and rectangular plugs of balsa wood glued over the holes (**photo 67**). These prevented the 'concrete' blocking the holes. I then gave this central area a sizing coat of PVA (white glue). I was able to obtain a bag of fifty ¹⁄₁₂ scale frogged bricks; fortunately it actually contained 57 which was one more than I needed! These were the final stock of a long-standing *M.E.* advertiser but I have since discovered that similar bricks can be obtained over the internet. To buy the quantities needed for a decent sized construction is quite expensive. In the early 1990s Stan Bray described a way of making bricks from fireclay, though this appears a long, slow process. I have tried using Das clay with limited success. Has any *M.E.* reader discovered an economic and effective way to mass-produce miniature bricks? Some of the little handmade bricks had a ridge along one or more edges; these were removed by rubbing back and forth on a carbide grit file. This had some cost for my fingertips but worked well.

Now for the 'bricklaying' itself (**photo 68**). I first armed myself with some general information on the bricklayer's art. I used quick setting mortar, which has the additional advantage of having a very fine texture compared to traditional mortar. I put another coat of PVA down and laid the first layer of bricks while it was still wet. It was remarkably easy to put the bricks down with a very thin but regular layer of mortar (photo 68). My trowel was a thick, soft plastic picnic knife. I used the excess mortar to fill in much of the central void. A couple of hours later, the second course of bricks went down just as easily and I began to muse on building a whole engine-house of tiny bricks ... **Photograph 69** shows the finished two courses of brickwork.

Following through this exercise encouraged me to believe that even those bigger, more complex projects that I have pondered are achievable in time and convinced me that it is worth making an effort to make sure that even 'freelance' designs are proportional to full size.

The next day I drilled through the balsa plugs and trimmed them off level with the top of the bricks. I was now ready to fit the cast base in place. To make scale coarse concrete I needed some fine aggregate. I had bought a bag of aquarium gravel, but this scaled to pebbles of a couple of inches across. Chicken grit was the right size but was pure oyster shell and didn't look right. A third try was bird grit - a nice mixture of tiny fragments of flint, crushed shell and limestone, with a tiny proportion



Ready to start bricklaying.

Bricklaying in progress.

Finished brickwork.

of charcoal. Scaling as a coarse gravel, very much like the old, coarse concrete of many Victorian concrete buildings. One or two larger pieces of shell had to be picked off the surface by hand but the end result was absolutely perfect.

This mixture was used to top off the void in the brick rectangle and the base was carefully fixed in place with 6BA studs. Finally, a final skim of concrete was added around the edges to bed everything in place. Having laid the bricks, frog uppermost, there was also a good mechanical key for the edge of the concrete. Naturally a little attention with tissue and sponge was needed to tidy everything up.

A day later everything was set and dry but there was a white bloom of lime over the concrete. I lightly scrubbed this off with a kitchen 'scratchie' and when dry it had a more mellow colour. I'm looking at it as I write this and I must say that making the base has probably been as rewarding as making any of the moving parts (photo 69).

Running the engine

Setting the valves is always a critical task to get the best out of any steam engine, especially a small one like this. The first step is to adjust the length of the valve rod so that the valve travel is symmetrical, exposing the same amount of steam port at either end of its travel. This is easiest to do, albeit rather fiddly because of the small size, with the steam chest cover removed.

The next task is normally setting the angle of advance of the eccentric. If you refer back to the section on the crankshaft, you will see that, because of the unusual method of construction, instead of setting the eccentric I experimented with different positions of the crank, holding it in place with superglue. I suggest finding a position where the engine will run and just using this until it is run in. Once you are happy the engine is running freely, you can experiment to find the best crank position for smooth, slow running and then fix it in place as detailed earlier.

I found that it was necessary to put a reasonable amount of effort into setting up and running in the engine. The issue was the arrangement of the guide bars, which were very sensitive to any unevenness in their mounting faces, especially after painting the model. Any tendency to misalignment caused binding that was fatal to the slow running that this engine is suited to. It may be that a period of faster running in will help but if you do this it is a good idea to remove the governor, or restrain the balls from flying out so they don't hit the legs of the table.

The valve design for this engine is such that it will use minimal expansive working and it should be happy on either compressed air or low pressure 'wet' steam. Mine runs happily on just 1.4psi of air, or the slightest breath of steam. I have only run it for short periods on steam – just enough to prove the point. I put some steam oil in the steam line, most of which rapidly exited through the exhaust! For extended running a simple displacement lubricator would be ideal.

This is not an engine I would expect to be put to practical use, although powered by a few psi of steam I am sure it would happily run some scale overhead shafting and perhaps a selection of machine tools – such as the Stuart lathe and pillar drill. **Photograph 70** shows the finished engine on its engine bed and the nameplate fastened in position.

Conclusion

All in all, building Norden was a very rewarding task. I learnt that it is worth consigning things to the scrap box - even if they are machined correctly - if they don't look right. One side effect of this was that I found I had about 50% of the parts for a freelance horizontal mill engine, based on one at Abbey Pumping Station in Leicester, in my scrap box. Cylinder, steam chest and cover, piston and rod, eccentric …
I also have most parts for a governor – the Abbey engine has none. Following through this exercise encouraged me to believe that even those bigger, more complex projects that I have pondered are achievable in time. Finally, it has also taught me a few things about realism and convinced me that it is worth making an effort to make sure that even 'freelance' designs are proportional to full size.

I am a regular user of the *Model Engineer* website forums so if you have any questions or thoughts on this engine, please post them there. Even if you don't decide to follow suit, I hope you have found the story of Norden an interesting one, and agree that my model is a credible recreation of the engine Mr. Lees found 'rotting away' in a mill in Norden, near Rochdale. **ME**

The finished engine with nameplate.

A New Boiler for Bantam Cock

Paul Tompkins' updated design.

PART 18

Continued from page 636 (M.E. 4468, 1 November 2013)

This article forms part of the Bantam Cock construction series by LBSC but we have decided to replace that author's section covering making the boiler with this updated article by Paul Tompkins. The original text will resume in due course.

Ever since the very beginnings of this hobby of ours, no subject has caused more debate or, for want of a better word, 'controversy' than that of the miniature locomotive or traction engine boiler. Many hundreds of safe and efficient boilers have been manufactured in the home workshop, over many decades, by employing what are now seen as outdated methods and ideas. Unfortunately times have changed; we have now moved on to the point where current recommendations suggest many old designs of boiler are now, rightly or wrongly, obsolete.

Having met Steve Eaton and his Bantam Cock many years ago now, I instantly took a liking to, and had a huge respect for, both Steve and his superb locomotive. Being also the proprietor of a professional company engaged in the manufacture of copper boilers, I discussed with Steve the need for some updated locomotive boiler designs to meet current recommendations. Why not start with Bantam Cock?

The subject of boiler construction has often been discussed and written about in the past and I have no intention of going over old ground but intend to, hopefully, guide the prospective builder in the right direction with a few of my own findings gathered over time.

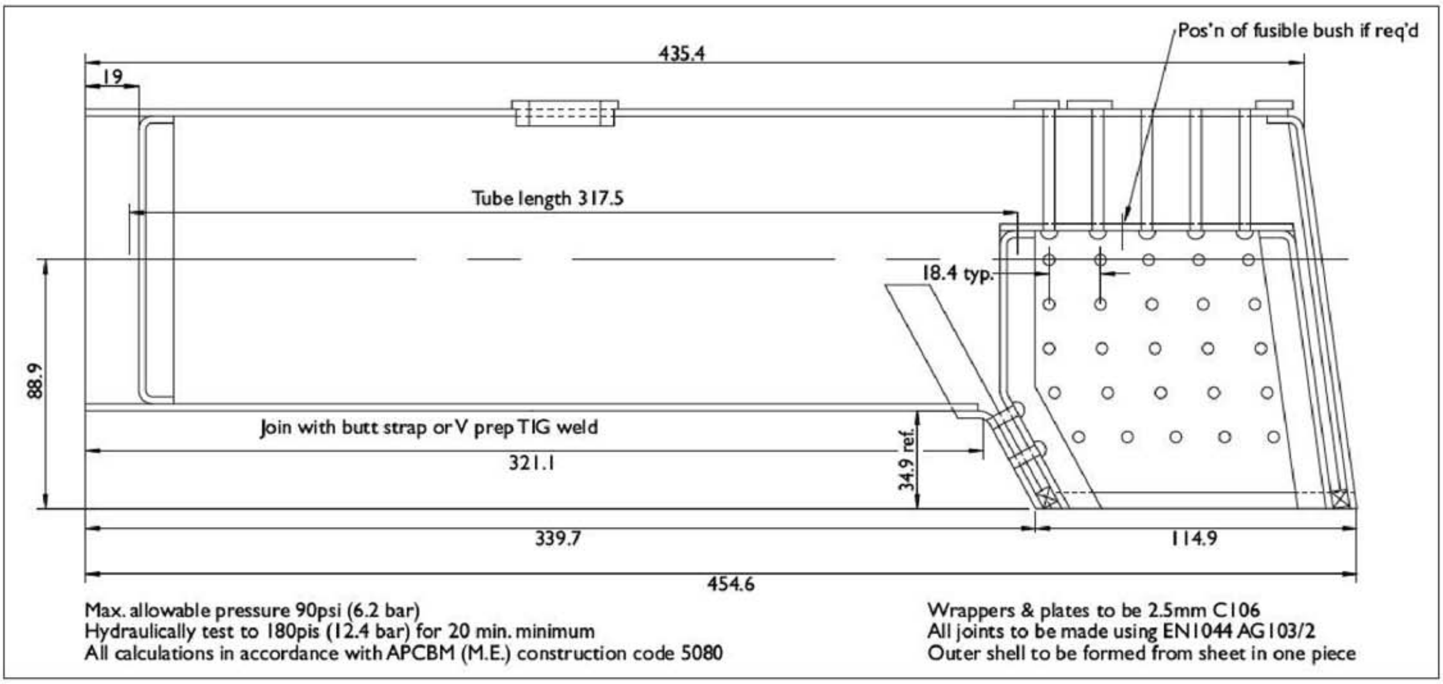
With and without combustion chamber

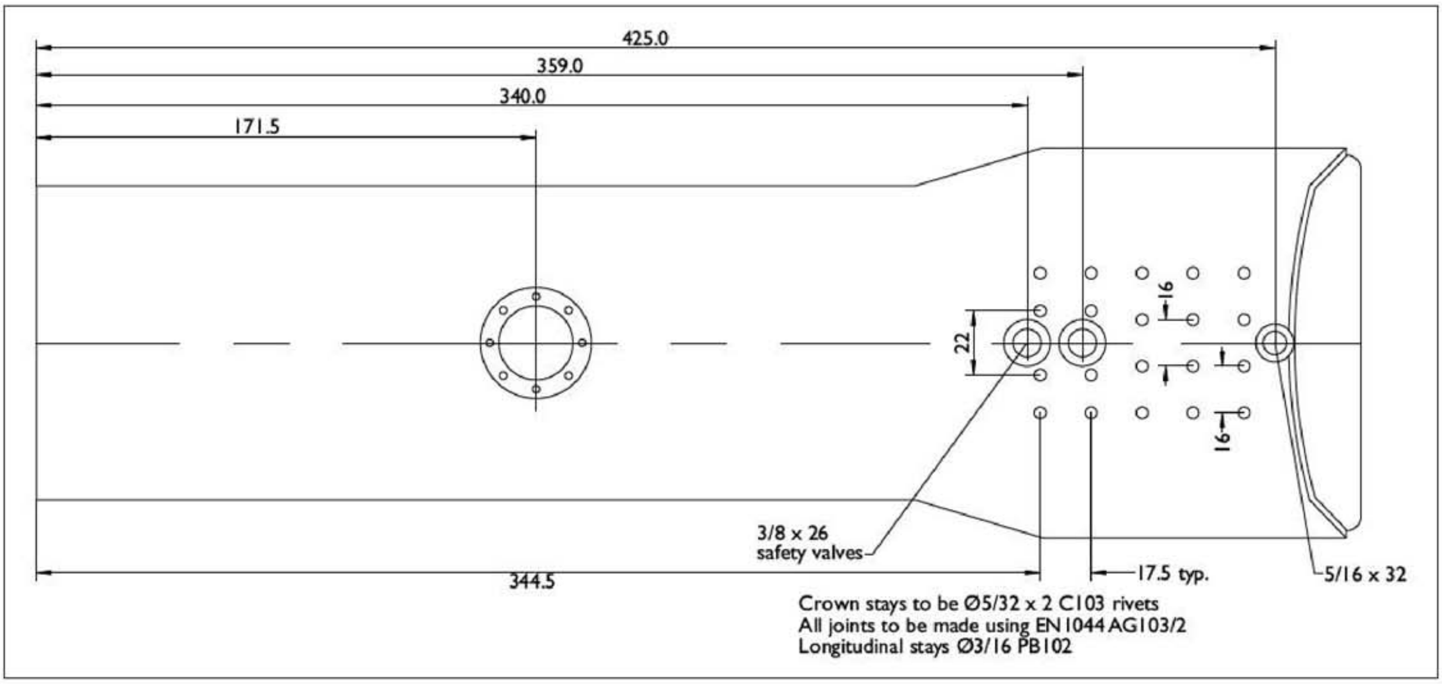
I intend to offer two designs of boiler; the first a simple boiler with no combustion chamber. This, I would imagine, will be the most popular of the two by some margin. The second will have a short combustion chamber with no cross tubes. This will involve more tooling and forming but less soldering in intricate places than the original combustion chamber. The entire boiler will be manufactured from the same thickness sheet, 2.5mm C106. This means a thicker barrel, firebox and plates. However, it may well be more economical to purchase one thickness of sheet than two of different thicknesses.

At a first glance the design will look very similar to the original with only a few changes as follows.

Solder

With the European Union ban on the sale of cadmium bearing silver solder, we now have no supply of 42% cadmium bearing solder. Our only choice is to go with a cadmium free option. The most common alternative to cadmium bearing solder is 55% AG103. I would also bring to the reader's attention 56% Ag102, which is slightly more expensive but carries less zinc. I would not advise step brazing - it is not





necessary and for the home workshop I believe makes the job harder. Yes, as you go joints will be melted; flux them and keep an eye out, even using this to your advantage as once it 'glistens' you should be at the right temperature for the next joint intended.

The outer shell

The outer shell is formed entirely from one piece; I have, in the past, manufactured other boilers with a separate barrel and outer wrapper which, on paper, may look easier but, in practice the piston ring is inside a relatively small diameter tube and awkward to get at. I have produced a pattern from which to cut the sheet that will form up the barrel and an outer wrapper in one piece. The 'legs' of the outer firebox will be slightly longer for trimming up afterwards. This file will be available on the Model Engineer website (www.model-engineer.co.uk). The file can be sent to any laser cutter you may wish to use; they may even cut a copper blank out, however readers might wish to clean a few thou off the edges. (I have also drawn profiles for the flanged plate formers. Steel is the best material for this by far.) If the sheet is correctly annealed - and re-annealed as and when required - I am sure the builder will find it a straightforward job. A Piece of 4 inch soil pipe or similar may come in handy. I manufacture all my round tops in this way, from 5 inch gauge B1s to the 7¼ inch gauge Romulus in 5mm thick material. The only joint to be secured will be the butt joint along the bottom of the barrel. I recommend a butt strap running from the throat up to ½ inch from the end of the barrel, at least 15mm wide. Use around six loose rivets to hold in place whilst soldering. I recommend the strap goes on the outside of the boiler. Alternatively some suppliers may TIG weld this for you.

Throatplate

Having formed the outer shell, I have now specified a double-flanged throatplate which requires a little more forming than usual, however there is far less chance of cracked joints as progress reaches the later stages.

Due to there being no combustion chamber the tubes >>

inevitably work out longer. With this in mind I have specified 7/16 inch x 20swg tubes.

Crown stays

I do recognise that many successful boilers have been (and still are) made, both in the home workshop and commercially, with girder type crown stays. However to my mind there can be no substitute for rod type crown stays using long C103 cold formed rivets. I have always used them and will always recommend them. The firebox stays are, like the wrappers and plates, thicker than the original. I believe this will make the silver soldering of the stays easier; thin sheet and tiny rivets are harder to keep at the right temperature. The shape of the firebox also allows them to be soldered using a propane burner.

Bushes

The bushes are a very important part of the boiler and I feel, in the past, may have been skipped over. I advocate (especially now we are using cadmium free solder) the use of PB102 *only* for bushes. It is the finest material for the job as it carries less risk of frying or over heating when soldering. The only slight disadvantage is it will be harder to drill and tap. So, for the small tapped holes, I recommend going metric; 'black ring' taps may be purchased which go through PB102 like a knife through butter. First drill the holes 2.1mm at a slower than normal drill speed and using plenty of water based coolant (not oil based). The dome, regulator and fire door bushes are all tapped blind in this one size. When installing the fittings A2 stainless cap head screws can be purchased at very reasonable cost.

The subject of boiler construction has often been discussed and written about in the past and I have no intention of going over old ground but intend to, hopefully, guide the prospective builder in the right direction with a few of my own findings gathered over time.

Assembly

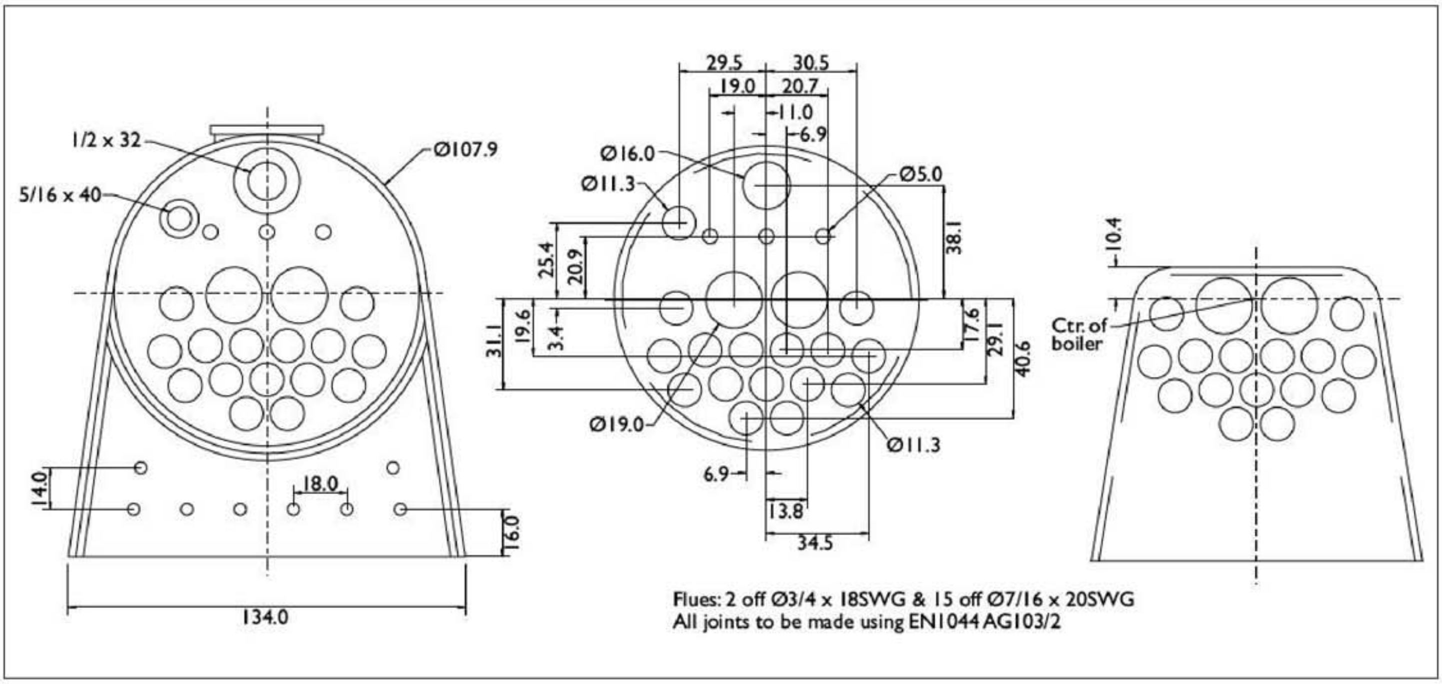
I would recommend order of assembly for the home workshop as described here. No joints should be tight - a nice rattle will help vital penetration which should be checked at each stage before moving on to the next. I also recommend the builder keeps 'trial fitting' at every stage to keep an eye on distortion. Before starting work, the builder should consult their club boiler inspector who may advise on construction and, importantly, at what stages he will need to visually examine progress.

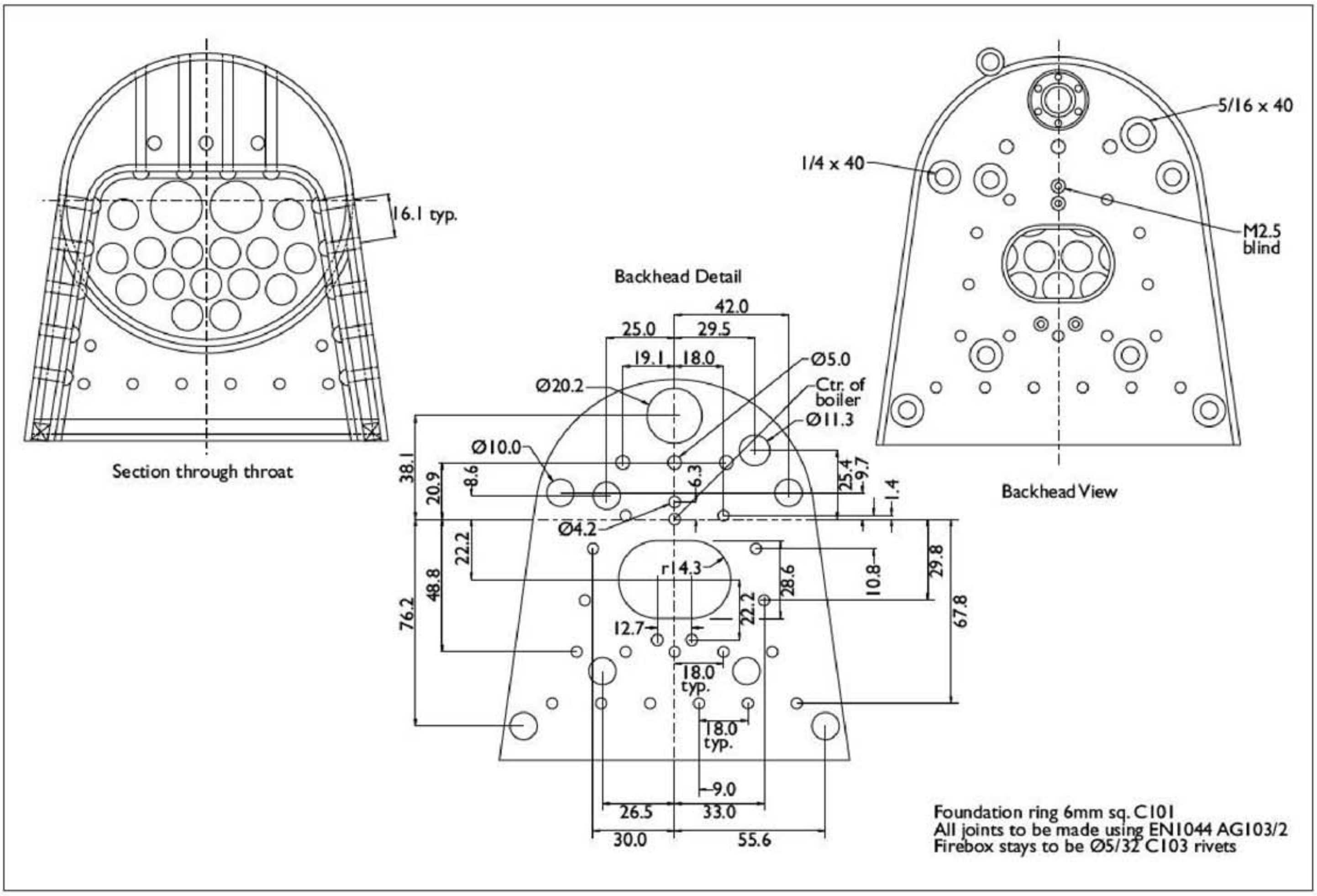
1. Solder the outer shell butt strap.
2. Solder the throat plate
3. Solder the dome, safety valve and manifold bushes
4. Solder the firebox tube plate and tube stack. Leave the rear door plate out for now.
5. Solder the front tube plate and bushes
6. Solder the foundation ring into the outer shell, front and each side.
7. Slide the firebox into the shell; spot through all stay holes, drill for clearance, remove and de-burr. Countersink the outside holes around 50% through the plate.
8. Slide the firebox back in and solder the foundation ring inner and outer crown stays.
9. Solder one side of the firebox stays and throat stays
10. Solder the other side inner and the outer side of the stays mentioned in the previous step.
11. Solder the remaining outside side stays and throat.
12. Position the rear door plate in the firebox, spot through from the backhead for the fire hole ring and stays.
13. Solder in the rear door plate and fire hole ring.
14. Solder the front tubes to the front tubeplate and the longitudinal stays.
15. Solder the bushes and the foundation ring into the backhead.
16. Solder the assembled backhead into the boiler.

A final note on testing

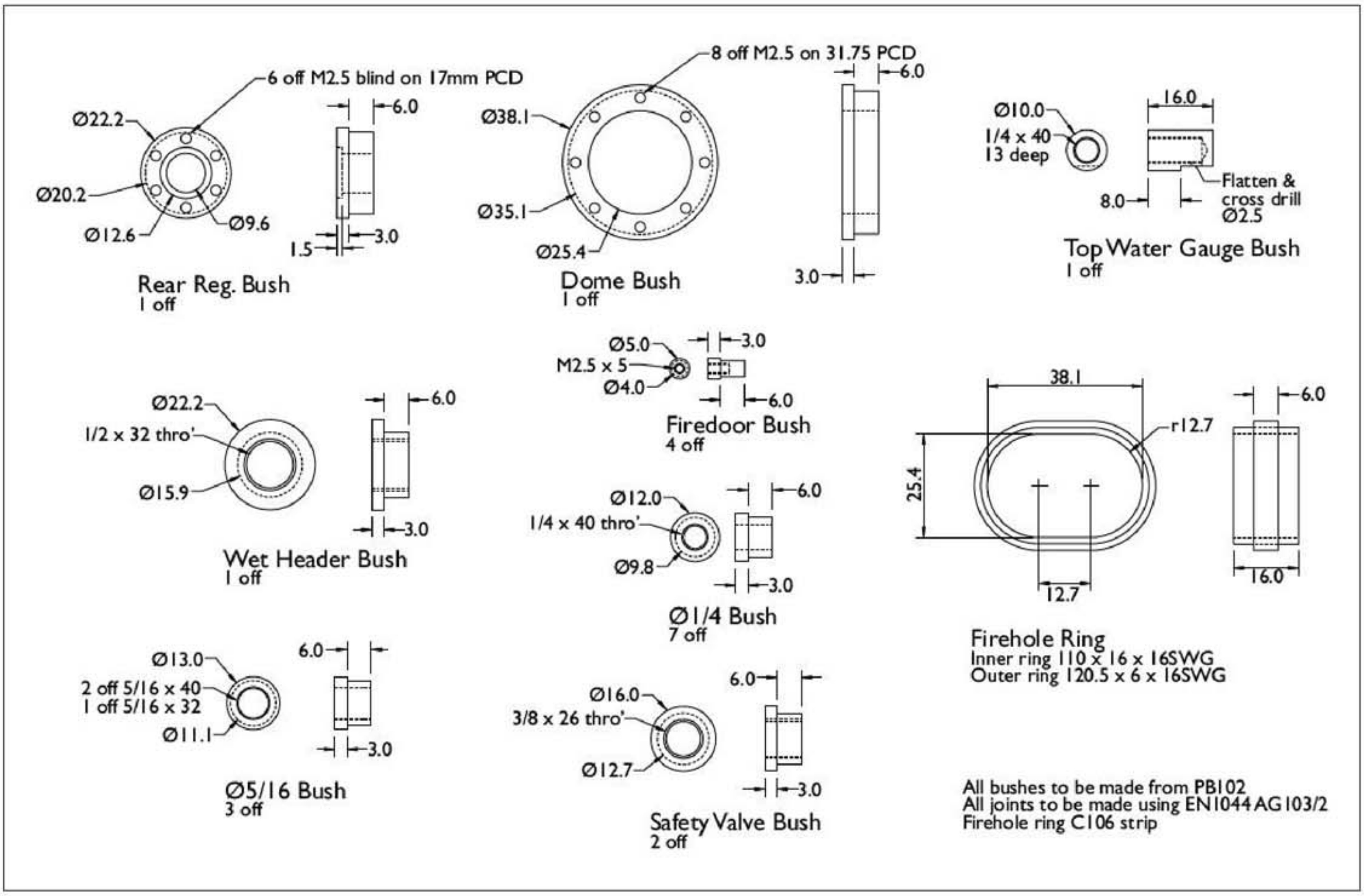
Leave the boiler stays long (so it looks like a porcupine) until a satisfactory test has been completed. Leave the boiler under test conditions while cutting the stays down carefully. Don't flush them off, leave them around 20 thou proud.

To be continued.





Foundation ring 6mm sq. C101
All joints to be made using EN1044 AG103/2
Firebox stays to be Ø5/32 C103 rivets



All bushes to be made from PB102
All joints to be made using EN1044 AG103/2
Firehole ring C106 strip

A Compound Condensing Marine Engine

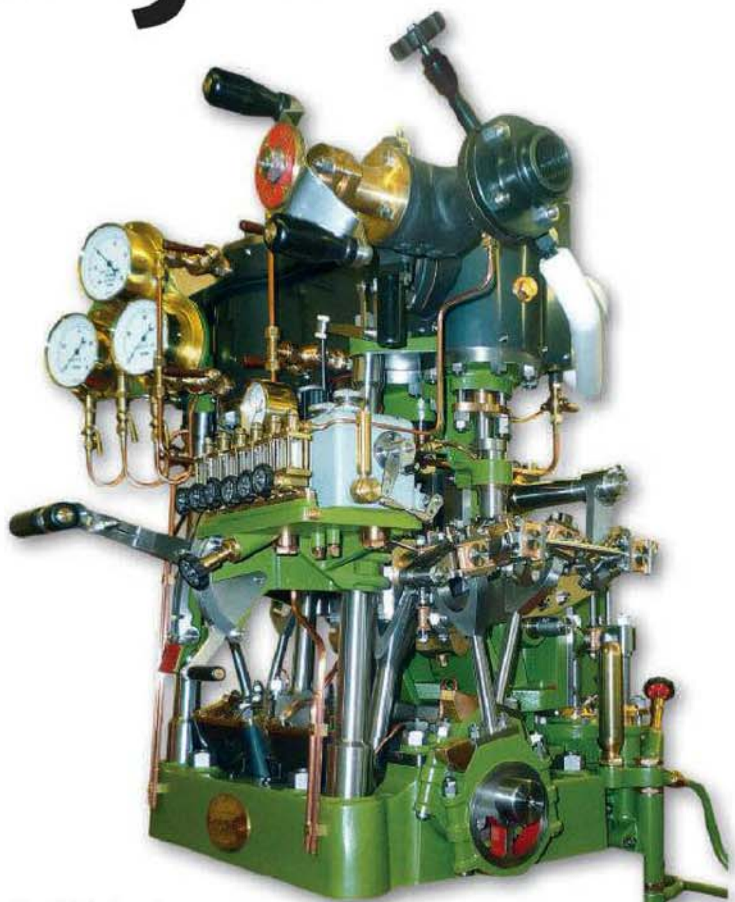
James Lauder makes the engine of his dreams.

PART 6

Continued from page 767 (M.E. 4470, 29 November 2013)

For the wearing face, the crossheads are fitted with cast iron shoes. These are machined with a sloping face to engage with a corresponding sloping face on the crosshead. An integral adjusting screw enables a fine adjustment to be made of the distance between the centreline of the piston rod and the wearing surface of the column. This is a critical point so it is nice to have the luxury of an adjustment. When all is correctly set, four small studs and nuts are tightened to secure the assembly.

The upper end of each rod is machined with ½ inch diameter parallel portion and ½ inch BSF thread to secure the piston. A ½ inch BSF stainless steel machine nut with ten castellations completes the assembly (**photos 77, 78** and **79**).



The finished engine.

Connecting rods

It is with a feeling of some alarm that I realise I can remember the days when Percival Marshall himself wrote Smoke Rings! His notes, observations and comments were always apt and interesting but one little piece stands out in my memory above all others. It was a short essay delivered under the heading The Connecting Rod. In it he singled out the one mechanical component, so familiar to all Model Engineers, that he felt was unique. I do not remember his exact words but his theme was that he felt it embodied more artistry in design and required a greater range of workshop skills in manufacture than most other components. I was impressed; I thought he had struck a very true note. Years later I found myself thinking long and hard about mine for the Leak compound.

Arthur's castings included an embryo pair in SG iron but, even after machining, they would still have been heavy and not really what I had in mind. Moreover given the likely working environment my policy was to use stainless material wherever possible. As for the type of rod, the choice depended on the sort of engine

Ready for the hacksaw!

Turning the rods.

Finished rods complete with shoes wrist-pins and castellated nuts. Note the shoe adjustment facility.

Finished connecting rods, big end caps and bearing shells.

I was building; indeed if I had any notional prototype in mind it was a relatively small high speed engine for a craft with a displacement measured in hundreds rather than thousands of tons.

My final design is shown in **photo 80** and is based on a type often chosen for smaller high speed engines for all purposes. Manufacture would have been by forging, machining and polishing. The top end is a Y-shaped fork to carry a fixed wrist pin, the rod which is round in section is extended down with a slight taper to carry an integral big end and matching cap. Two bolts with nuts and lock nuts secure the assembly with a pair of cast iron liners sandwiched between. The bearing itself consists of a pair of white metal lined brasses which are prevented from turning by a small inward extension of the liners.

Turning back to the top end details: most steam boat enthusiasts are familiar with the knocks noises and troubles that can, for one reason or another, afflict little end bearings. As described earlier the piston rod cross heads have split brasses and these are for wrist pin dimensions of ¾ inch diameter by 1½ inch bearing length. So I have both ample bearing area plus a ready means of taking up wear. A good start. That leaves lubrication and the means of securing the wrist pin to the top end of the rod. Dealing with the latter item first, I considered the options. I could use Loctite, but that would make assembly to the crosshead more difficult and removal of the pin for maintenance or renewal without damage impossible. I could use taper-pins; okay but fiddly and reliability doubtful. I could use pinch-bolts; properly fitted they would be ideal but they might look ugly and certainly would not be prototypical.

When I get a problem I take a bath and often the relaxation that comes with immersion in water leads to the solution of the problem! It did so in this case.

When I get a problem I take a bath and often the relaxation that comes with immersion in water leads to the solution of the problem! It did so in this case. First I considered a vertical split in the top of each eye and a transverse pinch-bolt. This looked awful and at TDC would have fouled the piston rod gland studs. Then I considered a horizontal split with vertical pinch-bolts. This looked much better, especially if the pinch-bolt pockets faced away from the front of the engine. I drew it out on my squared paper and more ideas came. I found the wrist pin eyes could easily be machined with a housing to accommodate an M5 socket cap screw with ample room above the head for a locking cap with a ⅜ inch x 40 thread. Moreover it dawned on me that dismantling or re-assembly of the wrist pins could be greatly assisted by the use of the locking caps as jacks to open the eyes and so greatly facilitate sliding the wrist pin. The technique is to remove both locking caps, loosen the pinch-bolts a turn or so, pop a small ball bearing into the hexagon socket head of each cap screw, replace the locking cap and tighten. As the cap contacts the ball bearing a further little twist has the effect of opening out the eye. In practice when this is done to both eyes, axial removal or insertion of a wrist pin is ridiculously easy. After use the ball bearings can be recovered with the aid of a magnet. So now the locking caps have two functions: the primary one being to lock the cap-head set screws during normal running and a secondary one being to aid axial removal or insertion of the wrist pin whenever necessary.

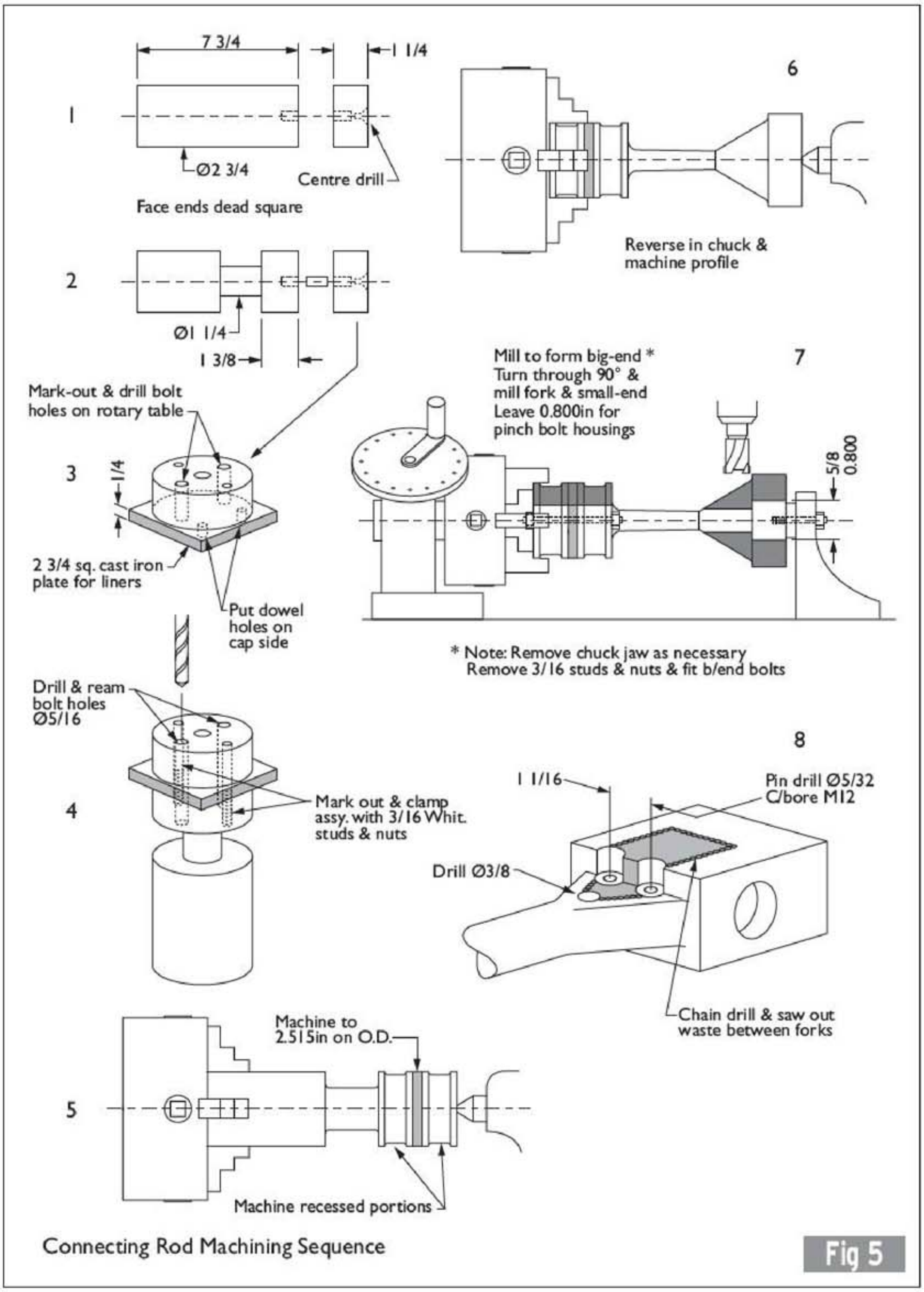
Lubrication

Now to lubrication. This is provided via drilled holes in both wrist pin (**photo 79**) and connecting rod. Oil from the pump enters the inner end of each wrist pin and thence to a cavity to lubricate the crosshead brasses. For the big end a hole in one branch of the fork leads to a long hole drilled down the centre of the rod to feed into the upper bearing shell. The end of each wrist pin is marked to ensure that the oil holes line up on re-assembly to the rods.

When design and details were finalised I set about drafting a machining sequence for production of the two rods from the 2¾ inch diameter bright stainless bar already purchased. A copy of this is shown at **fig 5** and explains the method more succinctly than can be done in writing. It contrives to machine each rod and matching big-end cap simultaneously by securing them with temporary studs and nuts for the preliminary turning, drilling and reaming operations, and replacing them at a later stage with their fitted big-end bolts for the milling and boring operations. The material for the liners was included in the 'sandwich' so that simultaneous machining left only a number-stamping operation to complete them also. All the turning was performed on the 'Cheap Imported' and the remainder of the work on the Deckel, including boring for big ends and wrist pins using a boring head in the vertical spindle. This was done at one setting to

Small-end pinch-bolt pocket.

Crank-case view of H and LP big-ends.



Connecting Rod Machining Sequence

Fig 5

ensure perfect axial alignment in both planes.

The whole scheme worked well and left only the final formation of the forked top-end and pinch-bolt pockets which was completed by a combination of bench-work and milling on the Deckel. Photograph 80 shows the finished rods, caps and white-metal lined brasses, **photo 81** is a close-up of a pinch bolt pocket, **photo 82** is a crank-case view of both big ends and **photo 83** shows oil grooves being cut in a top half bearing shell.

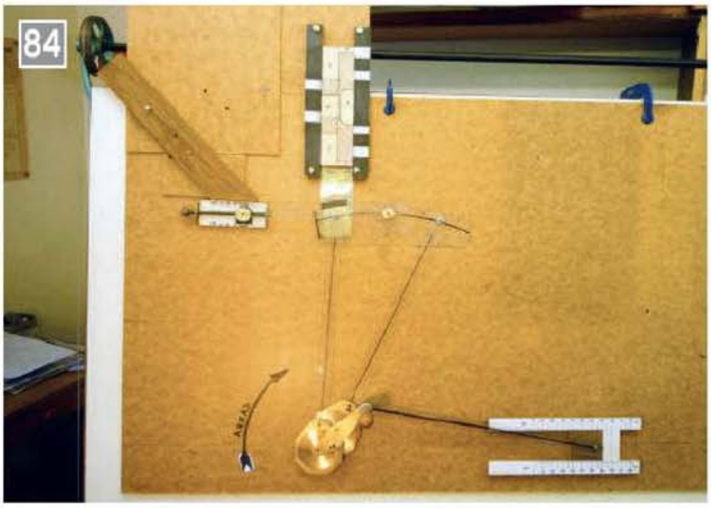
The whole scheme worked well and left only the final formation of the forked top-end and pinch-bolt pockets which was completed by a combination of bench-work and milling on the Deckel.

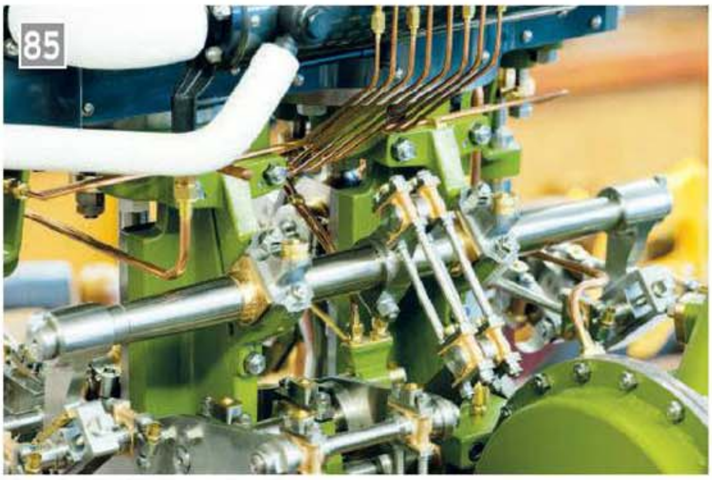
Valve gear and weighshaft

To prove the valve gear I made a twice full size working model fixed to a sheet of hardboard using mainly hardwood strips, Perspex and brass. Valves ports and piston were simulated with scales and marks on sliding blocks and brass eccentrics could be set for either HP or LP function. The assembly could be cranked by hand to move piston and valves in correct phase. Control of the expansion link position was by means of a hinged wooden lever, with a marine type cut-off adjuster attached to its lower end, coupled to the Perspex quadrant by a Perspex drag link. The cut-off adjuster carried a paper scale on which to record the cut-off percentages. The lever could be moved to the ahead or astern position to represent the weighshaft function (**photo 84**).

With everything arranged according to Arthur's design I produced a set of valve events


Cutting oil grooves in a top bearing shell.


Twice-size model of valve gear.


The weighshaft in its new location.
Note the cut-off adjusters keyed on at each end.


Eccentric straps and sheaves.


Top half of eccentric strap with oil box and syphon tube.


Eccentric sheaves studs and nuts.
Very proto-typical in appearance.

that seemed entirely reasonable. Thus reassured I recorded the cut-off percentages for both HP and LP on the adjuster scales and in due course engraved 'half-size' brass replicas to secure to the finished adjusters. Fixing holes for this were elongated to facilitate calibration on first valve setting. It was comforting to find that cut off positions tallied perfectly when I got to that stage. However the twice-size model did suggest a necessary change to the position of the weighshaft centre line and, after some trial and error, a position was found that minimised die block slip. Accordingly I produced patterns for two small iron castings to carry the shaft in split brasses in its new location on the backs of the engine columns (fig 1 and **photo 85**).

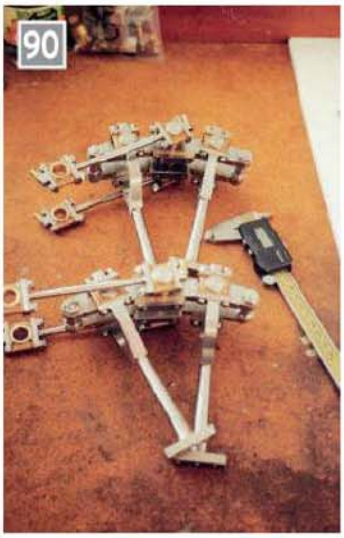
I discarded the gunmetal eccentric strap castings in favour of much lighter, more prototypical cast iron straps from my own patterns. The rejected ones were massive and became a useful source of raw material (fig 1 and **photos 86** and **87**).

Eccentric sheaves, also in cast iron, are split to embrace the crankshaft, their angular location being determined by keys at the appropriate angles. The two parts of each sheave are secured with studs and nuts in the traditional way. They do look very prototypical! (fig 1 and **photo 88**).

As with the connecting rods, the eccentric rods are machined from bright stainless bar and are formed with forks and palms at their upper ends to embrace the expansion link assembly (fig 1 and **photo 89**).

The expansion links are the 'double bar' type that eventually became almost universal for marine reciprocating engines. They were machined from gauge plate but left un-hardened (fig 1 and **photos 90** and **91**). >>

Rods, quadrant links, die-block and drag-links.



Both sets - lifted from their eccentrics. A floppy handful!

Looking straight at the HP end.

The cut-off adjusters were milled from a large chunk of stainless steel bar (goodness knows where I found it), as were the other levers on weighshaft and counter-shaft. All are keyed to their respective shafts; the keyways being cut using the slotting head that came with my Deckel. (Changing heads looks easy enough but no wonder I got a hernia!)

For the many small bearings in the valve gear, and also those for pump actuation, I thought split brasses were desirable. Accordingly I fabricated a brass pattern from which Messrs R. G. Heanes and Son of Sheffield produced thirty-six little lost wax castings – more than enough to produce the fifty six bearing halves required. Bolt-hole centres are common but bearing diameters vary according to duty. All have polished cast iron caps with oil pockets, wick tubes and brass covers (fig 1).

LP piston with lower cover in place and top cover removed.

Close-up to show large amount of material removed from outer ring. O-ring seals are also visible.

LP piston fully assembled with Clupet rings and lifting screws in position.

The finished receiver/re-heater. The inlet and outlet connections are now replaced with banjo unions.

Pistons and rings

Sheet 4 of Arthurs' drawings gives details of these, both in cast iron. The HP piston is shown as one solid piece and the LP as a two piece assembly with a small central cavity. I redesigned the LP piston to reduce weight even further. It now comprises an outer ring with top and bottom covers located by registers and a dowel; each cover being secured to the ring by eight stainless cap-head set screws. All three pieces are machined internally to remove as much surplus material as possible. As first made it weighed 1.70kg. After further judicious work it weighed 0.85kg. Special attention to sealing will, hopefully, prevent the accumulation of condensate within. Both pistons each carry two 'Clupet' rings, (**photos 92, 93** and **94**).

Receiver and condenser

Arthurs' receiver design is straightforward with a steam jacket around the pipe connecting the HP exhaust to the LP steam chest. He suggests feeding the steam jacket from a take-off valve in the steam line and passing it out to drive the condenser circulating pump. This re-heat plan is very sensible if full advantage is to be gained from compounding such a small engine but I have replaced the plain tube with a finned tube (Abacus Tubes Ltd., Huddersfield), to improve heat transfer and have provided a glass wool jacket round the whole assembly, held in place by Russian Iron (**photo 95** and fig 1).

●*To be continued.*

Problems of Combustion in Small Engines


GRAHAM ASTBURY

Graham Astbury explains the theory and practice.

PART 2

Continued from page 781 (M.E. 4470, 29 November 2013)

This article was prompted by two letters to postbag seeking the thoughts of readers on the problems encountered in running small internal combustion engines on propane. As no readers had replied, I thought that since I had worked on preventing combustion, I would try to explain how combustion occurs, particularly with respect to small internal combustion engines.

Ignition

The next point to consider is ignition. The most conventional system for ignition in an internal combustion engine is the spark plug, where an electric spark is passed between the two electrodes of the spark plug. For any flammable gas mixture, there is a minimum amount of energy required to initiate the combustion - the minimum ignition energy. For a typical propane-air mixture at atmospheric pressure, around the stoichiometric concentration, the minimum ignition energy is 0.2 millijoules (mJ). This is actually a quite small amount of energy and an electric spark of this energy cannot be felt by the human body. The minimum ignition energy increases with a reduction in pressure and decreases with a rise in temperature and pressure within certain limits. Also, the ignition energy increases as the mixture approaches the flammable limits and as the proportion of inert gas increases.

The moment the spark passes through the mixture and it is ignited, a small 'kernel' of flame is formed around the electrodes of the spark plug. This then develops into a spherical flame front, which then propagates through the mixture. There is a short delay between the forming of the kernel and the propagation of the flame front and this is known as the ignition delay. It is relatively short, typically less than a millisecond but as usual it is affected by the pressure, temperature and the proximity to the stoichiometric concentration - the nearer the flammable limits and the more inert gas in the mixture, the longer the delay. If the delay of a millisecond is thought trivial, at 5000 rpm, an engine rotates 30 degrees in a millisecond, which is why the timing of petrol engines advances as the speed rises.

> The flammable range of coal gas is almost 50% greater than that for propane and the quenching diameter is 30% smaller. Consequently, it can be seen that if the mixture produced by the carburettor is too lean or too rich, then propane will be the one that is more likely to be out of its flammable range than petrol or coal gas.

If the actual spark gap is now considered, a very small gap will require a much lower spark voltage to jump the gap but as the gap is small, the quenching effect of the electrodes is greater, so as usual in life, the spark gap is a compromise between low voltage and potential for quenching and good ignition but very good insulation being required for the high voltage. This is why a typical spark voltage is between 8 and 15 kV and a typical gap is between 0.5 and 1.0mm (0.020 to 0.040 inch).

There is another property that affects ignition - that of the autoignition temperature. This is basically the temperature at which a fuel will ignite, just because of its hot surroundings. However, the figures quoted in the literature should not be taken to be absolute. As with the flammability limits, the *autoignition temperature* of a vapour is dependent on several factors - the size of the apparatus, its cleanliness and the concentration of fuel in the atmosphere. Thus, quoted autoignition temperatures are comparative only. As an example, petrol, paraffin (kerosene) and diesel (gas oil) are quoted in **ref 6** as having autoignition temperatures of 456 degrees C, 210 degrees C and 338 degrees C respectively. The autoignition temperature is relevant later in the discussion of other types of engines.

Summarising combustion so far:

- All hydrocarbon fuels have a lower and upper flammable limit.
- All hydrocarbon fuels need a minimum concentration of oxygen to burn.
- Flames are quenched when passing down narrow tubes. >>

- The diameter at which a flame is quenched increases as the mixture deviates from stoichiometric concentration and the oxygen content decreases.
- Fuels need a minimum ignition energy to ignite.
- The energy required for ignition increases as the mixture deviates from stoichiometric and the oxygen content decreases.
- There is an ignition delay between the passing of the spark and the propagation of the flame.
- All fuels will spontaneously ignite above a certain temperature.

Internal combustion engines

So far, the information presented was about combustion in general. It is now time to apply this to the internal combustion engine and in particular the four stroke Otto or spark ignition engine. Taking a typical four stroke engine, the intake stroke pulls in a mixture of fuel and air and then on the upstroke, compresses it. I shall refer to all pressures as absolute, so that atmospheric pressure is considered to be the base case - and is equal to one atmosphere or about 14.7 psi or 760mm Hg or 1013 mbar. We can assume it is 1000 mbar, or 1 bara (as the abbreviation for bar absolute), for all practical purposes. The gas mixture is now compressed and the typical compression ratio would be about 8 to 1, so the pressure in the cylinder will rise to at least 8 bara. In fact, the pressure will rise more than this because as the gas is compressed quickly its temperature rises also (remember the bicycle pump getting hot when pumping up the tyres?), so a typical pressure might be about 10 bara. The spark now passes through the mixture and after the ignition delay of less than a millisecond, combustion develops and passes through the mixture, completing the combustion in a time typically of one to two milliseconds. These times are indicative only and depend on the engine speed, mixture, pressure, cylinder volume etc. The pressure now rises by a factor of 7 or so as the combustion is completed, so the cylinder pressure will now be about 70 bara. This pushes the piston down and the engine develops its power. This, however, really only applies if the engine is operated at full throttle. In practice, engines rarely operate at full power for long periods and typically operate at part throttle. At part throttle, the pressure at the intake valve is less than atmospheric, so may be only 0.5 bara or so. Therefore when compressed, it will only rise to 5 bara and on ignition, the pressure rises to about 35 bara - much lower than when at full power.

At the end of the power stroke, the exhaust valve opens and the gases pass out to atmosphere, assisted by the piston rising for the exhaust stoke. It would be thought that the exhaust would be expelled completely but as the clearance volume at the top of the cylinder is not swept, some exhaust gases remain. When the next cycle starts, this gas expands as the piston goes down, until the pressure in the cylinder reaches that of the intake manifold and in the example of part throttle, it was assumed to be 0.5 bara. At this point, the volume of gas in the cylinder has expanded to twice the clearance volume or at a compression ratio of 8:1, about ¼ of the cylinder. As the piston goes down, it now draws in the air/fuel mixture and the resulting mixture in the cylinder is now only 75% combustible mixture and 25% exhaust gas, which can be considered to be equivalent to nitrogen. This means that the oxygen concentration is not 21%, as would be thought, but only ¾ of this, or about 16% oxygen. This mixture now has the composition 3% propane, 72% air and 25% nitrogen and is indicated by the black dot in fig 1.

As the mixture now contains less than 21% oxygen, the ignition delay will increase, which is why car engines are fitted with a vacuum advance as well as centrifugal advance. In older carburettor cars with conventional coil, capacitor and contact breaker, the effect of timing delay is easily demonstrated by rotating the distributor backwards and forwards slightly whilst the engine is running at a fast idle - and the engine speed will change quite dramatically as the timing is altered. Cars fitted with engine management systems are more complex and tamper-proof, so fiddling with the timing is not possible but the same advance and retard of the spark is there but a more complex algorithm is used taking into account the engine speed, air intake temperature, manifold vacuum and the propensity for detonation of the mixture.

Application to smaller engines

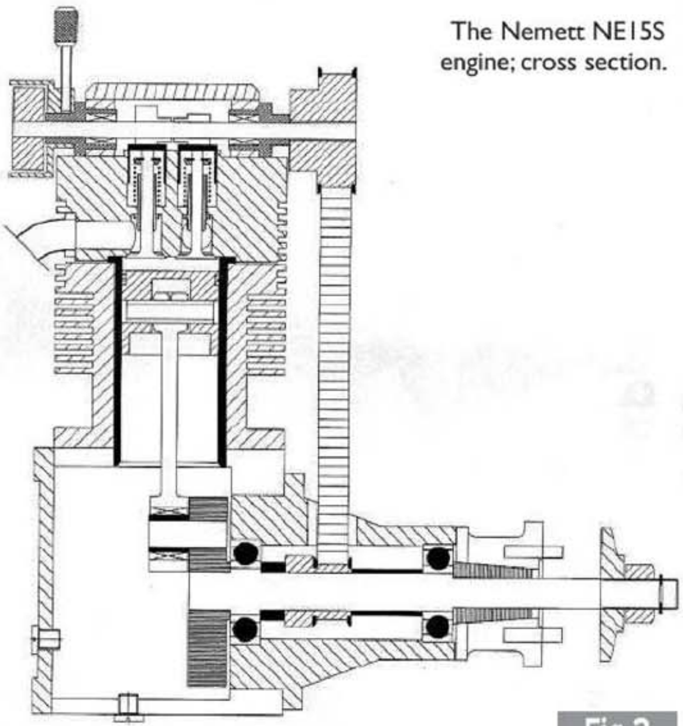
Turning to smaller, model engines and taking the example of Nemett's NE15S 15cc four stroke engine, the compression ratio for this engine is designed at 9 to 1. This engine specification is given in the *Model Engineer*, Issue 4271, Volume 196, page 438 (13th April 2006). With a bore of 25mm and a stroke of 30mm, the swept volume is actually 14.72 cc and the clearance in the head is ⅛ of the stroke (to give a compression ratio of 9:1), at about 4mm. This is designed to run as a spark ignition engine burning standard petrol (gasoline), or as a glowplug engine burning glow fuel, which typically consists of methanol, lubricating oil and nitromethane. A little more about glow-plug fuels and diesel fuel for small engines later.

Since the NE15S is designed to run on petrol, it will also run on propane. Three fuels are compared in **Table 1**, with data from ref 2, except that the quenching diameters are from **ref 7** and **8**. The quenching diameter of petrol is not given but in combustion terms, 2,2,3-trimethyl-pentane ('iso-octane') can be taken to be the main constituent in petrol, so the quenching diameter for this is quoted.

If the flammability characteristics of propane and petrol are compared, they are seen to be sufficiently close that modifications to the engine are not required at all. In James Wells' letter, he suggests that coal gas is 'very forgiving' as a fuel and comparing the characteristics with propane and petrol, it can be seen why this is the case. The flammable range of coal gas is almost 50% greater than that for propane and the quenching diameter is 30% smaller. Consequently, it can be seen that if the mixture produced by the carburettor is too lean or too rich, then propane will be the one that is more likely to be out of its flammable range than petrol or coal gas.

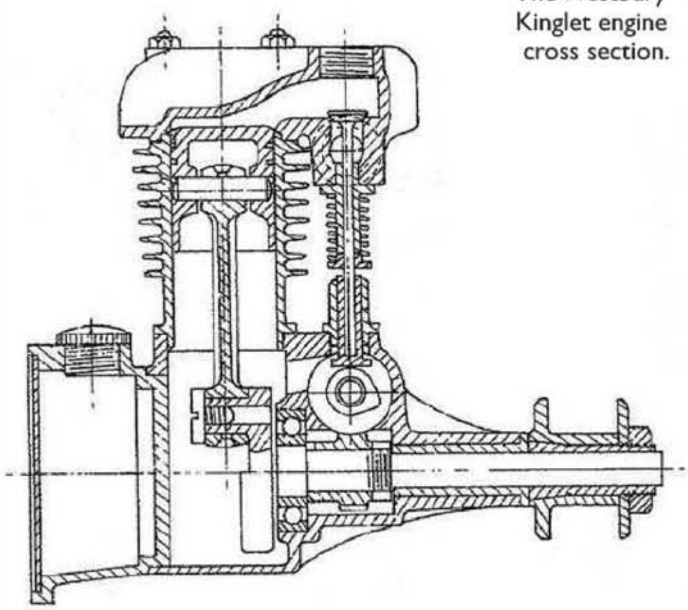
As a consequence of having a mixture which is drifting away from stoichiometric, not only will the ignition energy rise as it approaches the flammable limits or the minimum oxygen for combustion but also the quenching diameter will increase. Although the quenching diameter is small compared with the engine size, it can be seen from the cross-sectional drawing of the

Table 1	Propane	Petrol	Coal Gas
Lower flammable limit, % by volume	2.2 %	1.4 %	5.3 %
Upper flammable limit, % by volume	9.5 %	7.6 %	32.0 %
Ratio of upper limit to lower limit	4.3	5.4	6.0
Minimum oxygen for combustion, % by volume	11.4 %	11.6 %	11.5 %
Quenching diameter, mm, ref. 7	2.7	2.7	
Quenching diameter, mm, ref. 8	2.7		2.0



The Nemett NE15S engine; cross section.

Fig 2



The Westbury Kinglet engine cross section.

Fig 3

Nemett NE15S engine (**fig 2**) that at top dead centre, the distance between the piston crown and the cylinder head is a mere 4mm. Under stoichiometric conditions, the quenching diameter for propane decreases as the pressure increases but is logarithmic, so eventually, irrespective of the pressure, there is a minimum quenching *diameter*, which can be taken to be less than 2.0mm. If parallel plates are considered as would be the case with the gap between piston crown and cylinder head, then the quenching distance as opposed to quenching diameter, is only 65% of the quenching diameter (ref 8), so the minimum gap required between the piston crown and cylinder head reduces to only 2.0 x 0.65 = 1.3mm. Since the gap on Nemett's NE15S is greater than this, there is no reason to suspect that this engine will not run satisfactorily on propane, *providing that the mixture is correct*. If the mixture is too rich or too lean, then it is quite likely that the quenching distance will increase and the incorrect mixture will not burn properly. This is particularly likely on a demonstration engine that is idling, as the scavenging is not as thorough as it would be on full throttle, so the oxygen content of the mixture is depleted. It can be seen that an engine running on an almost closed throttle with an incorrect mixture will probably have a mixture where the quenching distance is greater than the piston to cylinder head clearance and the engine will either fire erratically or not fire at all.

Where an engine has side valves, the cylinder head is closer to the piston for the same compression ratio, as the valves have to be accommodated adjacent to the cylinder rather than above the piston, as can be seen in the cross-section of Edgar T. Westbury's design of the 'Kinglet' 5cc side valve engine, shown in section in **fig 3**. It can be seen that in order to obtain a suitable compression ratio, the piston crown to cylinder head distance is much reduced but even this 5cc engine is designed to run on petrol. Note that there is a depression in the cylinder head where the spark plug fits at the side immediately above the valves. As the spark is now in a pocket, the dimensions of which exceed the quenching distance, the engine will run as the flame will not be quenched by the piston crown being too close to the cylinder head at the point of where ignition is initiated. Had the spark plug been fitted to the head on the centre-line of the cylinder, then it is possible that the engine simply would not run on either petrol or propane, due to the flame being quenched before it propagates through the mixture. As designed, this engine should be capable of running on propane. This engine is a very good example of the designer knowing how the flame front travels through the mixture and the need to avoid the potential for quenching. Again, the possibility of running on propane relies on the carburetion being correct.

If the clearance between the cylinder head and the piston crown is reduced, this will increase the compression ratio and improve the scavenging but there is a potential that the clearance will become too small and hinder the flame propagating. Conversely, increasing the clearance reduces the compression ratio and will avoid flame quenching but will result in poorer scavenging and hence may well make it difficult for the engine to run with an almost closed throttle due to the lack of oxygen in the mixture. Hence there is probably nothing to be gained by adjusting the compression ratio from that which was designed initially, as it is a case of 'swings and roundabouts'.

To be continued.

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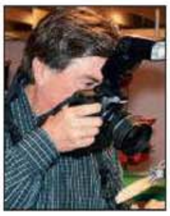
Proxxon 230 Mini Table Saw



ALEX
WHITTAKER

Alex Whittaker treats himself to a nifty new circular saw.

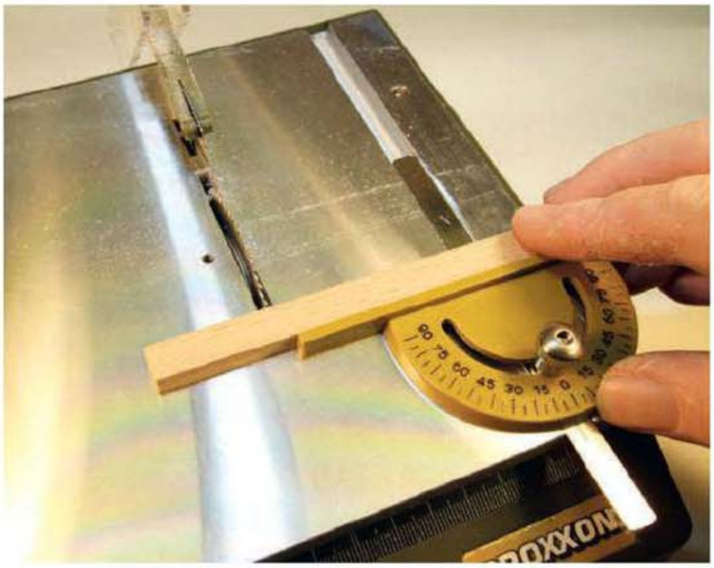
SPECIFICATION
- Power transmission by toothed belt in sturdy gearbox (ball bearings for rotating parts)
- Quiet VDE tested electric motor
- Milled tabletop plate, die-cast aluminium
- Lower housing made of ABS
- Slide-door on side for removing saw dust
- Toothed belt drive with 2-stage torque
- Dimensions: (L x W x H) 240 x 180 x 80mm

Capacity:
- Wood 8mm
- Plastic 3mm
- Non-Ferrous metals 1.5mm
- Table top: 160 x 160mm
- Operating voltage: 230 Volts / 50 Hz

Even though I am first and foremost a traditional aeromodeller and model steamboat fettler, over the years I have gradually transmogrified into a model engineer. This has come about by building my own glow, diesel, and marine steam engines. So, my home workshop now houses two lathes, a milling machine, a pedestal drill and a brazing hearth. All this in addition to numerous power tools such as a table jigsaw and a bandsaw. However, what I did not have was a small table saw for the precision cutting of wood, plastics, light alloy and brass sheet.

Now, I freely confess I am not a natural 'craft skills' bloke. Consequently, in my model engineering I have developed a number of 'workarounds' to minimise my output of skew-whiff models. My main weakness is in the basic areas of cutting and fitting ordinary balsa, plywood, spruce and beech, plus the cutting of thin copper, brass and aluminium sheet. In the past, for simple cross-cutting of wood, I have used a good quality razor saw and a metal mitre box. Now you would think that this would ensure a nice, neat, square end to the strip or sheet, would you

not? Well, I often manage to get even this simplest process wrong. My ragged cut-ends often need remediation in the form of sanding back 'to square'. Experience proves that this can shorten the workpiece more than somewhat. I have exactly the same issues when cutting thin sheet metals and tubes. When it comes to the really accurate cutting of such materials, I have largely given up on my manual skills. So, I started thinking about a small portable circular saw that would more or less automatically deliver precisely sqaure and neat cuts in the smaller sizes of my modelling materials.



Feature list

I drew up a list of features I required. My models mostly fall within the traditional range of 0.049 - 0.60 powered two-strokes 0.90 powered four-strokes and small steam engines for 3 or 4 foot launches. In addition, making up my own tools, fittings and fixtures often requires the use of a good saw. The hulls and fuselages of my models comprise mainly balsa wood and ply with some aluminium, grp, carbon, copper and brass in normal model shop sizes. Therefore my absolute requirements in terms of capacity were quite modest. It was the accuracy I desired. If I were building locos I would probably want something with bit more grunt, but for carriages, trams, boats, and wagons a smaller machine would be ideal. Given my lack of craft skills, I was looking for a handy bench-top machine that would cut my jobs without further preparation or sanding. The new machine would have to be compact and preferably mains powered. It would have to be versatile enough to cut plywood up to at least ¼ inch. The new saw would need a good secure fence. Also, I desired an adjustable mitre fence to cut wood at an angle. I was prepared to pay a bit more for a durable item. I was not looking to cut any serious metal - I have other ways of doing that, with my lathe, shears, and my milling machine. Nor was I bothered about cutting notches, grooves or slits, functions that some more advanced saws can offer. My milling machine and a few end cutters can usually achieve that for me.

Proxxon tools

In the end I could only find a handful of machine tools that seemed to approximate to my needs. Surprisingly, two very different table saws from the

Proxxon Company seemed to press all the right buttons. Initially, I was very interested in the Proxxon FET with its 22mm cut. This is bigger and more versatile than its little brother, the Proxxon 230, which has an 8mm cut. These two were around £350 and £120 respectively, so there was quite a gap in price and features. So, it took a few months of pulling faces and sucking my teeth at the cost, before I decided to bite the bullet and shell out £350 on the FET. Then three things happened. First, one of my auld modelling mates told me he had used the older version of the Proxxon 230 for yonks, and it was very good. He's a fussy chap, so I valued his opinion. Second, general family living costs seemed to take a steep hike, with competing demands being made on finite resources. Finally, utterly by chance, I saw a brand new Proxxon 230 for sale on a show stall for less than a hundred quid. A quick fondle indicated that this appeared to be a well-designed, well-made device. I particularly liked it handy size. I accepted that there might be compromises, such as an 8mm cut, but I took a punt. I shelled out for the little machine, and invested a further £19.30 for the spare metal-cutting blade.

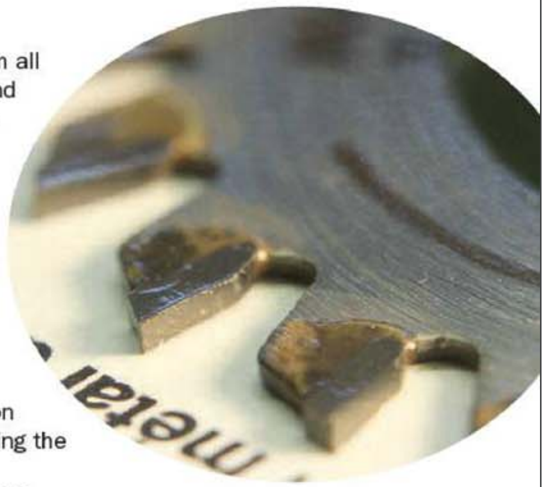
First look

First impressions were good. The little saw looks vaguely Teutonic in design - fit for purpose and lean and clean. (Check the spec chart below to see if it will fit your shed, and your modelling needs). The saw weighs more than it looks and its table is nicely milled from a solid billet of aluminium. The 230 should be screwed to a base of chipboard or ply, but I used it straight out of the box. There is a floating transparent safety guide over the blade and the slitting wedge. The machine comes with a fence and mitre attachment. The blade height is not adjustable like its bigger brother the FET, and of course, you have to live with an 8mm capacity. Access to remove sawdust and to change the blades is excellent, plus there is a supplied rubber take-off to mate to your vacuum cleaner for dust extraction. There are useful panel LEDS to indicate if you are working within the machine's compass or pushing it too hard. Proxxon market a full range of useful accessories, too. These add to the versatility of the basic design. I particularly liked the way the supplied orange handled Allen key (necessary both to unlock the access door to the blade and to remove the blade) cannot be lost since it has its own moulded-in niche in the side of the unit.

What did I cut?

I fed the Proxxon 230 balsa up to 8mm and it worked a treat. Being a savage, I tried my 10mm balsa stock too and it handles it easily. Cutting becomes great fun! Edges were square and true, and they came off the saw neat and un-torn like they'd been milled. Jobs were 'to-size' and ready to glue up into the model without further preparation. Truly, no finish-sanding required! I felt this fact alone made this base model worth the money. When I tried plywood, it was a similar tale, no rips or splinters, or ragged edges. Don't do this at home - and it is beyond the nominal capacity of the machine - but it ate all the plywood I threw at it to the depth of its blade, nowhere near overloading it. This delighted me. Providing the metal fence was checked for square with my 4 inch engineer's square, all my items came out square and true. I was soon really enjoying this mechanisation of my duff bench skills. Spruce steam engine and servo bearers (within the capacity of the machine) were cut very nicely indeed.

OK, I'll come clean: on test - and well above its stated capacity - the little saw wuffed its way through ½ inch spruce engine bearers too! No sign of strain or a glimmer of an overload light. Then I tried a killer test; would it strip down mahogany veneer planks for my new home-brew scale steamboat? It cut them all square and true. I found that if you jury-rigged a longer straight-edge to the fence, it made an excellent wood stripper too. As a bonus, (although expressly forbidden in the instructions) I found that it cut neat trenches, like a router, in thicker section spruce, without triggering the 'overload' light.



This is versatile stuff for a modest machine. I could immediately see the saving in accuracy, time, and effort, since the work came off the machine without the need for further fettling.

Metal cutting

I swapped to the more expensive metal-cutting saw and found that it worked beautifully on light-section brass, copper, and aluminium. Just right for model-sized stuff from the 'K&S Metal Stand' in the model shop. It cut my prototype fibreglass circuit boards with no fuss, too. So it passed these standard bench tests with flying colours. I felt it was especially nifty since it is so handy to use on the bench top. You could quickly get into the rhythm of using this saw instead of hand saws and mitre boxes. Suddenly, all my tabbed joints and formers just fitted!

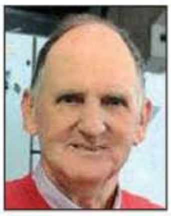
Things to consider

You have to decide whether you can live with a machine with a stated 8mm capacity, a modest table size and a fence that only extends about 70mm from the blade. I quickly decided I could. However, I did notice that, although conveniently placed, sometimes the mains switch could be inadvertently operated. The dust-extraction feature (to hook up to your existing superannuated domestic vacuum cleaner) works well. The fore-mentioned metal fence is better than it looks, though I routinely check it with a square. Of course, you can make bigger freehand cuts without the fence and, if mounted on a heavy ply base, you could devised outboard rollers or guides. The mitre attachment is plasticky but it worked satisfactorily with all my modelling sizes of materials. Metal would be better but that's just me being picky. I'm going to extend the fence for wood stripping and I have already devised a simple circle-cutting attachment for wheels and discs. The very handy milled-in slot in the table will be very useful for such simple adaptions. Finally, aforesaid sturdy aluminium table could be drilled and tapped to take jigs and guides of your own devising.

Conclusion

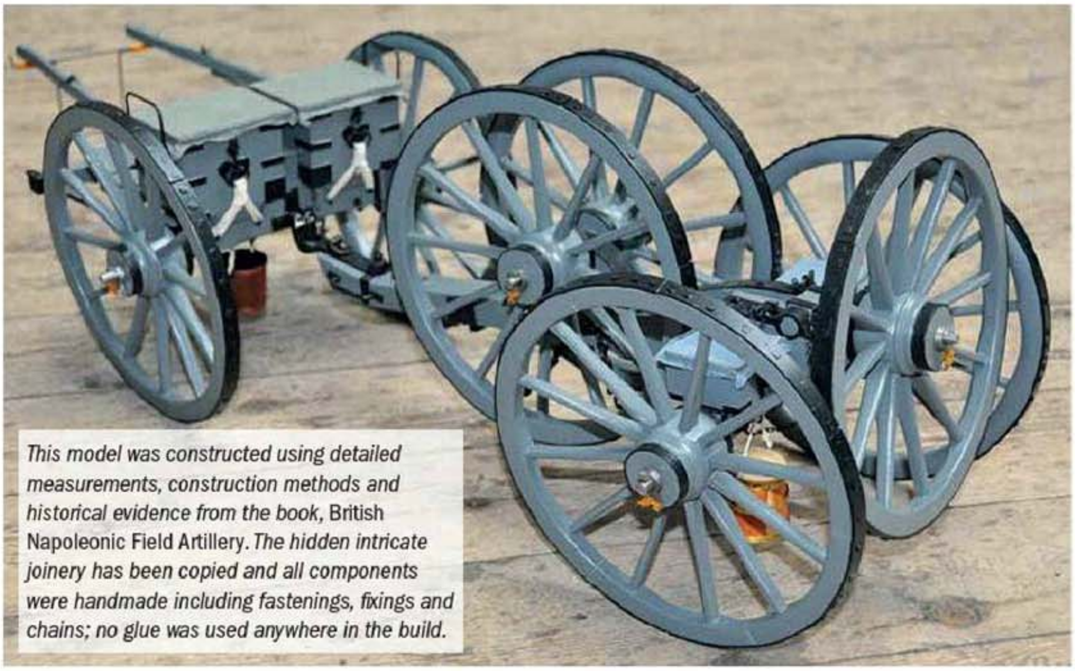
This saw is a bargain. The 230 is a very useful piece of workshop equipment. I found it could do more than promised. When you consider it is a mains powered device and you can get one for around a hundred quid, it's worth a very close look. I got my money's worth. In fact, I was delighted with its overall performance and especially pleased with the uses of the more expensive metal-cutting blade. It even cuts light, non-ferrous metals and printed circuit boards very capably. It is a joy to operate and it feels a sound, well made product. The noise is not unpleasant, either. It seems a very refined machine, probably due to the quiet belt drive gearbox. It really is great fun to operate. If however, you demand a more butch machine, then the cheaper, full-size table-saws from Machine Mart et al, might be your first port of call but you may not get the accuracy. **ME**

Axles and axle arms
for Model Horsedrawn Vehicles



JOHN CASTLE

John Castle explains his own technique.



This model was constructed using detailed measurements, construction methods and historical evidence from the book, British Napoleonic Field Artillery. *The hidden intricate joinery has been copied and all components were handmade including fastenings, fixings and chains; no glue was used anywhere in the build.*

I am a model wheelwright and for most of my adult life I made models of some sort. In 1975, however, I discovered model horsedrawn vehicles and have made little else ever since.

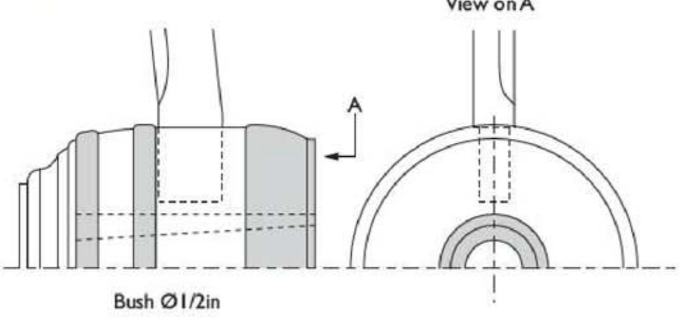
Very early on I decided that at the scale I choose to work in (⅛th) I could copy the construction methods of the original builders and my models would incorporate all the original joinery and fastenings, wood or metal of the originals. This includes my wheels, which are properly wrighted, needing only a slight modification in the jointing of spokes to nave. Unless I make a mistake when making a wooden part - which I will then repair - I do not use glue in any of the joinery. The dowels, pegs, coach bolts with square nuts and, of course, nails give the model its strength.

My main interest in the hobby is farm carts and waggons. Every county, from Yorkshire south, has its own distinctive variation so there is plenty of subject matter to choose from.

There are some common features, however; no matter whether the vehicle had an all wooden axle, an iron axle or axle arms let into a wooden axle bed, a common characteristic was that the axle arm was tapered from the shoulder out to the end, and that the outer end of the axle arms was canted downwards by several degrees. I developed a method of off-centre turning all wooden axles on the woodworking lathe but as I had no metal turning facilities until about twelve years ago, I had initially to rely on the tool rooms of various companies I worked for or model engineers I was acquainted with to turn axles/axle arms for me. I had to make do with axles or axle arms that were made from square section bar, taper turned at the end to the scale length and I then had to give the arm its downward cant by bending; not particularly satisfactory but I did not have an alternative.

In order to save weight the original builders would have a considerable amount of metal removed from the axle where it was attached to the axle bed or, in the case of axle arms, the part which was buried in the bed would be tapered; in some cases the taper would be fairly straight, in others there would be a considerable downward

Fig 1



sweep. Most of the time this feature would not be seen but I find it satisfying to copy full size practice in the knowledge that I had followed best practice. The following is my method of replicating the original parts.

Axle arms

For the axle arms, in a departure from the original I do not incorporate steel (iron) boxes (bearings) in my models as on the original wheels. Whilst doing so would be perfectly possible it is a little impractical as I have to keep my models in a store in my garden. In this situation, of course, condensation becomes a problem, causing rust so, in their place I use a simple brass bearing made from an appropriately sized brass rod. I cut a length of rod a little longer than needed to suit the bore of the nave being made, then, in the lathe, turn off the ends to finished length. With a centre bit in the tail stock I make a start for the drill. The drill size will be marginally less than the diameter of the outer end of the axle. The drill is passed all the way through the rod and next I change the drill for a tapered reamer. I picked one many years ago; probably for taper pins, its taper very nearly coincides with the taper of the originals and it has a cutting helix. This will be inserted into the pre-bored hole, which is then opened up until the larger diameter equals the size (picked off the plan being worked to) of the visible width of the arm. These parts did vary as some were as small as 2 inches wide and went up to 3 inches. As a rule I will make all the bushes in one go. They are needed for the next stage, which is to turn the axle arms. They will be used as setting pieces (**fig 1**).

For the axle arms, I use rectangular steel bar stock. The size will vary depending on the project but a good standard would be ¼ x ⅜ inch or ¼ by ½ inch, depending on the amount of cant. The first operation is to mill a length equal to the length of the circular tapered arm down to ¼ inch square. This is done to one side so that there is one straight side to the piece and a stepped down section on the other (**fig 2**). The total length of the work piece should be a little longer than necessary to allow for adjustment to fit; again the axle arm blanks will all be milled as a batch. Perhaps it's worth mentioning here that it was not necessary for the original builders to work to fine tolerances. Provided the wheels rotated freely and there was not going to be undue wear, then they would do the job. Wheels on carts and waggons do move a little along the axle arms, which is the reason for incorporating a taper. There was a shoulder at the inner end of the arm but the wheel would run up along the taper. For this reason there is no need for super accuracy in making the model parts; provided the wheels turn freely and with a little sideways movement, then that is all that is required.

Next we move back to the lathe, which must be equipped with a top slide to be able to turn the taper. The three jaw chuck is changed for a four jaw independent which we will use to hold the rectangular bar, off-centred so that the square section at the end is as near as possible running true. The lathe I have has a 100mm chuck so there is plenty of space through the headstock to accommodate this, the lathe (Chinese) has a cast compass which I find is not as precise as it could be so I tend not to rely on it, but set the tool off. By use of the tapered reamer held in the tailstock, simply rotate the tool holder until it is as near as possible parallel to the edge of the tool. I make finer adjustment as I start the turning.

Now, taking fine cuts, the only movement of the tool will be along the top slide. There will be none at all longitudinally or transversely. When I have formed a short, cylindrical taper on the end I will pick up one of the pre-prepared bushes and use it as a setting piece. First check along the four faces of the turned item (there will be a long, curved arc which, if the set-up was spot on, would all be equal. If they are not then check where corrections are to be made and move the part in the chuck taking a few more light cuts until they are and the turning will be concentric).

Now, check the taper. By now the work piece should be sufficiently turned that we can part slide the bush over the end; if the end of the bush meets the taper and there is sideways movement then the taper is too steep. If the bush slides loosely up the taper and there is sideways movement then the taper is not steep enough (**fig 3**); reset the tool holder and after a few more light cuts, try again until there is nice contact along the arm. Continue turning until there is a nice ¼ inch circular section at the inner end of the arm and the bush will slide right on and sit nicely against the shoulder with no undue movement.

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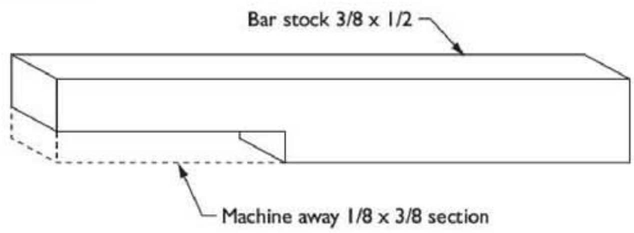
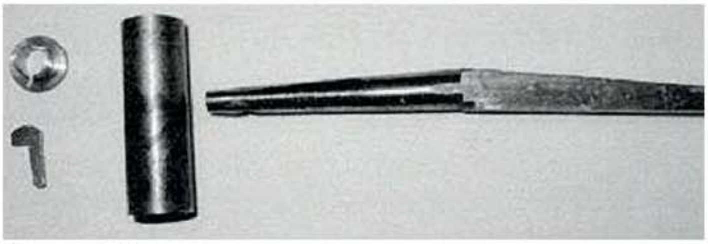
Fig 2





Components for an axle arm assembly.

An assembled axle arm.

Fig 3

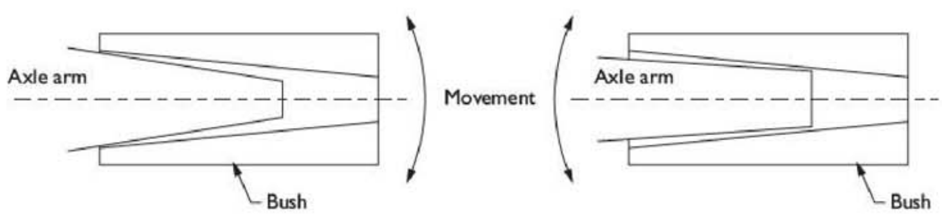


Fig 4

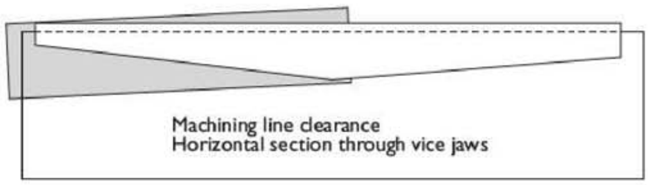


Fig 5

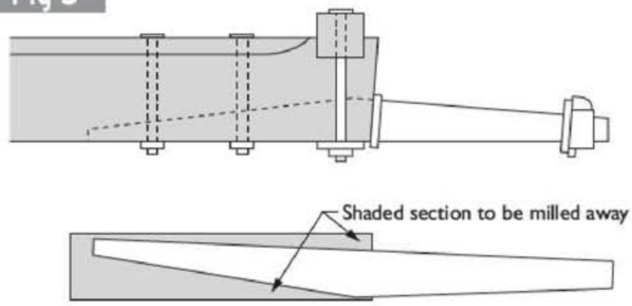
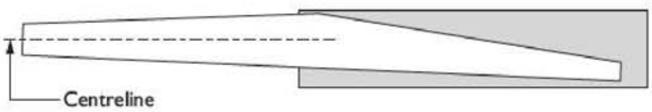
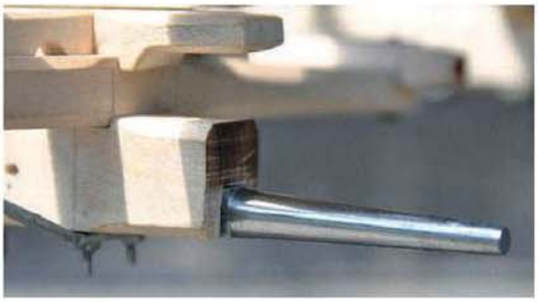


Fig 6





An axle arm mounted in an axle bed showing a downward cant.

The next operation is to create the downward angle of the axle arm and the reason for the off-set milling will become obvious here. There were no hard and fast rules for the amount that the axles were set down, indeed the angle would vary from county to county and even between builders in the same area. For some the angle would be very small, such that the bottom edge of the turned portion of the axle arm would run level with the part mortised into the wooden axle bed. Other areas opted for a larger angle which, because the top of the wheel was thrown away from the cart/waggon body, would allow for a wider body with a greater load carrying capacity.

For the first of these types all that is required is to up-end the axle arm in the milling vice and, using the turned portion as a setting guide, mill away the rectangular section until a flush edge is achieved (**fig 4**). For the second type it will be necessary to refer to the drawing and mark out the steeper angle. My chosen option - to ensure the angles are all the same - is to make a simple wooden jig in the form of a triangular block of wood, slightly less in thickness than the axle but with an angle determined from the plan. The work piece will sit on this in the vice rather than on parallels, but then the back end of the arm will be milled away until the flat portion matches up with the inner end of the turned axle arm - but no deeper.

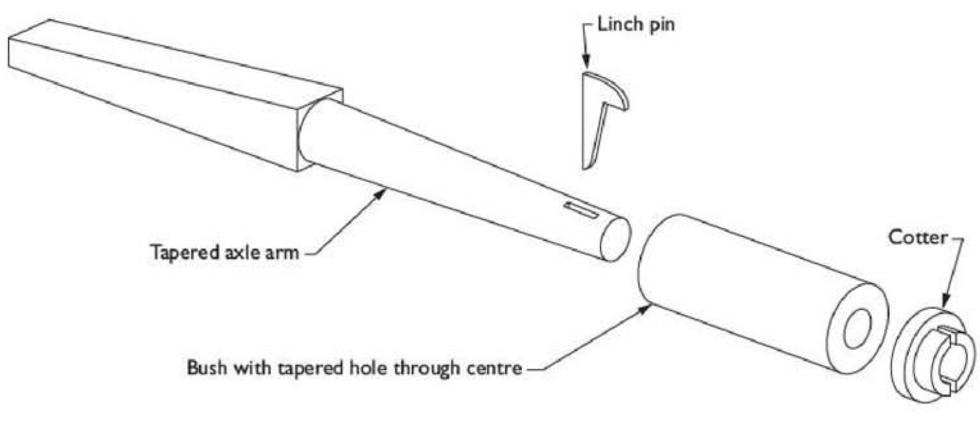
The only remaining job to do is to lose weight and that is done by milling away some of the portion of the axle which will be hidden in the wooden bed. Again no dimensions will be given (**figs 5** and **6**). I opt for a depth of approximately ⅛ inch at the inner end of the arm, which is arranged in the vice so that a straight edge between this and the inner turned diameter is parallel to the edge of the vice jaw, and the upended triangular portion is milled away.

After this all that needs to be done is mill the entire arm to finished length and to drill any holes needed for retaining bolts. Through axles are a little different in that they are made from square section bar. This is cut to length for the entire axle and a section is marked off at each end for the turned portion. The axle can be held in a four jaw chuck or, if the section is not too big, then in a split bush held in a three jaw chuck. The taper is turned at each end exactly as described earlier. To achieve the downward angle of the arm, a cut is made with a hacksaw, very close, just inboard of the maximum turned diameter at each end. This needs to be very nearly right through. Depending on the angle required it may be necessary to open these cuts slightly with a Swiss file because we need to bend the axle arm down to the required angle, closing up the cut. It will probably be found that the cut is still rather open; if it is then rummage through the scrap box and find something that is thin enough to fit but thick enough to fill most of the space, clean all faces up then flux them well and fill the joint with silver solder. Make sure the joint is well flooded so that it will be possible to file off any excess and leave nice, flush surfaces which, when painted, will be invisible.

All that is needed now is to mill the portion of the axle between the shoulders to whatever profile the plan calls for.

ME

Fig 7



4472 and The Gresley Society

DIANE CARNEY
Editor

Diane Carney writes about one of the very first attempts at preservation.

On the cover of this issue we have a picture of the most famous locomotive of them all, LNER Pacific, Flying Scotsman. *It was decided that the significance of this issue being number 4472 could not be allowed to pass without making the connection so I thought I would take a brief look back at the beginnings of the preservation of this celebrated locomotive.*

The image shows a leaflet that was issued in 1961 by The Gresley A3 Preservation Society, a group based in Edinburgh and which included members of the Edinburgh SME, namely Ramsay Ferguson and Douglas Spence amongst others who collectively tried to save 4472 from the 'scrapheap'. They were a small band of enthusiasts, probably unique at that time, that appreciated the significance of this record breaking locomotive - the first to be painted in LNER Green - and did their utmost to raise the £3000 needed to pay the scrap value and 'save her for permanent display'. Unfortunately they were not successful in their attempts. In 1963 Alan Pegler, a wealthy business man, purchased the locomotive outright, thereby preserving her for the future. The rest of that story, as they say, is history. Much has been written about the aborted tour of the US and the later actions of Bill McAlpine who stepped in to pay for the return of the locomotive, affording it a hairsbreadth escape from scrapping once again.

So, what became of the original Gresley A3 Preservation Society? Well, the fundraising had been started in November 1961 and continued until early 1963 - when the locomotive was purchased by Alan Pegler - at which point there was £980 in the account. The group was then renamed The Gresley Society. All those who had contributed to the fund received a letter offering them the option of having their money returned. Many, however, chose to leave it where it was and subscribed to the Society's efforts to purchase another Gresley locomotive. (It is believed that the Society had been put off attempting to buy another Pacific when they realised quite how much money Pegler was ploughing into the running of *Flying Scotsman*, even in the early days!) In late 1963 The Gresley Society purchased an N2, Eastern Region suburban tank locomotive for £800, which they own to this day and which recently spent some time at Bo'ness, the headquarters of the Scottish Railway Preservation Society.

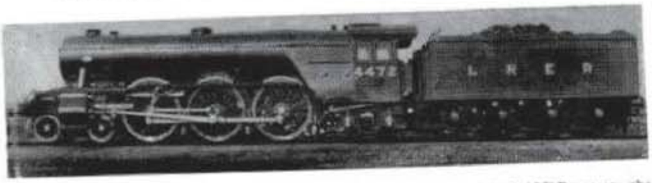
> It is believed that the Society had been put off attempting to buy another Pacific when they realised quite how much money Pegler was ploughing into the running of *Flying Scotsman*, even in the early days!

Whilst everyone has heard of Alan Pegler, Bill McAlpine and the like, the efforts of those few men in the Edinburgh SME, who were amongst the very first steam locomotive 'preservationists' this country had ever seen, is rarely recorded. Douglas Spence, named on the leaflet as the Treasurer, went on to complete a very nice 5 inch gauge model of an A3, *Spearmint* which, happily, now resides with us, while Ramsay Ferguson built a very fine and unusual 5 inch gauge J88. **ME**

SAVE OUR SCOTSMAN

The Gresley A3 Pacific "Flying Scotsman" is due for the scrapheap

RAILWAY ENTHUSIASTS THIS MUST NOT BE



★ **Lovely to Look at**

The first engine to be painted in L.N.E.R. green, she emerged from the Doncaster shops in January, 1923, the forerunner of this class of five engines. Another distinction was that she was the only engine to have bright polished wheel centres and tyres (rims) and polished brass splasher beadings. She even became a film star at Watton, Herts, in the spring of 1928.

★ **History is Made**

On May Day, 1928, at 10 a.m., she pulled out of King's Cross at the head of her namesake train, and by early evening had completed the first-ever world record non-stop run of 393 miles to Waverley. Previously a new type high-sided corridor tender had been fitted with a capacity of 9 tons of coal and 5000 gallons of water. In running trim she then turned the scales at just under 159 tons.

★ **Her Finest Hour**

Coaxed by Driver Bill Sparshatt and Fireman Webster of King's Cross sheds, she created a record run on November 30, 1934, on a test trip from King's Cross to Leeds and back. Allowed 165 minutes for the 185¾ miles, 4472 bettered this timing by 13¼ minutes. Given her head on the descent from Stoke Summit on the return trip, speed was maintained at 100 m.p.h. for some distance between Little Bytham and Essendine.

★ **Everybody's Darling**

To quote H. C. Casserley, "4472 was one of the best known of the whole lot, and already became 'Flying Scotsman' after the train of that name, which it frequently worked." Driven by electric motors, 4472 ran continuously at the 1924 Wembley Exhibition, where she was the star L.N.E.R. exhibit.

THERE THEN ARE THE FACTS

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Out and About 2013

MARTIN WALLIS

Martin Wallis reviews the 2013 season of road steam events.

Mark with his Steam Traction world road locomotive.

Rushden cavalcade

My first 'out and about' in 2013 was, as usual, the Rushden Cavalcade which is held over the first May Bank Holiday. As is always the case, an excellent show had been prepared for visitors with a vast array of vintage vehicles, both steam and otherwise. I have included pictures of the Steam Traction World's new three speed double crank compound Burrell road locomotive before and at Rushden I saw my first fully completed and running example (**photos 1** and **2**). A number of these engines have been built up as showman's engines but the builder of this example, Mark Harris, had chosen to stick with the road locomotive outline. These models are purchased in instalments as fully machined kits and are assembled and painted by the builder. Mark had made a super job of his model with numerous little tweaks and additions to personalise it. For example the brass stars are his own, drawn by his wife and cut by hand from plate. The model is in maroon, picked out in black with what I assumed was gold leaf but, in fact, was gold paint, demonstrating what can be achieved with the right paint

The model ran as well as it looked.

The 4 inch scale Little Samson steam tractor built by Bill.

and careful application. Mark discovered that he was unable to drive the model satisfactorily with canopy fitted as he could not reach forwards far enough to access the controls, so the canopy was made to be removable. Mark is presently building a pair of 4 inch single cylinder 'brake band' drive Fowler ploughing engines, this time doing everything himself: including pouring his own castings.

Bill Cooper was exhibiting his 4 inch scale Little Samson and while this was not the first rally it had attended it was the first time I had seen it. The use of cast wheels, a feature of the prototype, saves a considerable amount of time, which, together with the period curved spokes on the flywheel, gives the model a distinct 'period' flavour. The rubber tyres seemed to fit in nicely, the model being kept notably clean and dirt free (**photos 3** and **4**).

The inclusion of **photos 5** and **6** may seem a bit unfair as they are a record of a small misfortune in the form of a sticking cam follower on the half size SDDG Sentinel steam waggon, completed in 1993 by M. Bray. However after 10 years of faultless service it is entirely understandable that it might choose to have an 'off day' and the purpose of the illustrations is to emphasise how much may be achieved on a budget without the use of commercial castings. The four cylinder engine is an all-home-made fabrication and the gearbox was donated by a Reliant Robin.

Note the loose coal box, which can be easily lifted out to aid engine cleaning.

A major attraction amongst the full size engines at Rushden, certainly for your author, was the 1899 William Allchin roller owned by the nearby Northampton and Lamport Railway Preservation Society (**photos 7** and **8**). The engine was purchased by the County Borough of Northampton Highways Department as No. 1 in their fleet in February 1900 for the grand some of £400. It subsequently spent its entire life in and around Northampton. The roller remained in council ownership until donated to the NLRPS in July 2009; fortunately winning Peoples' Millions Lottery funding to enable restoration to fully working condition. One more model to mention is this nice 4 inch scale Ruston Proctor (**photo 9**) by C. Bacon.

The working parts of a half scale Sentinel Waggon.

The engine is top left and the push rods for the poppet valves can be seen, as can the Reliant gearbox and automotive universal joint(s).

Allchin Roller No 1131 built in 1899 is named Northampton.

The Allchin 'zigzag' rear wheel rims make for easy construction and eventual wheel rim replacement.

A very nice 4 inch scale Ruston and Proctor was also at Rushden. The model was completed in 2002 by C. Bacon.

>>

1 inch Minnie by B. Stephenson.

1 inch scale Minnies by R. Haswell and B. Aston.

A 2½ inch scale Minnie built by L. Mills as a road engine.

The motion on Mark Angus' 6 inch scale McLaren; it was not possible to stand far enough back to photograph the entire engine.

The back tank of the McLaren, the brake arm was the only casting used.

The Harrogate show

The National Model Engineering and Modeling Exhibition held on the Great Yorkshire Showground in Harrogate can always be relied upon for a stunning display of model engineering and 2013 was no exception. There was an excellent selection of models from small to very large. There were three 1 inch scale Minnie designs; the first built by B. Stephenson (**photo 10**), the second by B. Aston and a third by R. Haswell (**photo 11**) and a 2½ inch scale example built by L. Mills, all to the drawings of L. C. Mason (**photo 12**). The 2½ inch scale design was built up as a road engine with a plated flywheel and canopy.

In the hall, and part finished and unpainted at the time, was a very nicely engineered 6 inch scale McLaren being built by Mark Angus (**photos 13** and **14**); the model represented eight years' work so far. This model is now complete and had its in-steam debut at the Pickering show this year. Of particular note is the number of parts that have either been machined from the solid or fabricated, for example the front wheel hubs, water pocket, box brackets and many other fittings. The chimney base is the only part on the front end that is a casting. The wheel rubbers are fork lift tyres opened out and bolted on. Mark estimated that the model was built probably about ⅓ cheaper than would normally be expected. The model was exhibited on the PEEMS stand – the Pickering Experimental Engineering Model Society. Running outside was an example of a fully finished 4 inch McLaren by A. Williamson (**photo 15**).

Before leaving Harrogate a space ought to be reserved for something non-steam and little could be better than the beautifully detailed 2 inch scale Scammell Scarab and trailer built by M. Wiese scaled from the example once owned by the Bridgewater Transport Department of the Manchester Ship Canal Company who used it for making deliveries in the 1950s and 1960s. The model took three years to complete

This is what Mark's engine may look like: A. Williamson's very fine 4 inch scale McLaren Road Locomotive - one of numerous models in steam outside the halls at Harrogate.

2 inch scale Scammell Scarab and trailer built by M. Wiese.

The detail in the cab was just stunning.

using original Scammell drawings and is powered by a cleverly hidden 12V electric motor (**photos 16** and **17**).

Strumpshaw

The second May Bank Holiday is the chosen date of the Strumpshaw Rally held at Strumpshaw Park near Norwich. It was their 21st Anniversary year and a bumper occasion for all involved. There was no shortage of steam in the model section, the emphasis being on the larger models. As is increasingly the case at most rallies, the number of smaller models continues to be outstripped by larger examples. Indeed at Strumpshaw there were just two 3 inch scale engines listed in the programme compared to fifteen 6 inch scale examples; the most popular size being 4 or 4 ½ inch scale.

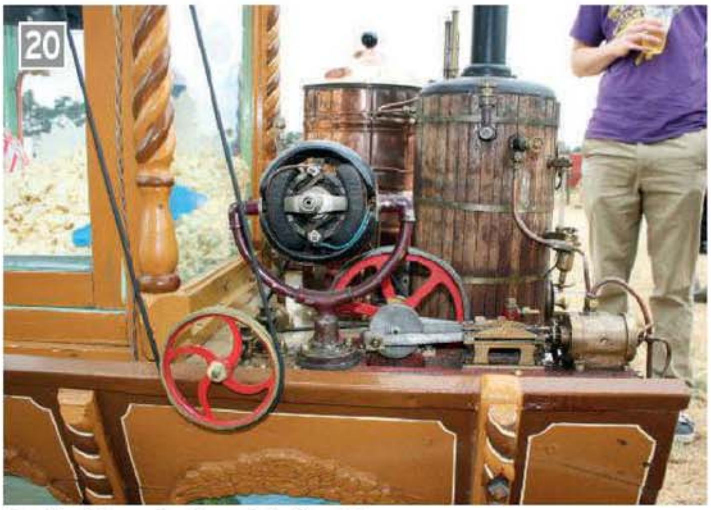
Of interest at Strumpshaw was Marshall 54486 (**photo 18**) for, while it is entirely routine for model engineers to customise or individualise their engines, it should not be forgotten that full size builders regularly did the same. This engine was built to the specific requirements of the customer, Mr. Faithfull, who required a short and narrow engine for use in the narrow lanes and small stack yards on the Isle of Wight. Subsequent to the engine's appearance at the Peterborough show in 1910 other potential customers saw the wisdom in Mr. Faithfull's thinking and a further six were built.

Marshall Agricultural Engine 54486 built in 1910, owned by the Norfolk and Suffolk Engine Club.

Weeting

Weeting rally, held near the town of Brandon, Norfolk, at the end of July - while not being as large an engine rally as it once was - is still well worth a visit. Of some interest, although not strictly road steam, was a vintage popcorn making apparatus (**photos 19** and **20**) whose history does not extend beyond the engraved plate 'T. Walker, Engineer, Tewkesbury 1907'. Other than the maker and the date, very little else is known about it. The popcorn was originally heated by town gas and a steam engine (the one fitted is not original) turned a propeller to agitate/stir the popcorn while roasting. The drive mechanism presently fitted looked suspiciously Meccano-like so, like the engine, a substitution. It is owned by Mr. Hammond and was bought by his dad in about 1960 in very poor condition. A small dynamo (believed to be original) provided power to illuminate the cooked popcorn when it was dark.

1907 popcorn making machine made by T. Walker, Engineer, Tewkesbury 1907.



Details of the engine (not original) and dynamo.

●*To be continued.*

Count Louis was built in 1922 by Bassett-Lowke for Count Louis Zborowski and spent many years on the Fairbourne Railway.

Count Louis
90, and Still Going Strong

ANN EVANS

Ann Evans visits Andy Walton of the Denver Light Railway to see his current workshop occupant.

Further details of the Denver Light Railway can be found by visiting: www.denverlightrailway.co.uk or call Andy on 01922 404911.

Restoring steam engines is all in a day's work for Andy Walton who runs the Denver Light Railway in Bloxwich. Like many a good business, his interest in mechanical engineering began in the garden shed as a hobby around ten years ago when he started to repair his his own 7¼ inch gauge tank engine, *Erin*.

Although he had worked as a volunteer fitter for seven years at the Severn Valley Railway, he considers himself self taught, with the help of many friends. However as his reputation for repairing, restoring and building all things mechanical grew, so his hobby expanded until he was forced to take on a workshop. Then, to cope with increasing demand, two years ago he moved to an even larger workshop - an 3,000 square foot building on two levels where he now employs four men and an apprentice, repairing, restoring, rebuilding and building from scratch all manner of model steam engines.

"One of the first things I re-built was a Ronaoke petrol hydraulic locomotive which came to me as a part-finished project," said Andy, adding that it's not unusual for engines to come to him as boxes of bits, the results of someone taking their model to pieces and then finding it more complicated than expected to put back together again. Sometimes, he says, the jobs are so complex that it can take 5-6,000 hours or even longer to complete.

He chose the name Denver Light Railway after the Denver Rio Grande railway, which he dreams of visiting one day, in particular to see the K36 locomotives which are still

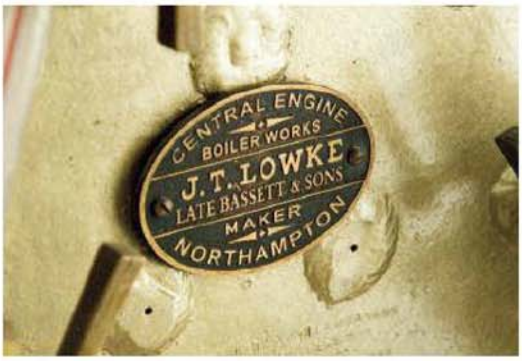
The boiler backhead.

running today. In between working on other people's engines, he is currently building a 7¼ inch gauge Denver Rio Grande C19 2-8-0 from scratch for himself.

Most of the time however, Andy is kept busy working on other people's locomotives and steam vehicles. He said: "Work tends to come from private individuals and the demand now seems to be for bigger locomotives as people have bigger ambitions. More and more people want these large models, but many people can't build them nor carry out repairs. Plus, of course, many skilled enthusiasts are getting older and can't build to the same extent that they perhaps used to."

Over the years, Andy has taught himself the necessary skills which enables him to make tracks, points and turntables; to do silver soldering, welding and metal-work; livery paintwork – everything, even down to making drawings for parts which can't be found elsewhere and making them from scratch.

He added, "Sometimes you have to be quite ingenious in getting around problems and working out what is wrong with an engine, and how to put it right. It's a lot of hard work, but it's enjoyable work. What adds to the pleasure and excitement of the job is when a particular locomotive comes into his care that is steeped in history. This is precisely the case with the 15 inch gauge steam railway engine and tender that is currently nestled under a tarpaulin in his workshop after undergoing some routine maintenance work.



Replica maker's plate on the boiler backhead.


Side view of the tender showing the air receivers for the brakes.

Count Louis' locomotive

Count Louis is a 15 inch (381mm) gauge steam locomotive built in 1924 on the instructions of Count Louis Zborowski (1895-1924), the racing driver and automobile engineer famous for building the *Chitty Bang Bang* and *Higham Special* racing cars of the 1920s.

This wealthy and flamboyant, half American/half Polish gentleman, who raced for Aston Martin and Mercedes, also had a passion for steam. Along with his wealthy land-owner friend, Captain J. E. P. Howey, he had a dream of running the fastest, most impressive 15 inch gauge locomotives ever, with the intention of running them through the grounds of Zborowski's Highham Park Country Estate at Bridge near Canterbury.

They asked prominent designer, Henry Greenly to design two locomotives, which he did. Unfortunately *Green Goddess* was too big for Zborowski's railway so he commissioned the last Class 30 Little Giant - to be made by Bassett Lowke - and *Green Goddess* famously found its home on the new Hythe to New Romney line.

Tragically, Zborowski died before he saw his dream come to fruition. Aged just 29 he was killed after hitting a tree when racing for Mercedes in the Italian Grand Prix at Monza in 1924. No-one is quite sure whether he actually got to ride on his 15 inch gauge trains, one can only hope that he did.

Captain Howey arranged for the Class 30 to go to the Fairbourne Railway, where it was named *Count Louis* in his honour. Andy commented, "The fate of one of the other Class 30s was less fortunate; *Sans Pariel* did not survive but another, *Synolda* did survive and is at the Ravenglass and Eskdale Railway in Cumbria, should anyone want to go and see her."

Over the years Count Louis has undergone all kinds of repairs and five years ago it was given a major overhaul by TMA Engineering who refurbished the chassis, re-turned and indeed and re-cast some of the wheels and fitted new axleboxes. Since then, Andy has been involved in working on the locomotive from time to time. And then, a year ago, it was brought into his workshop for an intermediate overhaul.

"It was in need of some TLC when it came here," said Andy. "At some time in its history it had had a new steel boiler fitted. It seems that years ago it had gone in for boiler refurbishment but the company doing it went bust and the boiler was lost. Luckily drawings still existed to enable production of another one. The boilers have to be thoroughly examined every seven years and also inspected every 14 months so these are things that we will be doing next year.

"Since it's been here, we've looked at the engine, re-bushed all the motion, re-machined some of the wheels and carried out general maintenance. It runs at 150 PSI and takes about an hour and a half to get it ready. You have to use forced draught to draw the fire until there's enough steam. We've also fitted it with modern air brakes to comply with current legislation; the steam air pump for the air brakes came from America. We have also put electrics in the tender, which are a back-up for the air brakes, plus it has a chain driven compressor. It's safer now that it was ten years ago.

"The original plates got worn away but are still stored safely away. The ones you see today were made five years ago when the engine was restored by TMA."

It's undergoing general maintenance now and enjoying regular runs on various 15 inch gauge railways around the country. And there's nothing Andy loves more than driving it with the wind, smoke and steam in his face.

"I love this locomotive to pieces," he concluded. "Whenever we take it out it makes us smile. It is so big and it travels at quite a speed for a very old engine. I have to say it's entertaining to drive this. You certainly know you are on it."

Now, at 90 years old, *Count Louis* is gleaming and beautiful and as raring to go as it was almost a century ago. **ME**


Andy Walton of the Denver Light Railway.

A Dean Myers
Rider-Ericsson Hot Air Engine

JOHN PACE

John Pace takes on a commission.

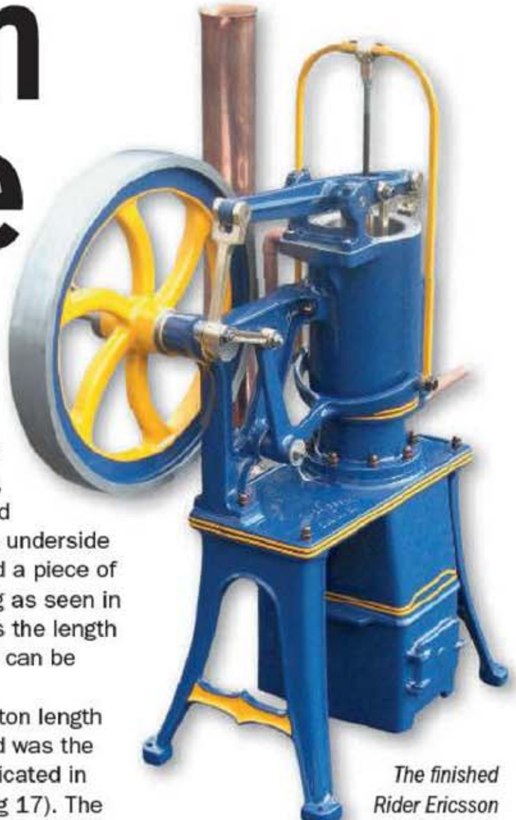
PART 7

Continued from page 763 (M.E. 4470, 29 November 2013)

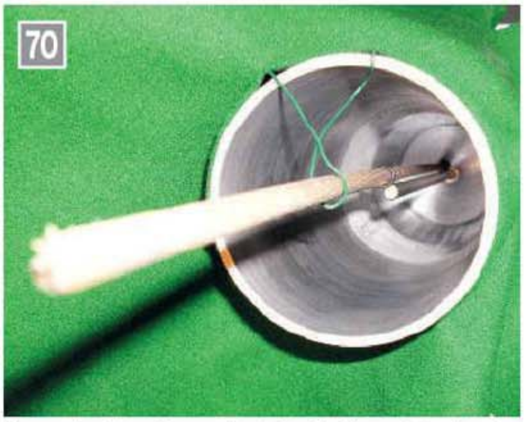
A friend of mine, Dr. John Dimmock, who collects all types of engines, bought a set of castings for a hot air engine and asked me whether I could build it for him. Having never built a hot air engine and having little knowledge of how they work, this was quite a departure from my usual interests of workshop equipment and model aircraft but, nevertheless, it seemed an interesting project.

The rod is cut off at the mark and re-fitted, the crankshaft is rotated until the rod moves up through the power piston and when it gets to the position where it stops and before it starts moving back, the length of the rod to the power piston underside is measured. I used a piece of dowel and an O ring as seen in **photo 70**. From this the length of the power piston can be determined.

The displacer piston length was worked out and was the same length as indicated in drawing No. 315 (fig 17). The piston is rolled from sheet steel; I turned and parted off some steel discs for the ends. The lower disc has a guide bush silver soldered in the centre and the upper disc I slightly modified by making four saw cuts and using a separate clamp ring to close the split bush on to the piston rod instead of the grub-screw fixing shown on the drawing.

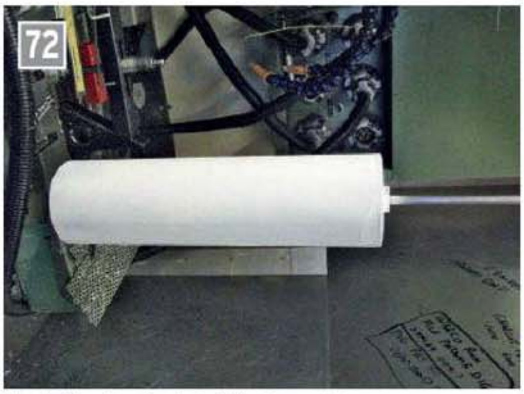


The finished Rider Ericsson engine.



Measuring the rod to work out the displacer piston length.

The rolled sheet steel displacer piston and end caps.



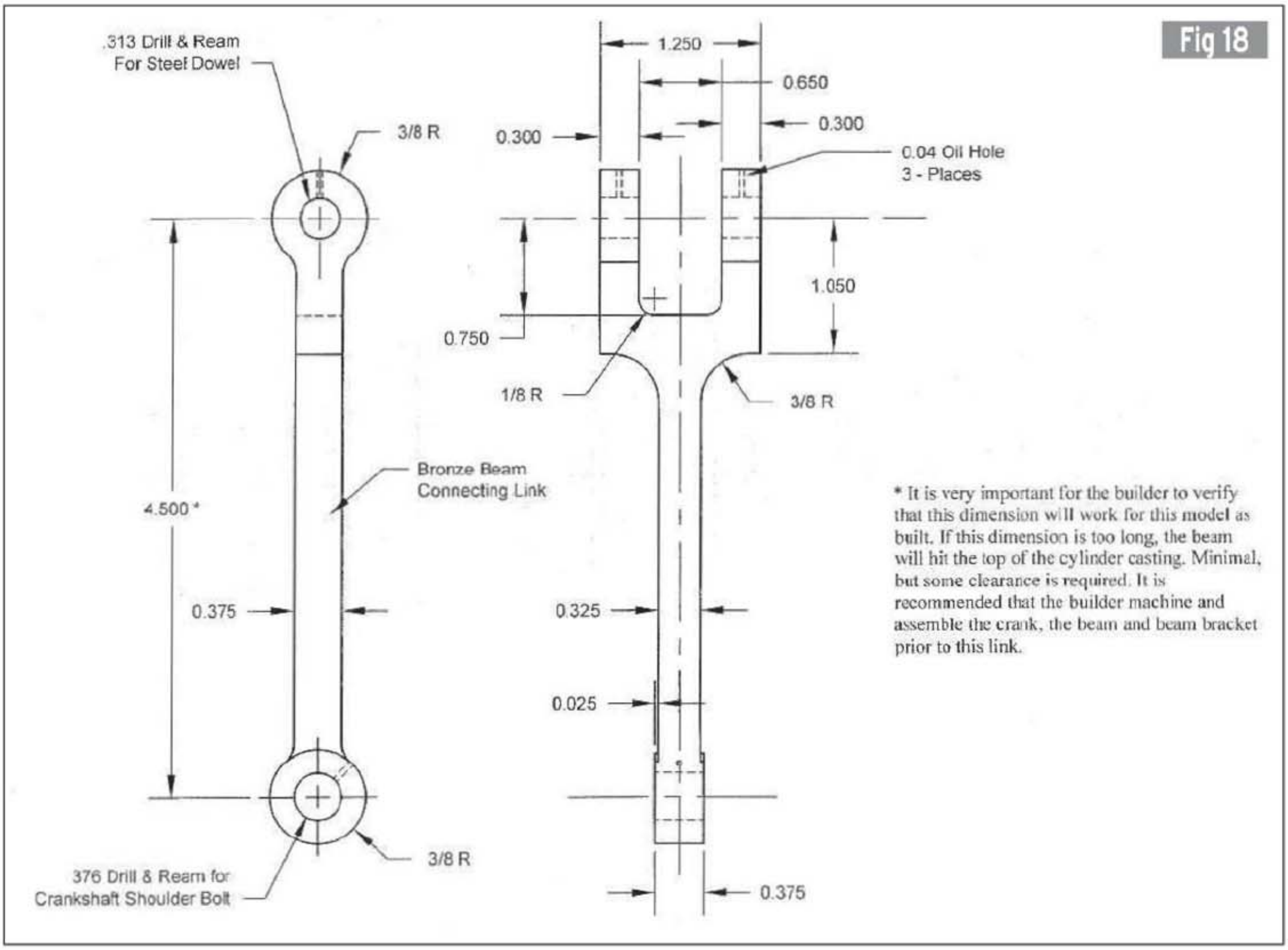
The finished and painted displacer piston.

The set-up for the machining the beam link.

The rolled cylinder and ends are seen in **photo 71**; the split bush and clamp are on the left. **Photograph 72** shows the finished displacer piston painted with some white heat resistant paint.

Beam connecting link

I had been waiting for some time for the brass rod to make the beam connecting link shown in drawing No. 313 (**fig 18**). Up to now I had been using the dummy wooden link for setting up. At last it had arrived, seen here in **photo 73** on the mill in the dividing head and supported by the



centre. The bar is trimmed off on each side to just over the 1.250 inch dimension and then drilled and reamed 7⁄16 inch (**photo 74**). I have used brass for all of the linkage parts; the drawings show these as bronze but this would be expensive so using brass and bronze bushes reduces this cost. (It also allows for the easy replacement of the bearings at a later date if this is needed.) Rotating 90 degrees, the sides of the link are reduced to the 3⁄8 inch dimension. Note some extra support has been provided with a Keats and angle plate (**photo 75**). Changing the cutter, the centre is milled away to form the fork for the beam (**photo 76**). The job is rotated 90 degrees and the co-ordinate position worked out where the finished radius will blend in with the finished thickness of the beam, this is done on a simple drawing showing the centre of the eye and the centre of the

Reaming the holes in the beam link.

Rotated 90 degrees, the flanks are milled to size.

The centre slot also milled at this setting.

Rotated again 90 degrees; part of the profile is finished.

>>

Cut away from the bar stock the end fork is profiled on the rotary table.

Turned around, the crank end is finished.

Fig 19

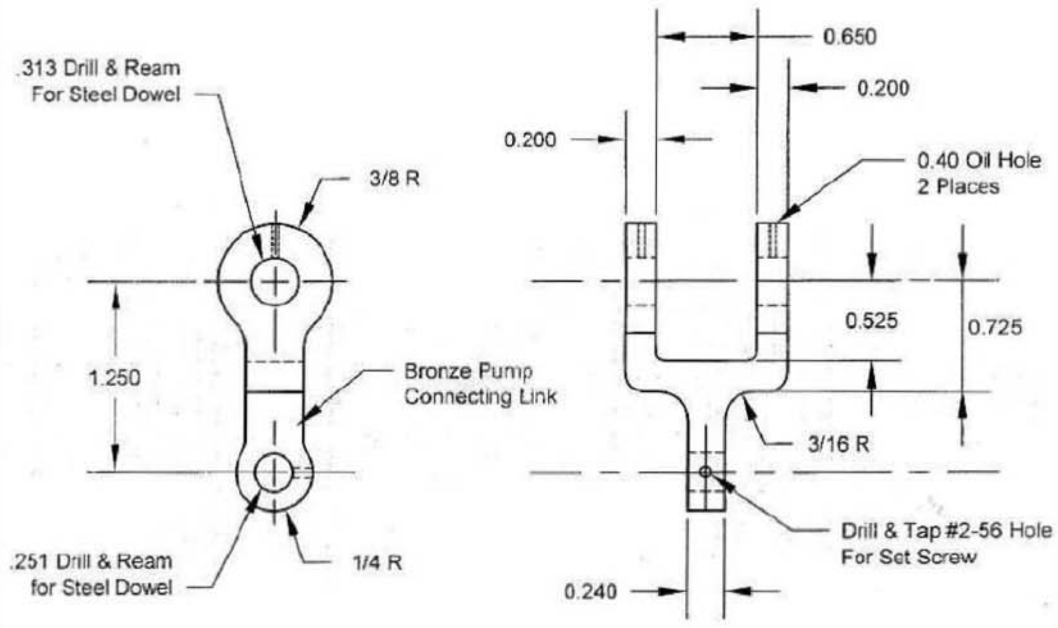
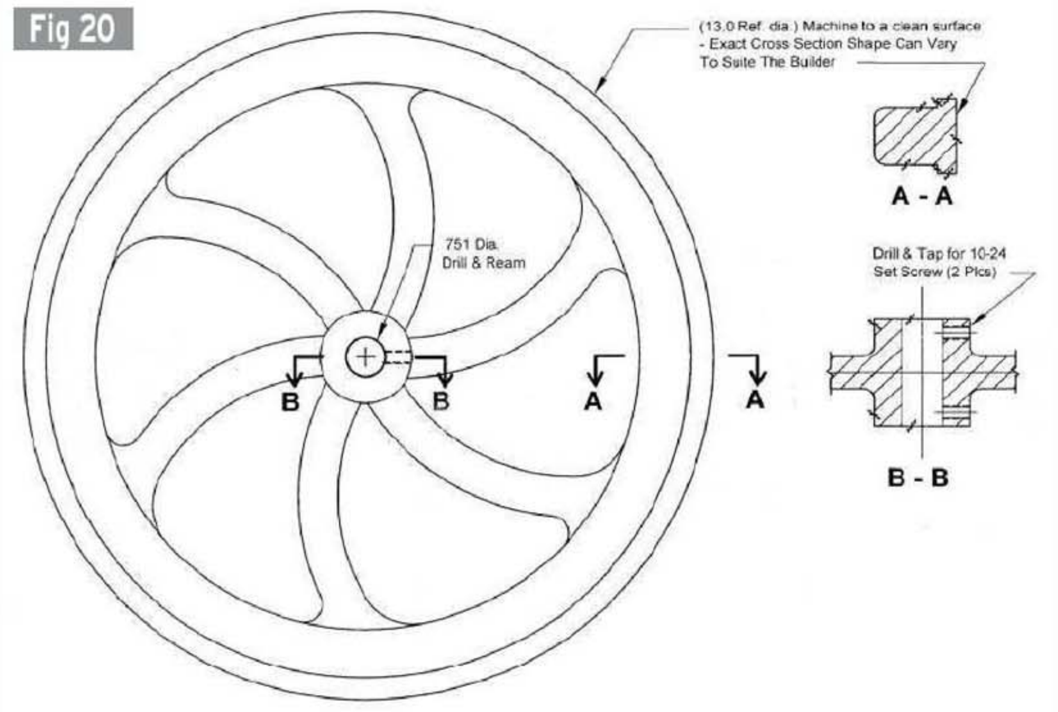


Fig 20



cutter with its edge touching both the radius of the eye and flank of the beam. The table stops are set to limit the travel in X and the cut applied until the co-odrinate position is reached in Y (**photo 77**). The final stage is seen in **photos 78** and **79**; the beam is set up mounted on a suitable arbor in the rotary table and the radius is cut on each end. Care is needed at the junction of the radius to make sure the cut is not too deep as this would ruin the look of the finished part.

Water pump link

Made in the same way as the beam connecting link, the water pump connecting link (drawing No. 320, **fig 19**) is seen part machined in **photo 80.** As all of the other linkage is now on the engine it is a simple matter to check that the dimension shown on the drawing is okay. As it turned out the 1.250 inch between hole centres was correct.

The flywheel shown in drawing No. 303 (**fig 20**) only needs machining on the outer diameter and the hub and cleaning up around the area inside the outer rim. Seen here set up mounted on the faceplate (**photo 81**). Held on the spokes using some square steel blocks, the blocks are bolted to the faceplate from behind and using two bolts, the outer blocks provide a firm grip. I made a modification to the hub fixing; I dislike using grub screws for this type of fixing on a parallel shaft, even when the bore has been made a close fit, as after it has been removed a few times it becomes a little slack. The addition of the fixing grub screw throws it off a little more and there we have it - a flywheel with a wobble. Nothing looks worse! It is the first thing that everyone sees. I over-bored the hub (**photo 82**) and used a taper collet - a screwed portion at the end has a securing nut which pulls the collet tight. The round nut has two holes for the pin spanner and they have a dual function - two threaded holes in the flywheel hub line up with these holes. When it is necessary to remove the flywheel the nut is loosened, the holes aligned and two bolts fitted which, when tightened, push the collet free. The taper portion of the flywheel is 2.00 inches long and the taper is 1 in 8 cut using a CNC file; the collet is also made using CNC. **Photograph 83** shows the collet; the thread is still to be cut. The finished collet and nut are shown in **photo 84.** The firebox has no drawing but is seen in the general arrangement drawing 301 (fig 1) and has some instructions on the detail of the internal insulation.

The firebox is a large, well made hollow casting that only needs cleaning up around the edges. Looking back at photo 2 you will see the casting flash around the edges. **Photograph 85** shows the casting clamped to the table to drill the mounting holes. There is no indication on the drawings for these; they are centred and 6 inches apart. The holes for the studs have to be drilled into the base plate and a clearance hole drilled into the leg that is closest to the firebox. The top and bottom need to be machined flat before holding, as in **photo 86**, to machine the chimney outlet, I just cleaned up the outer and will probably have to re-machine to suit the street elbow fitting that is needed for the stack. **Photograph 87** shows the use of the Dore boring head to external turn the chimney outlet. Machining the firehole door opening and fitting the door is, in part, a hand fitting operation. As can be seen in **photo 88**, the opening and the hinge lugs are machined. The door is machined a bit at a time to match. Eventually, the inner surface is lined with a heat resistant insulator; the drawings indicate ¼ inch thick refractory mat fixed in place using fire cement. I used 4mm thick mat doubled up in places; there is not much room to do this when the engine is assembled so I made a false roof to the fire box casting with a close fitting hole around the displacer cylinder (**photo 89**). This plate is very much a 'cut and fit in place' item secured with four

The water pump link is machined in a similar way to the beam link.

The flywheel casing mounted to the faceplate.

The flywheel hub modification taper bored to suit the mounting sleeve.

The part machined flywheel hub taper, CNC cut to suit the flyweel.

The finished flywheel collet and nut.

The firebox securing holes being drilled.

Boring the chimney outlet hole.

External turning the chimney outlet using the Dore boring head.

>>

Milling the firedoor hole.

The roof plate sitting on top of the firebox.

The plate fixed and filled with fire cement.

The insulating lining fitted in the firebox.

pop rivets from the inside. The plate sits below the top of the firebox by $\frac{9}{16}$ of an inch (**photo 90**). The plate is fitted and the gaps filled with fire cement. This makes the fitting of the insulator much easier to do and this can now be done before the engine is painted. This also allows the firebox the be fitted and removed at any time, should this be necessary, as only a small sealing ring is needed around the junction of the cylinder and roof. The space above is filled with loose, ceramic fibre protecting the lower cylinder bolts and improving the insulaton at this point. **Photograph 91** shows the lining fitted and skimmed with fire cement. The displacer cylinder was finished, cleaned and painted with heat resistant paint, available from car accessory shops (**photo 92**). The firebox chimney is made from copper pipe and joined to the firebox using a copper street elbow. A 2 inch fitting is specified but these are not obtainable in the UK. A metric size 54mm was used and I made a sleeve to fit on the firebox casting to adapt to this size. Even this plumbing fitting could only be purchased from an industrial plumber as most domestic plumbing outlets only stock plastic fittings these days. I made a split aluminium clamp to attach the elbow to the firebox outlet. I cast this item as I had no stock of metal this size. The copper elbow has a single slot cut at the bottom and the general idea of the size can be seen in **photo 93**.The chimney pipe is cemented into the elbow using firegum and exhaust pipe sealant used on vehicle exhaust systems. Like the heat resistant paint these are available from car accessory shops.

The completed engine unpainted and test run.

After the firebox was lined the displacer cylinder was cleaned and painted with heat resistant paint.

The copper chimney is secured with this home cast split clamp.

Conclusion

The engine now is pretty much finished and is seen in **photo 94** in the garden. As may be seen in this photo, the engine is assembled with some temporary bolts as the proper fixings are not yet made. The engine stands about 2 foot high and weighs in at about 40lb. The engine had just been test run; all of the linkage points were oiled and a gas blowlamp was held in the firebox door. After about five minutes to warm up, the flywheel was spun and the engine was off. The earlier comments about the geometry of the engine were forgotten as the engine was running almost in complete silence except for the click of the ball valve in the water pump. The engine runs at a minimum of about 80 rpm at the moment but I expect this will drop a little as the engine runs in. At this speed the water pump will deliver just under 2 litres a minute. Increasing the gas supply to the burner will make the engine run much faster.

I got to about 150 rpm but this seemed, to me, to be too fast and looks wrong. Any faster than this and the engine starts to shake. Much better to keep to about 90 rpm.

The owner of this engine wanted to have the finished engine painted. I am not keen on painting so he had another friend do the painting. As can be seen in the head photo, and in **photo 95**, the paint finish is superb and transforms the finished look of the engine. The final photo shows the new owner of this engine, John Dimmock, on the left looking pleased with his new engine. I am on the right.

It has been an enjoyable engine to make as the parts all fit well together and, as said at the start, the quality of the castings was very good.

ME

The finished engine.

John Dimmock on the left of photo looking pleased with his new engine and the author, John Pace on the right.

ISSUE NEXT ISSUE NEXT ISSUE NEXT ISSUE NEXT I

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Introduction to the Eta 15D
Ramon Wilson describes his 5cc version

- **A 3 inch scale Minnie Traction Engine** Chris Hazel scales up a classic design
- **An ML7 Refurbishment**
- **I. K. Brunel: a Different View**
- **Turkish Delight** Visit to a European Railway Museum
- **A Power Feed for a Shaper**

ON SALE 10 JANUARY 2014

Helping Dad make a **Simple Mill Engine**

STEWART HART

Stewart Hart's engine to encourage a beginner.

PART 7

Continued from page 772 (M.E. 4470, 29 November 2013)

The finished engine.

The 11 year old son of an old work friend has a developing talent for Computer Aided Design and has produced a number of 3D animated drawings for some of my models. Wishing to take this fledgling interest further, he and his Dad were lucky enough to drop on a very nice second hand Myford lathe. This got me thinking about my own struggles with lack of equipment and finances when first setting up my own workshop, and the need for a simple, low cost project that used the minimum of equipment and would stimulate interest for further projects.

The following items are described in **fig 20** (*M.E.* 4470):

Valve rod and eccentric assembly - part MP19

When I first drew the engine up I had a hinged coupling between valve rod and eccentric rod. You can see this in the 3D drawing but this caused me to puzzle for some time over how to adjust the valve with this set-up. In the end I went back and had a look through the photographs I took of the real engine. The penny dropped: on the real engine the coupling rods are off-set to each other and have a short coupling joint that can be moved along the valve rod and is connected to the eccentric rod with an eye (**photo 61** - *see issue 4470*). This is an even simpler arrangement than my first attempt and would make setting the valve event a straightforward, easy affair.

The valve rod (part MP20) has been dealt with previously.

Eccentric rod - part MP21

Made from a length of 3mm silver steel, cut off a generous length and thread both ends M3; bend the off-set in the vice, making final adjustments to the length and off-set at final assembly.

Valve rod coupling - part MP26

I made this from ¼ inch diameter stainless steel. The

The bar accurately cross drilled.

Threading M3.

Assembled valve rod coupling.

Parting off the eccentric sheath.

Boring the outer eccentric.

Turning the OD for a running fit on the sheath.

Facing off to length.

Trial assembly on the lathe.

part calls for a 3mm cross hole; the simplest way to do this is to first make a thick guide bush with a 3mm hole in it from the same bit of bar you are going to use for the part, then all you have to do is place the bush on the bar, clamp the two together in the drill vice and use the bush to guide the drill to drill across the centre of the bar (**photos 62** - *see issue 4470* - and **63**), it is now a simple job to cut the part off the bar and to turn and thread the other end (**photo 64**).

Eccentric rod coupling - part MP27

This is also made from ¼ inch diameter stainless steel, in a similar way to the valve rod coupling. The assembled coupling is shown in **photo 65**.

Eccentric assembly - part MP22

The eccentric is a three part assembly held together with high strength Loctite 603; this allows all the parts to be finish turned in the lathe.

Eccentric sheath - part MP23

I was lucky to have some 28mm OD x 20mm ID 70/30 brass tube in my scrap box that was ideal for the job. It was a little under drawing size on the OD but this could be tolerated. It was a simple matter of parting the tube off to length and drilling and tapping M3. If you are making from solid bar, however, you will have to face, skim up the diameter to size, centre drill and drill and finally bore out to size before parting off and drilling and tapping the M3 hole (**photo 66**).

Eccentric outer - part MP25

It's best to make the eccentric outer first as it is easier to fit a shaft to a bore than a bore to a shaft. The part is made from a stub end of 32mm diameter mild steel. Face off, centre drill then put down a couple of roughing drills; then with a boring bar, bore out to 16mm diameter. You can measure the bore with your digital callipers but remember the legs of the callipers have flats on them so you will get a false reading; the bore will actually be bigger than the callipers are telling you so aim for a calliper reading of about 15.8mm. Next turn the 20mm diameter to give a nice running fit on the bore of the sheath, make the 6mm length about 0.1mm longer than the width of the sheath, swap it round in the chuck and face the other end off to length (**photos 67**, **68** and **69**).

It's best to make the eccentric outer first as it is easier to fit a shaft to a bore than a bore to a shaft.

Eccentric inner - part MP24

Again made from a stub end of 32mm mild steel, start by facing off and skimming up the OD, then turn the 16mm diameter for a nice push fit on the eccentric outer (**photo 70**). The photograph shows a trial assembly of the part on the lathe. Swap it round in the lathe and face off to length, then put in a small centre mark and using this centre mark scribe a 7mm diameter arc. Anywhere on this arc, put a small centre pop to mark the throw of the eccentric (**photo 71**). Using the four jaw chuck and the wobble bar trick, clock the throw up, centre drill followed by a roughing drill then an 8mm reamer or, if no reamer is available, an 8mm drill (**photo 72**). Finish off by turning the 16mm diameter and drilling and tapping for the M3 fixing grub screw. The whole assembly is put together with high strength Loctite 603. Don't forget to put the eccentric sleeve in place and, in order to avoid contaminating the sleeve with adhesive (it wouldn't then rotate) the way to do it is to put a few drops of the adhesive into >>

Marking the eccentric throw.

Clocking up the eccentric throw with a wobble bar.

Eccentric assembled to the engine.

Threading the crankshaft.

The webs marked out.

Drilling the second hole in the webs with webs pinned together.

Checking hole centres: 23.30 – 7 = 16.3.

the bore; that way any surplus is pushed to the outside out of harm's way. If you do have a disaster, 'keep calm and don't panic' ... the adhesive bond is easily broken by a applying a little heat. This is best done with one of those hot air paint stripping guns (**photo 73**).

Crankshaft assembly - part MP28 (fig 21)

The crankshaft is a steel fabrication with the webs glued and pinned onto the shaft.

Crank pin - part MP29 (fig 21)

The crank pin is just a 22mm length of 6mm diameter silver steel.

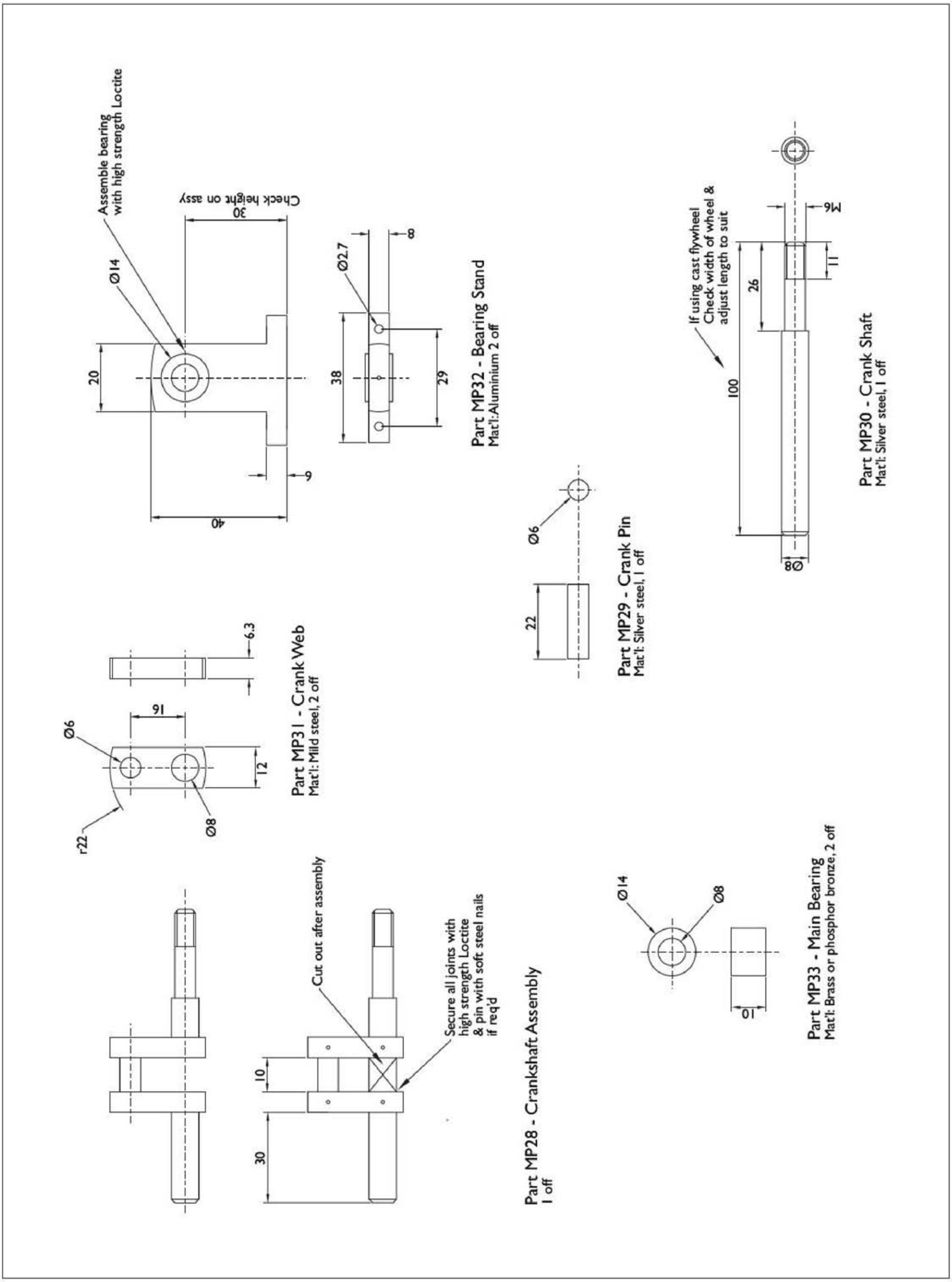
Crankshaft - part MP30 (fig 21)

This is a piece of 8mm silver steel; just cut off to length, face both ends and chuck true. Turn one end down to 6mm diameter and thread M6 with a die (**photo 74**). Note: if you are using a cast fly wheel you may have to increase the length of this part.

Crank webs - part MP31 (fig 21)

The webs are made from ¼ x ½ inch mild steel bar. Cut two pieces off the bar allowing a couple of mm on each face for finishing, mark the centre of the bar and the position for the shafts. It pays to have an appreciation of how a part functions and what are the important features that make it function correctly. It's not always obvious what the really critical features are and people have a tendency to focus on the feature that is easy to measure; in the case of the web you may think that getting the hole's centres exactly 16mm is important but, in fact, the really important feature is to get the hole centres in both webs exactly the same. They can be out by up to 0.5mm without having any functional effect but they must be both the same. If they are not the same things will be twisted out of line and the engine will be tight and not run. Having this understanding helps to simplify their manufacture. All you have to do is first drill an 8mm hole in each web, then tie the two webs together with a little stub of 8mm bar. Next, drill the second 6mm hole through both webs; the hole centres must come out the same. The centres for mine came out as 16.3mm which means the engine will have a stroke of 32.6mm which is easily accommodated within the length of the cylinder (**photos 75, 76** and **77**).

To finish off we now have to tidy up the ends. First, turn up an 8mm diameter mandrel with an M6 thread. Bolt the webs to this and, with light cuts, clean up the first end to give a nice arc, then turn the mandrel


Assemble bearing with high strength Loctite
Check height on assy
30
Ø14
20
40
6
Ø2.7
8
38
29
Part MP32 - Bearing Stand
Mat'l: Aluminium 2 off
If using cast flywheel Check width of wheel & adjust length to suit
M6
26
11
100
Ø8
Part MP30 - Crank Shaft
Mat'l: Silver steel, 1 off
Ø6
22
Part MP29 - Crank Pin
Mat'l: Silver steel, 1 off
Ø6
16
6.3
12
r22
Ø8
Part MP31 - Crank Web
Mat'l: Mild steel, 2 off
Cut out after assembly
Secure all joints with high strength Loctite & pin with soft steel nails if req'd
10
30
Part MP28 - Crankshaft Assembly
1 off
Ø14
Ø8
10
Part MP33 - Main Bearing
Mat'l: Brass or phosphor bronze, 2 off

POSTBAG

IMLEC puzzle?

Dear Diane; As a competitor in the 2013 IMLEC who used a significantly large amount of coal I knew I was not going to win or even be placed highly, however the following puzzled me:

My run and the winner's run were very similar in that we had a similar load, a similar speed profile and a similar time. However our work done figures were significantly different. Mine was 399324 lbft against the winner's 687134 lbft.

The recent article by Bernard North has, I believe, finally provided the answer. I believe that Steve Eaton is still the winner, though the efficiency is somewhat less than calculated.

To explain my comment it is necessary to look at the results graph for the winner, published in the article. Instead of looking at the high numbers in the drawbar curve, look at the low numbers and you see that, at 0mph (when standing in the station to load up) the drawbar is reading 12 lb. This condition is also present at the end of the run. During the run a number of low drawbar points bottom out at 12 lb. As a matter of interest all results I have seen show an amount of 'noise' when stationary though, with the exception of the above, based on the 0 lb line. The amount of 'noise' on the winner's chart is similar - but on the 12 lb line.

From the above it appears that an error of 12lb is present throughout the run. Over a distance of 20738 feet this offset accounts for 248856 lbft of work done which should be subtracted from the total quoted which leaves 438278 lbft. Taking this into account the winner's performance is still at the top of the comparison group of similar loads, though now in line with what could be expected.

As to efficiency, if we take the results for the first and second place competitor and divide the work done by the coal consumption we get a ratio of work done per pound of coal. For Steve Eaton's run with the revised work done we get 259336 lbft/lb of coal. For Steve Botterill we get

IMLEC solution?

Dear Diane; The IMLEC results are always full of interest , this year being no exception particularly that a new type of dynamometer was in use. Ears pricked up immediately when an efficiency of 3.6% efficiency was quoted, a value nearly 40% higher than the next very respectable 2.2% in second place with essentially the same load and coal consumption. There is an expression that if it is too good to be true it probably is.

I was not present at the event but as I understand it the engines were readied on the steaming bay before moving to the station to take on however many passengers the driver nominated. On completion of the run the passengers were dropped off. The dynamometer sensor was zeroed with the engine on the steaming bay thus ensuring that the work done was for the complete run, steaming bay to the end. Each competitor was given a handsome framed photo and print out of his detailed results. Chief judge Bernard North, in his report in Model Engineer Issue 4467 (18 November) included the print-outs for three runs and these are the only ones that I have but there is a question mark over the work done by the winner Steve Eaton.

I am not the one who spotted that although speed records showed zero speed whilst the passengers were loaded, of course the drawbar pull would have also been zero apart from a little noise. This is the case for Dave Roberts and Kevin Ayling but not for Steve Eaton where there is a residual load of 12lbs. In other words, mysteriously this is the new zero that applied throughout the whole of the run. Let me say that it was not my eagle eye that spotted this and I take no pleasure whatsoever in pointing this out but in fairness to all competitors it deserves to be addressed.

The easiest way to view the effect of this is that, on average throughout the winner's run, the drawbar pull was 33lbs. above original zero, however the new zero is in fact 12 lbs. therefore the real drawbar pull was 33lbs. minus 12lbs. = 21lbs. accompanied of course by a dramatic reduction in the work done and the thermal efficiency. Correcting this, the work done was in fact 435,498 ft.lbs. with an efficiency of 2.3%. In my book, even if accepted, the difference between first and second is too close to call given the nature of the overall uncertainties involved. It is really fanciful to quote one place of decimal let alone three. What caused the sensor to rest itself I have no idea but I have to say I feel sorry for all involved, particularly Steve Eaton.

The table below gives more detail, note the new values for HP!

Yours sincerely, Don Broadley

Name	Time (min)	Dist (ft)	WD (ft lbs)	Coal (lbs)	Ave Pull (lbs)	Efficiency	HP
S Eaton (orig)	27.5	20,738	687,134	1.69	33	3.629%	0.75
S Eaton (corr)	27.5	20,738	435,498	1.69	21	2.3%	0.479
S Butterill	26.9	14,349	371,856	1.48	26	2.24%	0.433
D Roberts	31.0	19,122	404,862	2.76	21	1.3%	0.396

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In the interests of security, correspondents' details are not published unless specific instructions to do so are given.

Responses to published letters are forwarded as appropriate.

251254 lbft/lb of coal. Steve Eaton is therefore better by a ratio of 1.032. Taking Steve Botterill's efficiency of 2.248% and multiplying by 1.032 we get an efficiency of 2.320%. For my result we get 107345 lbft/pound of coal which gives a ratio of 0.427 compared to Steve Botterill's which gives an efficiency of 0.96%, agreeing exactly with the published result, I believe, validating my methodology.

None of the above detracts from Steve's fine performance and enviable low coal usage but shows how close run the competition was. My reason for writing is that I feel that it is important where facts are presented they should always be challenged where apparent errors occur.

Alan Heywood (UDMESL)

Locomotive springing

Dear Diane; Congratulations to Artisan on an excellent article in issue 4470. It was supported by just enough theoretical background and included good practical advice on how to optimise springing. How often have we seen on locomotive drawings, 'use suitable springs' with no further detail provided?

I would like to add a cautionary note. When the load on leading (and trailing) bogies or pony trucks has been minimised to allow maximum adhesive weight, it is essential that the side control springs fitted to these provide just sufficient force to create the intended steering action. If the springs are too strong, as I have found to my cost, the tapered flanges on the wheels of the pony/bogie will climb up the rail and ultimately derail. I have resolved this by 'trial and error' but perhaps Artisan could give us some further guidance on how to take a more measured approach.

Best wishes,
Trevor Collyer,
Leyland SME.

Using Loctite

Dear Diane; James Wells asks about the use of Loctite. I'm a bit of a fan of Loctite, indeed I'm keen on any new technology that will speed up and improve the accuracy of my model building. Water-jet profiling, CNC machining, lost wax casting, wire erosion, vacuum brazing – I've used them on all on recent projects. I've yet to use 3D printing, but I'm sure the time will come.

Anyway, back to Loctite. I've used this to fit the wheels on two 5 inch gauge locomotives and, so far, they have not shifted on the axles. My current project is a 7¼ gauge 0-6-0 Jinty tank and not only are the wheels 'Loctited' in place but the crank axle is also glued together. I discussed the project with a technical specialist from Loctite. I asked if I should key the wheels or fit pins half in the wheel, half in the axle, for security. He felt that it was better to give the Loctite the full circumference of the wheel seat and not 'break the circle'. The crank axle is, however, highly stressed and I've added dowel pins to the axle ends of the webs (**photo 1**). It has only run on air so far; I'll let you know how it gets on in service.

As I understand it, you should allow one thou (0.001 inch) clearance per inch of diameter for a Loctite joint. The parts should be de-greased carefully and then, ideally, both parts should be coated with Loctite before assembly, to ensure that all of the mating surfaces are fully wetted. The trouble is that the stuff tends to run everywhere and you really don't want it getting into the axleboxes, for example. Masking tape or PVC tape are useful here. Clean up overspill with a cloth dipped in meths before it sets, otherwise it can be quite hard to remove. The assembly can probably be handled after only a few minutes but most folks leave the job overnight to be on the safe side.

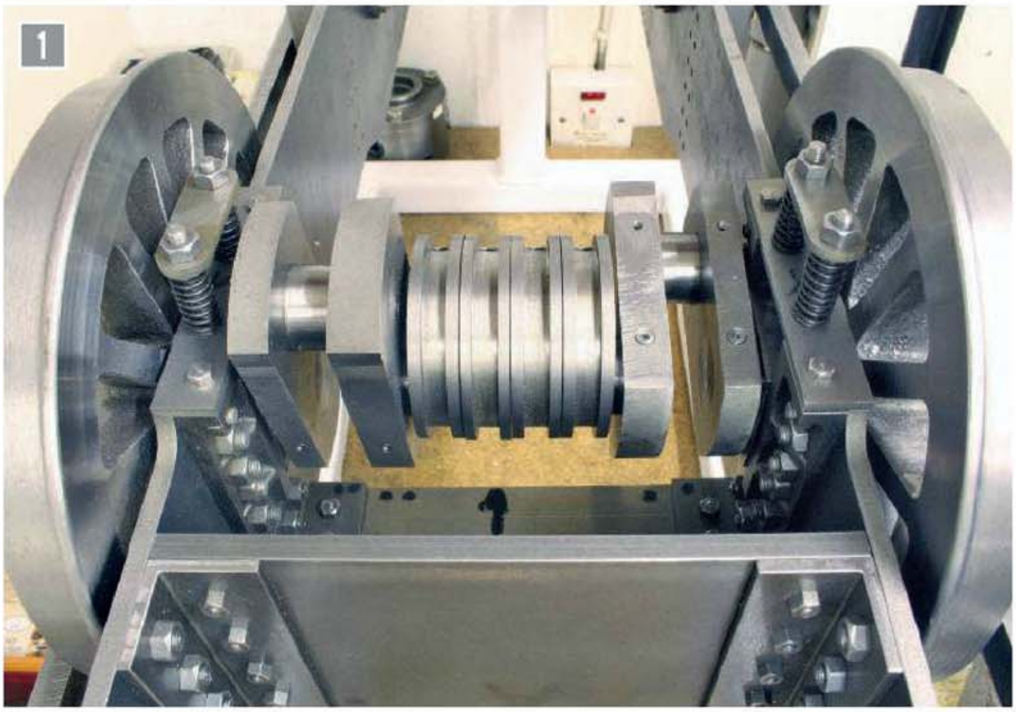
Loctite can 'set' within seconds in some cases, leaving you with perhaps a wheel half on the axle and now stuck fast. The trick here is to slow the reaction down by cooling. Put the clean parts and the bottle of Loctite in the fridge for 30 minutes. Practise assembling the bits dry, to make sure you know how it all goes together when the time comes. Cooling increases the setting time quite lot, perhaps to 10 minutes, although it seems to vary with materials and finish. I don't put shoulders on the axles of my locomotives (as advised by the late Neville Evans), which means I have to juggle distance rods whilst getting the axle assembly into the quartering jig. Cooling the parts down made this a fairly easy job, though quartering the crank axle was still quite nerve-wracking.

If the worst comes to the worst and you have to dismantle a 'Loctited' assembly then heat is about the only method. Loctite gives up and appears to melt at around 300 or 400 degrees C, giving off some quite nasty fumes, so do this outside.

I hope this is all useful information for James Wells.

Best regards,
Tim Coles,
Cambridge Model Engineering Society. The Gas Turbine Builders Association.

1



Emma Victoria
A 5 inch gauge freelance 0-4-0

Drawn and described by **Henry Wood**.

PART 15

Continued from page 729 (M.E. 4469, 15 November 2013)

What brought about the design of this model was a requirement to build a locomotive that could be lifted in and out of a car boot and onto the track relatively easily by one person. It also had to be capable of giving a reasonable performance on the track, have the power to haul at least four adults and be of well-proven construction at a modest cost.

Steam and exhaust pipework

Before the chassis can be run on compressed air to check out the valve settings etc., the steam inlet and exhaust pipework will need to be made and fitted. For the steam inlet pipes I have shown the usual arrangement of two pipes joined into a Tee piece, however, for the exhaust I have drawn up a swept pipe arrangement to help give a free exhaust to the cylinders.

Steam pipes

So for the steam pipes, two pieces of 5⁄16 inch diameter x 18 swg brass tube 2¾ inches long (or 2⅝ inches long for cast cylinder version) are required. These are screwed at each end 5⁄16 inch x 40tpi for ¾ inch length using the lathe and tailstock die holder. It is wise to keep these threads a reasonable fit in the cylinder steam chests and Tee piece.

To make the Tee, a piece of brass block ½ inch thick x ¾ inch wide x 1inch long is used with a piece of 5⁄16 inch diameter x 18 swg brass tube, silver-soldered in the top face. Start by drilling and tapping through 5⁄16 inch x 40tpi on the centre line of the block for the steam pipes. Then drill right through the block from the top face on the centre line with a letter L drill; open out the top of the hole to 3⁄16 inch deep using a 5⁄16 inch diameter drill to accept the steam feed pipe. From the underside, tap out the hole 5⁄16 inch x 40tpi for the oil feed check valve.

The steam feed pipe is made from a piece of 5⁄16 O/D x 18 swg brass tube. This is bent as shown to give an offset of ⅛ inch; on the top of this is silver-soldered a ½ inch x 26tpi union made from brass 5/16 inch long with a ¼ inch bore. The steam pipe, block and union being silver-soldered together using Easy-flo. To complete, four locknuts are now made up from 7/16 inch A/F hex brass, tapped out 5/16 inch x 40tpi and parted off at ⅛ inch thick.

Exhaust pipes

The short stub pipes that connect the cylinders to the swept exhaust pipes can either be made from solid brass bar or built up from brass tube with a brass screwed union silver soldered on.

On my own locomotive, I made these as shown on the drawing by using a piece of ⅜ inch diameter x 18swg brass tube cut to a length of 1¼ inch or (1⅛ inch for cast cylinder version) with a 3/8 inch x 32tpi thread put on one end. The union is made from a piece of ½ inch diameter brass; mount the bar in the lathe chuck, centre and drill down about ⅜ inch with a 17/64 inch drill, open up to 3/16 inch deep with a ⅜ inch drill to accept the pipe. Part off at 5/16 inch long. The union can now be silver-soldered to the pipe using Easyflo; repeat for the second pipe. The two locknuts are made from ½ inch A/F brass hexagon, tapped out ⅜ inch x 32tpi and parted off at ⅛ inch thick.

The next pieces are a bit trickier to make, so I would suggest that the builder sketches out to full size the two swept pipes and their connecting sleeve. This can now be used to lay the pipes over during bending to check their orientation and also used to mark off when cutting to length.

Start off by bending a length of ⅜ inch diameter x 22swg copper tube to achieve the 1 ⅛ inch inside radius shown. This can be done using either a bending tool or a bending spring to avoid the tube from kinking during bending. I bent my own pipes leaving the copper in its half hard state as purchased. However, should the builder encounter difficulties he could try further annealing. Once the required bends have been formed, the next job is to cut the pipes to length as shown on the drawing with the aid of the full size sketch mentioned above.

The top of the pipes can now have half their diameter cut back so that when they are brought together they will form a tube ⅜ inch diameter that can be pushed inside the connecting tube sleeve. At this point it would be wise to make the connecting sleeve. To do this a piece of ½ inch diameter brass should be mounted in the lathe, centred and drilled 11/32 inch diameter to a depth of ⅞ inch; tap out ⅜ inch x 32tpi to a depth of ½ inch, then part off the bar at ¾ inch long. Turn the bar around and re-chuck, drill down ⅜ inch diameter to a depth of ¼ inch, then remove from the chuck.

Push the top end of the two swept pipes into the sleeve and check their orientation by laying them over the sketch. The most important points to watch is to keep the pipes in-line where they connect to the cylinders whilst maintaining the blast pipe connection sleeve vertical.

With the assembly now correct to drawing, use a clamp to hold it together and silver-solder the top of the pipes into the sleeve, ensuring a good joint between the pipes.

To finish off the pipe assembly, two flat faced washers and two union nuts are required. The nuts are made from ⅝ inch A/F hex brass. Chuck in the lathe, centre and drill 13/32 inch diameter to a depth of 1⅛ inch, open up to 15/32 inch diameter and flat bottom the hole to a depth of ⅜ inch. Tap out ½ inch x 26tpi, then part off at 7/16 inch long. Repeat for the second nut.

For the washers, turn a piece of brass down to 7/16 inch diameter, centre and drill 17/64 inch to a depth of ½ inch, then bore a step ⅜ inch diameter x 1/16 inch deep, to accept the pipe a light press fit; part off at ⅛ inch thick and repeat for the second washer.

Slip the nuts onto the pipes, press the washers on the ends and keep the nuts pulled back, silver-solder the two washers using Easyflo.

For the jointing between stub pipes and swept pipes, I made up two washers from 1/16 inch thick 'Walkerite' type of material; these were cut to 7/16 inch O/D with a 9/32 inch diameter hole. I tried an O-ring here but felt these to be too soft for this application, however this can be left to the builder's preference.

To finish off the exhaust pipes, a blast pipe and nozzle are required. For the pipe a piece of ⅜ inch O/D x 18swg brass tube will do nicely. Cut the pipe to 2⅝ inches long, and screw each end ⅜ inch x 32tpi for ⅜ inch length.

To make the blast nozzle, start with a piece of 7/16 inch A/F hex brass, mount in the lathe chuck, face the end, centre and drill 3/16 inch diameter for a depth of ¾ inch, open out with a 11/32 inch drill to a depth of ⅜ inch and tap ⅜ inch x 32tpi. Part off at ⅝ inch long, turn around and re-chuck; turn a ⅜ inch diameter shoulder for ⅛ inch as shown, this is to support the spark arrester. Using a taper reamer if available, enter it in the top of the nozzle to produce a slight taper section as indicated.

Now comes the interesting part - to see the chassis run on compressed air but before this can be done, the cylinders will need to be removed from the frames and gaskets made for the end covers and the steam chests. For these I have always used the paper dividers that are available for A4 files - these are about 0.012 inch thick, and make a nice gasket when smeared with oil at assembly. The pistons will need to have their O-rings or soft packing fitted, which ever option was chosen, and the piston rod and valve spindle glands packed with graphited yarn.

With the cylinders nicely sealed, they can be re-assembled on the frames and secured with 2BA fixings. Next, at this stage, assemble the steam and exhaust pipes dry i.e. do not use sealing compound on the threads until the final assembly. Put a 5/16 inch x 40tpi plug in the oil check valve hole in the bottom of the steam Tee and make up four 3/16 inch x 40tpi plugs to blank off the cylinder drain cock holes. All that is required now is a pipe connection to connect a compressed air supply to the steam pipe.

Before connecting the air supply pipe, put a few drops of light oil down the steam pipe to lubricate the valves and pistons, also oil the rest of the valve gear and motion.

Re-connect the air supply and chock up under the buffer beams to lift the wheels clear of the bench.

Now comes the exciting part! Push the reversing lever fully forward into the full gear notch, slowly crack open the air supply valve and if all as been made and assembled correctly the wheels should turn freely forward. I found that my own locomotive would run nice and steady with only 20psi air supply.

Now comes the exciting part! Push the reversing lever fully forward into the full gear notch, slowly crack open the air supply valve and if all as been made and assembled correctly the wheels should turn freely forward. I found that my own locomotive would run nice and steady with only 20psi air supply.

If all seems to be okay then shut off the air supply, pull the reversing lever fully back into the notch, open the air supply and the wheels should again turn freely backwards. If, for some reason, the wheels do not turn relatively free and smoothly, then this needs to be investigated. Once satisfied with the cylinders and motion, then on the next strip down the crossheads and return cranks can be finally pinned.

To be continued.

CLUB NEWS

GEOFF THEASBY

Geoff Theasby reports.

Gauge 1 Mallard *with* Dwight D Eisenhower *at the NRM. (Photo courtesy of Mike Bland.)*

As this issue is numbered 4472, I'd like to tell you a story about *Flying Scotsman*. I'd like to but I haven't got one, so here is a story about a respected physicist and a kipper. Mention of Richard Feynman* on the website forum (www.model-engineer.co.uk) reminded me of his reputation as a safecracker, not using explosives or a 'jemmy' but using psychology. He realised that people often write down their security codes, passwords, PINs and combinations so he would look surreptitiously in their desk drawers and often find a code, which turned out to be that required. Once, a colleague of mine left his combination briefcase on his desk whilst he went to lunch. Knowing that people rarely change the combination from the default setting, we tried it and – yes! So we opened his briefcase and left a smelly kipper inside, stealing off to distant corners. How we laughed as he departed that evening without opening it! Reader, I worried him…

*For an example of Richard Feynman's style, search online for: 'There's plenty of room at the bottom'.

In this issue: praise and a brickbat, a birthday, a record, a clock, a roller, a crankshaft, two resignations, a fish (another one), slate, nationalisation and a new site.

Most of the photographs in this edition came from the Newsletter & Journal of the Gauge 1 Model Railway Association (**photos 1** and **2**). Incidentally, the National Railway Museum's *Review*, commenting on the Great Gathering of A4s, noted that the Royal Station Hotel, adjacent to the station, achieved a record 98.7% occupancy during this period. (I can recommend their bar meals.)

Dave Haynes writes: 'Firstly, many thanks for the Club News in *M.E.* It is an interesting and informative column and it is good to keep up with the clubs and societies. I didn't write to you the last time it appeared in your column (*M.E.* 4444 Nov/Dec 2012) but I now feel moved to comment on the re-appearance of the Baltic tank at Urmston in issue 4468. There were six types of Baltic tank in the British Isles and, in my opinion, the Furness Railway Baltic tank, which has been attributed to the chief draughtsman E. Sharples, was by far the finest looking. There are various reasons why it stands separate from the others, such as the distinctive framing beneath the smokebox but the main one is the absence of outside cylinders. This particular feature was a necessity due to limited platform clearance on the F.R. main line. Whilst it cannot be disputed that the locomotive at Urmston is a nice Baltic tank in F.R. livery, it is not a F.R. Baltic!' Yes. Research shows that the five Furness Railway Baltic tanks were built for the heavy traffic in and out of Barrow and were unique in having inside cylinders. E. L. Ahrons says that Kitson's built them in 1920 but other sources say they were all gone by 1935.

To counteract this paean of praise, I have received a

Two Gauge 1 Nord locomotives by John Werren and Ernst Hess, SNCF version on the right. (Photo courtesy of John Werren.)

complaint! My correspondent claims that my reports on his activities are trivial and irrelevant to his clubs' activities. I must admit to a dilemma here. Many clubs send me details of daily activities like track relaying, grass cutting etc, which every club does and is possibly only of interest to those involved and regular visitors. I say that I pick out the interesting and even quirky bits, rather than detailed reports of train running, who did what and regular activities which may not interest the casual reader. Reports of club activities should be taken over a period, to get a true flavour of what a club does, not taken in isolation. Lots of clubs have members, even a club ethos, which concentrates on a particular activity or style and they are to be congratulated. Excellence in modelling and aims is a worthy habit and I try to report this but it may not be mentioned every time.

Photograph 3 shows Dan Pantages' Gauge 1 Woolwich engine by Jim Hadden and Gail Graham. This model is patterned after one by Hornsby used at Woolwich Arsenal which was 18 inch gauge. Everything is scratch built, including the spark plug. It runs for 75 minutes on 5ml of petrol.

Photograph 4 is Bill Allen's Gauge 1 scratch built narrow gauge Uintah Railway 2-6-6-2 hauling Dan Pantages' Hadden steam ditcher.

The Whistle, from **British Columbia Society of Model Engineers**, reports that they had a fine summer, with over 66,000 visitors to their railway, which outstrips last year's record of 53,000. Some of their track and switches have been down for 20 years and is beginning to wear out. Therefore, about 3300 metres of track and switches have been replaced. The new carbarn (carriage shed) has been approved. In October members of the club visited Aldergrove Model Engineers, which has a 3-gauge raised track, a Gauge 1 track and a pond.

W. www.bcsme.org

Bradford Model Engineering Society's *Monthly Bulletin* was looking forward to the annual auction and the visit to York Model Engineers, which is right by the East Coast Main Line, so you can go trainspotting on the 'big railway' too! After winning the pop-pop boat competition earlier in the year, President David Bedding was unprepared for the flurry of activity which this provoked. He may have some stiff competition next year! Jim Jennings writes on an unusual clock he saw at Cliffe Castle Museum in Keighley. It uses a conical pendulum, rotating in a circle and was said to keep good time. It dates from one of the Paris Exhibitions of about 1867. Road Vehicle News mentioned the Ingrow Steam Gala at the KWVR. There were Burrells, Fowlers and Garretts, plus the operating locomotives of the KWVR. The 1881 Pudsey Roller is being restored with the help of the Road Roller Association. This Fowler stood in Pudsey Park from 1959 to 1990.

W. www.bradfordmes.co.uk

3

Dan Pantages' Gauge 1 Woolwich engine by Jim Hadden and Gail Graham. (Photo courtesy of Dan Pantages.)

Track Talk, from **Urmston & District Model Engineering Society**, has a nice picture on the front of Allan Hickson at the controls of Wrexham member Ian Murray's fine LMS 'Crab' at the Week of Steam (**photo 5**). Frank Gibson writes about partaking in a driving experience day. Suitably instructed by Keith Tilbury, Frank was eventually allowed out on the track on his own and has subsequently joined the society. An anonymous article relates the R101 disaster.

W. www.udmes.co.uk

The *Monthly Newssheet* of the **Ryedale Society of Model Engineers** relates the visit to Sheffield & DSMEE with their 5 inch gauge Worsdell 'C' class locomotive as in *M.E.* 4470. The driver training days attracted lots of people and locomotives and a good time was had by all. I find it fascinating that people are prepared to run trains to a timetable, using proper signals, bell codes and everything. It must make for a very interesting day.

W. www.rsme.org.uk

A non-enthusiast friend of mine has a friend who builds model locomotives. These take many hours to build and decorate. See: http://raymondwalley.com/loco/gwr/armstrong.html The featured model took 288 hours.

The **North West** group of the **Gauge 1 Model Railway Association** discussed at a recent meeting Maurice Rushby's idea for a built-up crankshaft comprising discs of different diameters, held together with 6BA screws. He

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4

Bill Allen's Gauge 1 scratch built narrow gauge Uintah Railway 2-6-6-2 hauling Dan Pantages' Hadden steam ditcher. (Photo courtesy of Dan Pantages.)

Bucyrus 250 Ton crane from a kit by Alan Friedland, built by Peter Prydderch of the Gauge 1 MRA. (Photo courtesy of Alan J Friedland.)

went on to show some Super-8 films he shot in the 1970s, which were complimented on their quality.

W. www.g1mra.com

Photograph 5 shows a Bucyrus 250 Ton crane from a kit by Alan Friedland, built by Peter Prydderch of the Gauge 1 MRA. I don't think the UK had cranes this big but the USA did. This is not Peter's crane but the photograph was supplied by Alan.

Dave Roberts who has, since 2006, edited 26 issues of the Urmston and District Model Engineering Society news letter 'Track Talk' is standing down. He has done a brilliant job and will be a difficult act to follow. Dave is well known in the North West as a prolific builder of fine locomotives, LNWR enthusiast and frequent participant in the National efficiency trials. Another club member who is well known by members and visitors alike is Alan Simpson (Simmy), one of the founder members of the club, who celebrated his 90th birthday on the 4th of November. There are few engines he has not driven at Urmston, including those belonging to visitors. **Photograph 6** shows him driving the club's electric locomotive, *Spirit of Urmston*. He was taking a train of school children from Cadishead who came to the track by main line from Irlam to Chassen Road just before the summer holidays. It was their big day out organised between the school and the club. Dave also sent me a photograph, which was too small to use, of a model of a Patrick Stirling 4-4-0 in 7¼ inch gauge, taken at the Leyland club. It seems that drawings were produced but no locomotives were ever built.

W. www.udmes.co.uk

(More photographs next time.)

Geoff Dowden writes from **Rochdale Society of Model & Experimental Engineers** to say that he is standing down as editor. He has done the job for six years and taken it from a couple of paragraphs to the large and chatty publication it is today, with lots of photographs of members enjoying their hobby. Also, to amend a phrase often used by politicians, he wants to spend more time with his locomotive…

W. www.rsmee.com

Blast Pipe, from **Hutt Valley and Maidstone Model Engineering Societies**, mentions the model of *Owain Glyndwr* which appeared in *M.E.* 4465 and says that their member Peter Carr has a 3 inch scale model of the same locomotive, 7¼ inch gauge, which has run for many years at their track. In developing a riding trolley to go with his locomotive, John Antliffe adapted a clear plastic tank as the water container. This led to the introduction of a battery powered fish and some weed and may cause some confusion amongst the younger passengers.

W. www.hvmes.com

Wortley Top Forge Model Engineers hosted visits from the Autistic Play Scheme in July and August, with about 40 visitors each time. A new sign has been made for the railway by a local company, at no cost to the club. It was made by shotblasting against a rubber template stuck to a piece of slate. The Forge was visited by about 100 tractors in June, on a run to raise money for Multiple Sclerosis.

W. www.wortleymes.com

I have previously mentioned being given some old copies of *Railway Magazine* and have reached that of March/April 1946, which amused me with the somewhat trenchant views in the Editorial on the subject of the forthcoming Nationalisation of the railways. Of course, this was all new and untried in the UK and, in fact, no-one really knew how it was going to work out. Now we know, of course, and some very fine locomotives came out of it. Other aspects were less successful.

Robert McLuckie writes: 'The **Edinburgh Society of Model Engineers** were given notice to vacate from our current location 8 years ago. The owners of the private estate have been very kind and originally gave us five years but allowed the society to stay until we found a suitable site. The search for land has been difficult but the good news is that we have been successful in our bid for a forest of 11.22 acres. This is to the west of Edinburgh and approx 14 miles away which is not too far to travel. More good news is that we have also been successful in a bid for lottery funding to the value of £8,500 and even more good news is that we have been accepted to receive a £10,000 interest free loan from the Northern Association of Model Engineers. The sale was finalised on the 1st November so we are now proud owners of a very large piece of land. The right hand corner of the site measures 171 meters following the road and 140 metres back from the road. The rest of the site runs diagonally away to the left at some 300 metres. To give you some idea of the size, you could easily fit the cruise liner QE2 on this land with room to spare. We have a lot of work to do first, with planning permission and forest regulations, and how many trees can be felled. However it would be great to get advice from other clubs who have set up a new track from scratch.'

W. www.edinburgh-sme.org.uk

And finally, *'We are more dependent on science and engineering than at any other time in history. However, there is plenty of evidence that far too many people are scientifically illiterate, often having been put off science at school.'*

Robert Winston.

Contact:
geofftheasby@gmail.com

Alan Simpson of Urmston & DMES who celebrated his 90th Birthday on 4th November. (Photo courtesy of George Meldon.)

DIARY

DECEMBER

26 **Cardiff MES.** Steam up and family day (morning). Contact Don Norman: 01656 784530.

26 **Colchester SMEE.** Boxing Day Steam up. Contact Yvonne Chappell: 01255 860765.

26 **Ickenham DSME.** Members' running day. Contact Phil Wimbush: 07759 275353.

26 **Leeds SMEE.** Boxing Day Steam Up at Eggborough track from 10am. Contact Geoff Shackleton: 01977 798138.

26 **Sutton MEC.** Boxing Day Run, 10am – 4pm. Contact Jo Milan: 01737 352686.

27 **South Cheshire MES.** Steam up and get-together. Contact Stuart Daw: 01782 767587.

28/29 **Northern Mill Engine Society.** Steaming Days at Bolton Steam Museum. 10am-4pm. Contact John Phillp: 01257 265003.

28/29 **Nottingham SMEE.** Christmas Holiday running. Contact Cliff Almond: 07812-268559.

29 **Edinburgh SME.** Track running day (Christmas steam up) at Newliston House. Contact Robert McLuckie: 01506 655270.

JANUARY 2014

1 **Chesterfield & District MES.** Arctic running! Contact Mike Rhodes: 01623 648676.

1 **Frimley & Ascot LC.** New Year's Run, 11am. Contact Bob Dowman: 01252 835042.

1 **Ickenham DSME.** Members' running day. Contact Phil Wimbush: 07759 275353.

1 **Northampton SME.** New Year's Day club run with refreshments from 12 noon. Contact: secretary@nsme.co.uk 07907 051388.

1 **NW Leicestershire SME.** Public running for New Year's Day, 12am – 3pm. Contact Den Swain: 01530 412048.

1 **Rochdale SMEE.** New Year's Day steam-up from 11am. Contact Len Uff: 0161 928 5012.

1 **Oxford (City of) SME.** New Year's Day steam-up from 11am. Contact Chris Kelland: 01235 867148.

2 **Sutton MEC.** Bits & pieces. Contact Jo Milan: 01737 352686.

3 **Brighton & Hove SMLE.** Sussex Past; a Magic Lantern Show. Contact Mick Funnell: 01323 892042.

3 **North London SME.** Slides, videos and film etc. Contact: Ian Johnston 0208 449 0693.

3 **Portsmouth MES.** Any Questions. Contact John Warren: 023 9259 5354.

3 **Romford MEC.** Competition night. Contact Colin Hunt: 01708 709302.

4 **Tiverton & District MES.** Running Day at Rackenford track. Contact Bob Evenett: 01884 252691.

5 **Reading SME.** Public running in Prospect Park, 1.30pm. Contact Peter Harrison: 07920 833546.

6 **Lancaster & Morecambe MES.** Informal meeting. Contact Mike Glegg: 01995 606767.

8 **Leeds SMEE.** President's Night. Contact Geoff Shackleton: 01977 798138.

10 **Colchester SMEE.** Andy Hope: Model barge building. Contact Yvonne Chappell: 01255 860765.

10 **Ickenham DSME.** Malcolm Parsons: The Good, The Bad & The Ugly Met. Steam Locos. Contact Phil Wimbush: 07759 275353.

13 **Bedford MES.** Video evening: The North British Loco Works. Contact Alan Beard: 01234 301867.

14 **Northampton SME.** Ollie Batt: LPG Global Transprtation. Contact: secretary@nsme.co.uk 07907 051388.

15 **Bournemouth DSME.** Bob Devereux: South African Steam. Contact George Wheatley: 01202 825307.

17 **Brighton & Hove SMLE.** Bob Bird: Sound on Disc 2. Contact Mick Funnell: 01323 892042.

17 **Rochdale SMEE.** Bob Hayter: Big Boys' Toys. (Castleton Community Centre.) Contact Len Uff: 0161 928 5012.

17 **Romford MEC.** General discussion evening. Contact Colin Hunt: 01708 709302.

18 **North Wiltshire MES.** Play Day, visitors welcome but please contact Ken Parker: 07710 515507.

19 **NW Leicestershire SME.** Public running Winter fun day, 12am – 3pm. Contact Den Swain: 01530 412048.

22 **Bournemouth DSME.** Annual Dinner at the Crooked Beam. Contact George Wheatley: 01202 825307.

22 **Leeds SMEE.** John LInkins: The Middleton Railway. Contact Geoff Shackleton: 01977 798138.

24 **Colchester SMEE.** Contact Yvonne Chappell: 01255 860765.

31 **Brighton & Hove SMLE.** Don Black: Black Gold. Contact Mick Funnell: 01323 892042.

www.model-engineer.co.uk/events/

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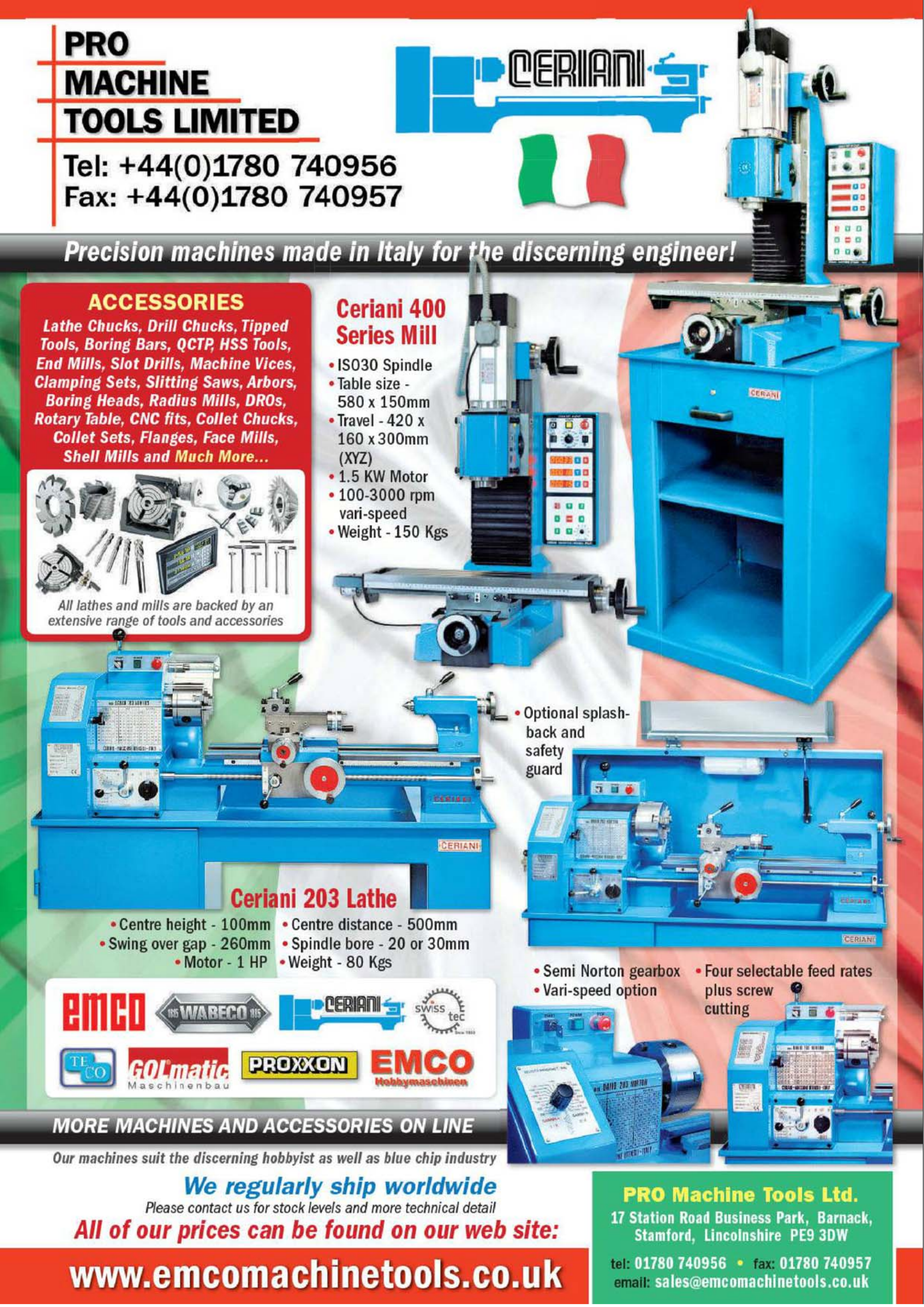
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