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Vol. 202 No. 4351

8 – 21 May 2009

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Model Engineer is published for \$136 per year by MyHobbyStore Ltd c/o EWA Magazines, 205 US Highway 22, Green Brook, NJ 08812. www.ewamags.com. Periodicals paid at Dunellen, NJ. Postmaster please send address correction changes to Model Engineer Magazine c/o EWA at the address above.



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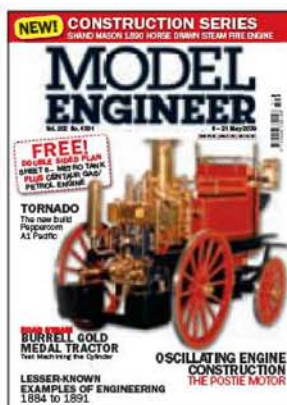
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This superb Shand Mason fire engine was built in 1:6 scale. A construction series with full metric drawings starts on page 568. (Photograph by Gunter Kallies)

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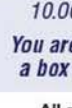
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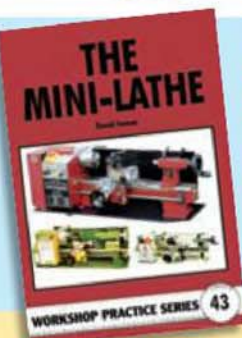
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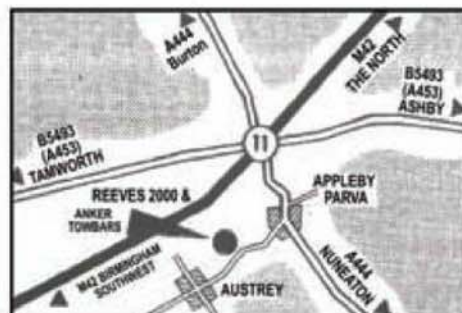


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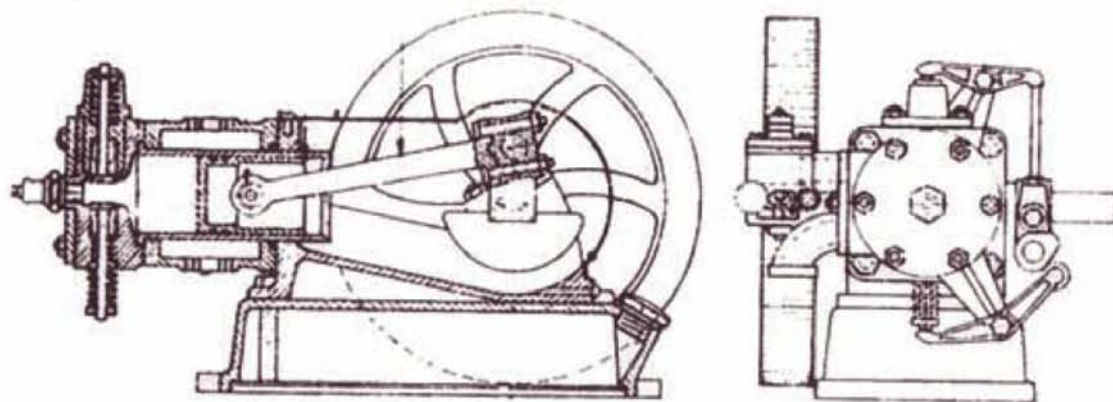
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DAVID
CLARK
Editor

Model Engineer Exhibition - rules and entry forms

During the excellent open day at Myfords mid April, I had a meeting with some of the Model Engineer Exhibition judges about the future of the competitions. There was quite a bit of discussion about modern engineering practices, mainly laser cutting, water jet cutting and kit built items such as Polly locomotives.

Every day, more and more components become available from the trade. You can now assemble a complete cab for a locomotive in a day and assemble a tender in a weekend using a sort of tab and twist system. Where do these commercial items fit into the competition? On the current entry form you have to state which if any components were bought in or not made by yourself. So what does this mean if say, you purchased laser cut frames for a locomotive? Obviously this is not all your own work. What if you purchased a set of frames and drew round them before cutting them out and spotted through the holes from the laser cut master. Could this be classed as scratchbuilding?

What if you are competent in a CAD package and drew out your frames complete and then paid someone to cut them on a laser? Is this different to someone who buys a ready cut set of frames?

What about the use of lost wax castings to super detail a model? How does this compare with someone who fabricated the fittings? What if you make the master pattern and use it to produce more castings?

Clearly a whole can of worms is opening up and I don't envy the judges task of setting up a whole new interpretation of the rules but they feel it has to be done and I for one agree with them.

It is hoped to thrash more details out during the Harrogate Exhibition. The entry forms and rules will be published as soon as they are sorted out.

Harrogate Model Engineering Exhibition

The Harrogate ticket office has had problems for several weeks resulting in many people complaining that they cannot get advanced tickets and some people have been saying they think the exhibition has been cancelled. The exhibition is on as normal and the ticket office will open early each day so visitors can get the tickets ready to go in at 10am: with the minimum of waiting. Don't miss this excellent exhibition; it really is worth a visit. The Friday will be exceptionally busy but Saturday and Sunday are likely to be a bit quieter although still relatively busy. I shall be there for all three days this year so feel free to come and talk to me. I shall be wearing a name badge for easy identification. The exhibition is open on the 8 - 10 of May at the Harrogate showground.

2008 Model Engineer Exhibition - medals and certificates

I managed to sit down before Easter and contacted everyone I had down as not having received medals and certificates. Fortunately it was not as bad as I thought and the majority of winners had already received their medals. In the end, about 10 people had not received their medal but by now, all should be in possession of them. Certificates are to follow and are being done by Mike Law as he has the certificate paper and the template.

In 2009, I would like all winners to collect medals and certificates on the final day of the exhibition when they collect their models. I don't see a problem with this as you have to sign to take your models off the exhibition premises so as long as there is someone to sign you out and give you your medal and certificates, I don't foresee a reoccurrence of last year's problems.

STOP PRESS Readers' Workshops

The *Readers' Workshops* special edition has been delayed a couple of weeks. I am not sure of the on sale

date and am not sure why it has been delayed. I will let you have more information in the next issue. It will include descriptions of 12 workshops, many from well-known contributors to *Model Engineer* and some from *Model Engineers' Workshop* contributors. Also included is a feature on the SMEE workshops at Marshall House written by Mike Chrisp, a former editor of *Model Engineer* so it will be well worth waiting for. You can still pre-order through www.myhobbystore.com or customer services on 0844 848 8822.

Out and about

I had a good run around over Easter week. I went to most places on my list and also got to visit **The Nottingham Society of Model and Experimental Engineers Ltd.** courtesy of Pete Thomas of Polly engineering. I will do an article in the news section, probably in the next issue about the visit. Nottingham has their own tame electrical and electronics chap and one of the items (several of them in fact) he has made are colour light signals powered by LEDs. So what you might say, we all use those but this particular signal light uses only one LED. It is so bright, it can easily be seen well over 50ft. away and I have asked him for an article. You will not believe the light output from this one tiny little LED until you see it.

Myford Open Day

This was a tremendous success. Myford even had their first ever coach party turn up from Woburn. I will do an article in the near future but will say that if you have a chance to visit the next open day, take it. I doubt you will regret it, but your bank manager might! I know mine will this time. I picked up several useful items including a 50mm Mitsubishi face mill that takes octagonal tips. I have been after one of these for ages. There was a wide range of second-hand tools and equipment, not all of it Myford. They ranged from centre drills through to a second user Myford gearbox. Lots of money was spent by all.



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Publication is at the discretion of the Editor.

The content of letters may be edited to suit the magazine style and space available.

Correspondents should note that production schedules normally involve a minimum lead time of six weeks for material submitted for publication. 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.

Cadmium bearing silver brazing alloys

SIRS, - While speaking to Johnson Matthey today regarding Easyflo 2, I was informed that they will no longer supply products containing Cadmium from December and that it was likely that there would be an actual ban on such products very soon. Anyone who needs to get some should get it sooner rather than later! A suggested alternative is to use Silver-flo 55 which has a melting range of 630-660deg. Centigrade.
Colin Ager, Norfolk.

Steam engines return to Stockton on Tees

SIRS, - It was with great interest that I read the article by Graham Tebbs (*M.E.* 4349, 8 April 2009) on the subject of his splendid efforts to reintroduce the building of model steam engines into the school where he works.

I too have one of these little stationary engines, slumbering away in the loft and a bit like its owner, now in semi-retirement but still capable of running should the occasion demand!

Back in the 1970s at Sheffield City College of Education, I was lucky enough to be taught Engineering Metalwork by the engine's designer Mr. T. E. (Ted) Haynes, when there was still a place in the Secondary School curriculum for the teaching of Woodwork and Metalwork. In those days we were assured that these were very much 'shortage subjects'. Alas, no longer.

The college workshops were crammed with wonderful machine tools, together with interesting and enthusiastic people to show us how to use them. For my part, and as far as I was concerned, time spent away from the workshops, studying other subjects such as Psychology or Sociology was verging on time wasted!

I still use, almost daily, the little hacksaw, the engineer's screwdriver and the tailstock-dieholder that I made under Ted Haynes' instruction. They were all elements of his basic

engineering course, as was the brass nameplate I still have on my toolbox.

The little steam engine was our final first-year job, involving almost all the processes we had learned along the way including pattern making, casting, turning, fitting, sheet metalwork, silver-soldering etc.

Mr. Haynes once said, and I think it's mentioned in his book, that one of the best things about building these little engines with schoolchildren was "to see the twinkle in a boy's eye" when they finally worked. And they did work, every time!

Well, I hope that Mr. Tebbs too saw 'the twinkle', and I thank him for reminding me of three very happy student years. And thank you also to Ted Haynes for setting me off on the road to the joys of model engineering, almost 40 years ago.

Steve Taggart, Stamford MES.

Tank sealing

SIRS, - As a regular reader of *Model Engineer*, I note that a discussion is beginning about tank sealing without the presence of heat which causes distortion.

This was a subject close to my heart because I am in the process of building a pair of Foster Wellington tractors in 5in. to the foot. Whilst reading a past copy last year of *Engineering in Miniature*, I read an article where the contributor had successfully sealed a large scale engine tender using a product used by car/tractor restorers to seal leaking/holey fuel tanks.

I can't remember any product names, though I am sure if you look at back issues of the appropriate enthusiast's magazines there will be likely to be advertising of the product.

I hope this may be of some interest in solving this dilemma.
Phil Wiseman, by email.

Universal work holder

SIRS - This very useful item has recently been offered as a subscription enticer for both *M.E.W.* and *M.E.* It has long been on my wish list of desirable gadgets, and may even have influenced my decision to begin a subscription to *M.E.W.*

But when I tried using it, I was a bit disappointed to find that the pins in the moving jaw were rather loose in the fixed part so that they moved about when tightening up or working on a small object. A little investigation soon showed that the holes are a fairly exact 5mm, while the pins were 4.72 and 4.75 millimetres. The solution is very simple! Being lazy and extravagant, I opted for 5mm silver steel. This is a good sliding fit in the holes in the fixed part. The ends of the original pins have been knurled to make them tight in the moving part. But 5mm silver steel is a good push fit, and a bit of Loctite removed all chance of escape. I made the new pins about 1/2in. longer to give a bit more motion, rounded one end like the original, and broke the sharp edge on the other end so that it would push into the hole. I was much relieved to find that when I assembled it, the holes lined up! So, for two pins, you can make this handy gadget much easier to use!

I nearly said the ends of the pins had been 'Manchestered'. Back in the 1950s, long before the age of Political Correctness, at Leyland Motors we were very rude about other engineers. We used to say that hammering a shaft to make it a tighter fit in a hole was Manchesterizing it. A hammer was known as a Birmingham Screwdriver. But the most scorn was reserved for the Tacklers, who kept the machines running in the Lancashire mills until the engineers could get in at the weekend to mend them properly. There were endless tales about their crazy ways of doing things; like the tackler who asked his mate to help him get his wheelbarrow up to the attic. When asked why, the answer was that he wanted to paint it and the pot of paint was in the attic. The ultimate insult on your workmanship was to be told: "You're shaping like a tackler!".

Martin Leigh, by email.

Investment soldering

SIRS, - As a retired Dental Technician, I read with interest Tim Sim's letter concerning Investment soldering (*M.E.* 4346, 27 February 2009). Sadly he is fast becoming a rare breed among Dental Practitioners, those who were well-trained in, and therefore understand the Laboratory side of Dentistry.

His description of the process is clear and I would only like to add a couple of points.

Rather than use a plaster and pumice mix it would be better to use a general purpose soldering investment. Dental Laboratories use different types of investments for specific alloys but usually have a multi purpose investment to hand.

A well-known manufacturer in North America is WhipMix Corp. I am sure their products as well as other suppliers are readily available in the UK. The manufacturer is not important.

As Tim points out, it is vital that all the sticky wax is removed with boiling water and the investment thoroughly dried before heating. In the laboratory, the investment is heated in a furnace to a specific temperature (possibly 700deg. C) to achieve a specific thermal expansion.

This is not necessary for our work but the investment should be heated in an oven to ensure it is completely dry. The investment should then be pre-heated with the torch, preferably on a charcoal block. This will assist in concentrating the heat. The hotter the investment is when applying heat to the part the quicker the solder will melt. Charcoal blocks are available from Jewellery or Dental supply houses.

When applying the solder it is best to wait until the flux becomes molten and glassy in appearance as the silver alloy will melt almost instantly at this temperature.

Rob Hoare, Canada.

Cheap bench drill

SIRS, - I have a problem; I purchased a 'cheap' bench drilling machine for about £25 price for what I hoped would

be precision drilling. However, when I tried it back home the drill wobbled noticeably. Some time later I purchased another drilling machine (I know - more fool me) just the same problem!

My question is, has anyone done the same? But more importantly, has anyone managed to fix it? I have thought of remaking the shaft, which I assume is bent, but is this the cause and will this fix it? I dismantled one drill and it does look like the shaft is bent. Are they made of inferior material?

If advice is to make a new shaft can anyone suggest to this novice, the metal spec to use and any other tips, e.g. should the bearings also be replaced?
Marcus Middlehurst, by email.

New standards

SIRS, - Sometime ago a lively discussion in *M.E.* concerned the European Parliament move to declare ALL imperial thread types illegal. This raised considerable concern amongst the readers. Fortunately after a presentation by NATO the move was dropped. NATO pointed out that many imperial fasteners are used in some 400 million items in use worldwide and to replace these with equivalent metric fasteners was not an option. Many of these fasteners were in critical aircraft applications and to replace them with non-existent metric equivalents was simply not possible. The cost would have been astronomical and the time was predicted to take some 20 years to accomplish.

So effectively the EP ruled that imperial fasteners are legal and it led to the standards authorities to reconsider the position. Today I discovered that the British Standards Institute has made an unheard move of reintroducing a new BA thread system specification, which replaces the obsolete 1951 version. Although the new BS93:2008 only covers sizes from 0BA to 16BA this is of little concern to *M.E.* readers. Common sense at last has prevailed.

John Fielding, South Africa.

The next generation

SIRS, - Many correspondents raise the question, where are the next generations of modellers going to come from and how do we interest them?

My Professional Institution, the IET have created a truly inspiring and award winning publication aimed at teenagers. It is called FLIPSIDE and lets teenagers discover unusual science facts, true stories, film reviews, gadgets, games and lots more. It is written in a modern way, well illustrated and with a clear appeal to its target audience. I was sent a sample copy and having read it myself, showed it to my own grandson, who devoured its contents with enthusiasm. Feedback from his parents inspired me to take out a subscription and he has found the following issues no less appealing. Every issue is greeted with interest and it is avidly read from cover to cover,



Mystery steam engine

SIRS, - I enclose a picture of a machine that was recently given to me. I am told it came from a car boot sale. The bores are 25mm and the stroke is 40 millimetres. The only text I can find is on the bolt heads. There is 'ESKA88' on it. I think the whole thing is metric and I suppose it is built in the Netherlands.

Can anyone tell me something about this little thing, its design, similarities, etc.?

Jan Roos, The Netherlands.

which shows that with this reader it is spot on.

Why not visit www.flipside.org.uk for a closed view, you will not be disappointed I am sure and may even subscribe!
Ken Willson, Fleet.

Mystery engine

SIRS, - Eric Crawford's father-in-law's engine looks well-made (*M.E.* 4347, 13 March 2009), but certain details suggest its design is freelance by comparison with full-size practice. These details are the shapes and proportions of the flywheel and reversing-lever, as it appears to be. The latter is in an unusual location, and I think the reach-rod would have been more substantial flat bar or fish-bellied round section, and straight, not cranked to clear the stand.

Mill Engines were not reversible, although some had variable-expansion valves, so this model could represent a mine winding-engine or similar. Engines for generators, reciprocating water-pumps or factory machinery were normally unidirectional.

It is an interesting machine deserving refurbishing for new lease of life with its new boiler. I can't advise on a boiler, but it should not be too difficult to find one suitable, using its cylinder dimensions and an assumed 60-80rpm as a guide. If it is reversible, it would appropriately drive a miniature colliery-winder, cable-tramway or similar.

Nigel Graham, by email.



MARTIN WALLIS

Martin Wallis
proof machines
the cylinder.

PART 3

Continued from page 501
(M.E. 4350, 24 April 2009)



The Gold Medal
cylinder as
collected from
the foundry.

Half-scale Burrell Gold Medal Tractor

In addition to having poured and sectioned an aluminium cylinder casting it was felt wise to further check that all was well by proof machining all the faces and the cylinder bores before getting any further

castings poured for other builders. No attempt was made to drill the holes for the studs and other fixings. **Photograph 20** shows the view from the front of the cylinder as collected from the foundry and **photo 21** shows the rear cover view.

By far the most common reaction of a novice builder to a cylinder drawing is one of trepidation and worry; there seem to be just so many dimensions and complications and, of course, the worry is compounded (sorry about the pun - couldn't resist it!) by the financial expense incurred. The hole in the wallet will not be small; the last thing a builder would want to contemplate would be an error that could not be remedied. Happily for us the cylinder on the 6in. *Gold Medal* Tractor has far fewer holes and passageways to drill and machine than normal as the majority are cast in. A further bonus is the lack of liners;

so two less parts to machine and no press fits or shrink fits to worry about. Remember, a complicated drawing is no more than the sum of a lot of simple ones, so take it one step at a time and don't worry.

'Be careful' may be too obvious a piece of advice, but even the most experienced machinist ought to still check twice and cut once. When a job is set up, and all is well, there is still merit in retiring for a cup of tea or to cut the grass and upon return re-checking everything again before starting. Before I bought my Sykes gear cutting machine I did all my gear cutting on my Bridgeport with a dividing head and form cutters; on one occasion after cutting many gears I forgot to lock the quill and during the course of cutting the teeth the quill crept down, only a tiny amount, but enough to ruin the job. So be careful, it is often the obvious that may be overlooked.

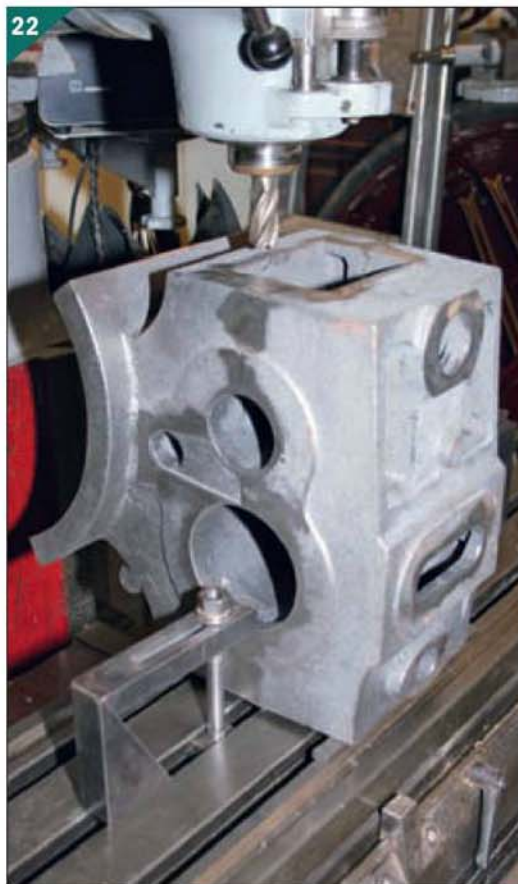


Around the back are the two cylinder bores, high and low pressure, below the HP bore is the cored hole for the LP exhaust.

Datum faces

The first requirement is to create some flat faces from which to work; both to enable the cylinder to be conveniently clamped down on the machine and so measurements may be more readily taken. The largest face is the low pressure valve chest so the casting was clamped to the table on that (**photo 22**). The LP face will be slightly convex because of the draft angle from the pattern so sit it on four little bits of packing, one in each corner. Use a large engineer's square to check that all the vertical faces that ought to be vertical are vertical. If necessary adjust the packing to get the best compromise.

The HP valve chest face may then be machined, just enough to remove the draft angle and give a flat surface. The casting is then turned over to machine the LP face (**photo 23**). In both cases only enough metal is removed to clean up the faces, the more metal that may be left the better as it gives more room to make adjustments if required later.



The cylinder is positioned with the largest face, the LP chest, on the machine table.



After machining the HP face the cylinder is turned over to machine the LP face. Note the two drain cock bosses cast under the LP bore.

Angle plates

Using an angle plate the cylinder may then be reset on the machine the right way up holding it by one of the valve chest faces. Since I had two angle plates it made a lot of sense to use both (**photo 24**) as the rigidity was greatly improved. The second angle plate was one I bought very cheaply a while ago, the low price was the result of it being

scatter gunned with assorted holes, evidently greatly reducing its desirability. The advantage for me is that I do not think twice about adding an extra hole of my own, which in this case I did.

The next important check is to see if the centres of the cylinders are horizontal (**photo 25**). This was measured with a vernier and found to be within just 0.025in.



The cylinder is returned the right way up and held between two angle plates. Note the dti to establish if the top face is horizontal.



Checking that the cylinders centres are horizontal. Measurements were taken from the top and bottom of the slide bar registers and the cored gland holes.



26
The back of the cylinder where the cover fits is machined. Note again that two angle plates are used for maximum rigidity. Note the stud, packer and nut still in the regulator chest from previously holding this face to an angle plate to ensure verticality.



27
The cylinder is resting on the machined back face and is set axial to the table so one of the gland bores may be completed and the table then indexed along to bore the other.

were not horizontal a small correction could have been achieved by packing the angle plate(s) a fraction away from 90deg. thus tilting the cylinder. Naturally the LP and HP valve chest faces would then need to be re-machined, but remember these were deliberately left over size should any 'adjustments' prove beneficial.

Measurements need also to be taken around the back of the cylinder to confirm the two bores concur with the bosses at the other end, happily they did. The regulator face at the top of the cylinder was then machined along with the other horizontal surfaces.

The cylinder is reset to machine the chimney end, it being easy to set up as there are plenty of machined faces to work from (**photo 26**). After the back of the cylinder has been machined the cylinder may be turned over so the two bosses for the HP and LP glands may be faced off and bored (**photo 27**). The bore sizes are left undersize to allow for subsequent finishing once the pistons and rods have been fitted.



28
The extended tooling to 'pick up' the machined holes at the bottom of the bores.

which was considered to be rather impressive - although an element of luck was undoubtedly present. I guess perhaps it ought to have been pretty good as the pattern was completed on the Bridgeport for greater accuracy.

The piston rods need to pass through the middle of each of these two cast bosses. It would look mighty strange if they did not, so the two bosses need to be properly horizontal. If by mischance the two bosses

Machining the bores

The bores need to be set to the holes previously bored for the glands, which inconveniently are right at the bottom of the cylinders. To pick up the gland holes the tooling illustrated in **photo 28** was made. It is nothing more complicated than a straight piece of steel bar with a sleeve on the end to correspond with the gland hole. The system



29
The low pressure bore is the easy one as both the boring head and quill will fit down the bore.



The high pressure bore is machined with as rigid a bar as may be employed, the dti is used to set the tool between cuts.

worked very well and the two holes were confidently picked up by 'feel' within a thou. or two in both cases.

The low-pressure bore was very easy to machine as both the machine's quill and a small boring head would fit down the cylinder bore (photo 29). With a boring head there is a graduated feed screw so it is easy enough to put on the cut. The cuts get ever lighter as the finished size approaches; by the last few cuts it is likely that the cuts may become so small that you will be uncertain if it is cutting at all. To measure, use an internal micrometer or turn a plug gauge to work to. It is worth taking care on the bore as you will in all probability be purchasing the piston rings and you want the best possible fit.

Once the bore is to size, before disturbing anything, machine the cylinder counter bore. The counter bore is an essential feature as it allows the piston rings to pass the ports before they are compressed into the bore.

As the quill is bigger than the bore the high pressure cylinder will require a substantial boring bar, the bigger the better. The bar illustrated is simply a piece of steel rod electric welded straight on to the end of a blank R8 shank (photo 30). These are easy enough to purchase from the trade. My R8 shank was certainly tough



Fly cutting the underneath of the cylinder.

but not hardened so it could be turned to receive the boring bar.

To set the cutter use a dti, this with care will allow small tool adjustments to be made. When advancing the cutter the dti is zeroed against the tip of the tool and the grip from the Allen screw which holds the tool in place is gently relaxed. A tiny tap or two from a small hammer advances the tool, the amount being recorded as you go.

Fly cutting the underneath

With a slow spindle speed and a tipped tool, ground to a near point, the underneath of the cylinder may be machined (photo 31). Too large a radius on the tip of the tool will cause chatter as the length of cutting edge in contact with the work increases. For the moment the cylinder has been machined with the tool set to sweep out

a 10.75in. diameter. This is the size of the boiler barrel but it may in due course be increased a little depending on how thick a gasket I use.

Fly cutting the underneath of the cylinder is one of those intermittent and potentially noisy jobs that are best done while the neighbours are away. Once done there is nothing to beat popping the cylinder onto the boiler to feel you are really getting somewhere. Real progress is being made.

Valve ports

The only modification that has been made to the pattern post the iron casting was to the valve ports. On the aluminium casting they were exactly as intended with a small machining allowance on all the port edges. Rather annoyingly on the cast iron cylinder the

machining allowance had disappeared, and it was a day or two before I realised why.

It had been impressed on me by model engineer friend of the need to make sure the foundry applied a refractory coating to the sand where it was in contact with the molten metal as otherwise the sand can fuse to the metal, indeed if the sand has not been fully compacted the metal can 'soak in' to the sand filling any sand voids, causing all sort of problems machining and cleaning up the casting.

I was assured by the foundry that a coating would indeed be applied to the sand, for the reasons I already knew about. I would guess that with the thinness of the port cores that the foundry may perhaps have given these cores two coats of refractory coating, or at least a heavier one than usual. The physical thickness of the coating increased the cross section of the sand core and thus the size of the cored valve port slots. I have, I hope, rectified this by gluing thin veneers to the sides of the core boxes to reduce the thickness of sand to allow for the coating.

Photograph 32 shows a full-size Gold Medal Tractor cylinder.

That concludes the initial preamble on the Gold Medal cylinder, it is now time to retire to the workshop and build some more of it before for the serialisation starts in earnest.

● To be continued.





TIM COLES

Tim Coles looks at the superb new-build Peppercorn A1 Pacific locomotive.

Some years ago I was manning the stand for my company at a trade exhibition when, during a quiet moment, I fell into conversation with a gentleman on a nearby booth. We quickly established a mutual interest in things railway generally and steam locomotives in particular. My main devotion has always been to live steam models but I had been vaguely aware of the *Tornado* project. It turned out that this gentleman, Chris Scott, was one of the founder covenants and activists in the organisation. Chris was able to tell me about the origins of the project in 1990 when a handful of enthusiasts mused on the lack of a preserved Peppercorn A1 Pacific. There had been attempts in the dying days of steam to save *Saint*

Mungo from the cutter's torch but these came to nothing and the breed became extinct. One bright spark amongst the enthusiasts suggested that they might build a new one; somehow the idea took hold and thus The A1 Steam Locomotive Trust was born.

The Trust's plan has always been to build a completely new locomotive, without using second-hand components or materials. She was not to be a replica of one of the original A1s, but to be the 50th member of the Class. In this way improvements and modifications could legitimately be incorporated for 21st century main line operation. Apart from generally using modern materials and construction methods, *Tornado* has a fully welded steel boiler



The inside connecting rod fully machined but without bearings.



The beautifully finished safety valves.



Left-hand outside cylinder and slide bar assembly.





Whipping up a Tornado!

Tornado pictured just after the official unveiling ceremony at the National Railway Museum in York. Photo: The A1 Steam Locomotive Trust.



The impressive front end of Tornado.



The centre coupled axle from below, showing the massive crank webs. Note the lower hornblocks with axlebox keep pins removed.



View of a hornblock showing that it is bolted to the frame, not riveted.

instead of a riveted structure with a copper firebox. Both vacuum and air brakes are fitted and the electrical systems incorporate a steam turbo-generator, dual battery circuits, AWS (Automatic Warning System) and TPWS (Train Protection and Warning System). Overall, the wiring has absorbed an amazing 2.4km of cable. Since no water troughs remain on the railways of this country, the water scoop gear has been omitted from the tender with the result that water capacity has been increased from 5,000 gallons to 6,150 gallons. When running on the main line it is planned that *Tornado* will pull lighter trains of 10 or 11 coaches than its predecessors which regularly hauled 15 coaches, but will run at higher speeds to fit in with modern traffic schedules.

Much of the £3 million or so needed to build this new locomotive has been raised by the many covenanters. These good souls agreed to make regular monthly donations to the Trust, which has charitable status, allowing it to optimise taxation and thus receive £12.82 for every £10 donated. There has also been generous support from industry, notably William Cook Cast Products, Rolls-Royce,

Cores and BAe Systems. There were times when the project wavered, but a strong management team was eventually established under the chairmanship of Mark Allatt, and the result has been a highly successful completion of the locomotive. *Tornado* first moved under her own power at the Darlington Locomotive Works in August 2008 after which she was moved by road to the Great Central Railway at Loughborough. Here she immediately performed almost perfectly 'straight out of the box', hauling 550-tons at 50mph with ease. After a number of trials, tests and minor adjustments, she was

moved to her temporary main line base at the National Railway Museum in York, where she was painted in LNER Apple Green with 'British Railways' on the tender and fully lined out, in preparation for unveiling by Dorothy Mather, the widow of the designer Arthur Peppercorn, in December 2008.

Tornado already has many bookings to haul both main line and heritage line trains in 2009. She is destined to become quite a familiar sight up and down the country in the future, a fine tribute to the many that supported the project for so long. The final question is - what will the Trust build next? **ME**



The locomotive's nameplate.



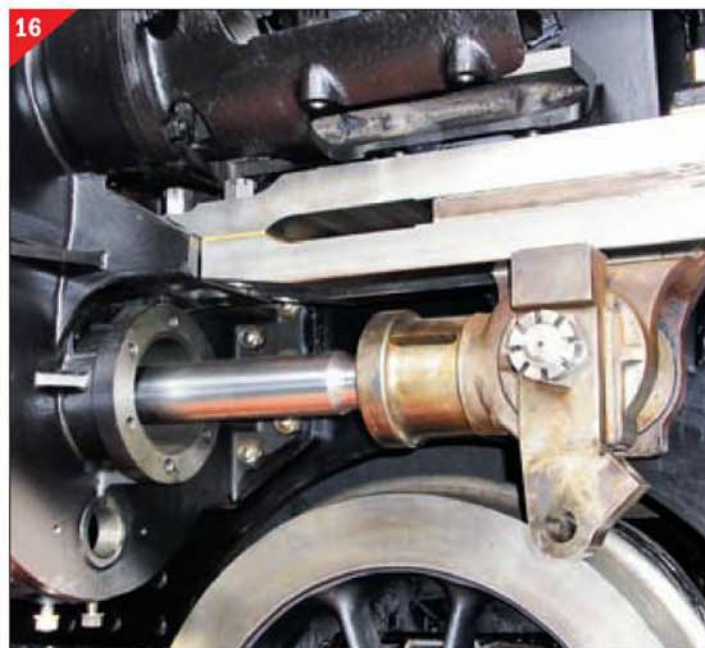
The massive big end of the inside coupling rod, minus the split bearing.



The cab structure in place.



The left-hand valve rod guide casting, bolted to the cylinder block.



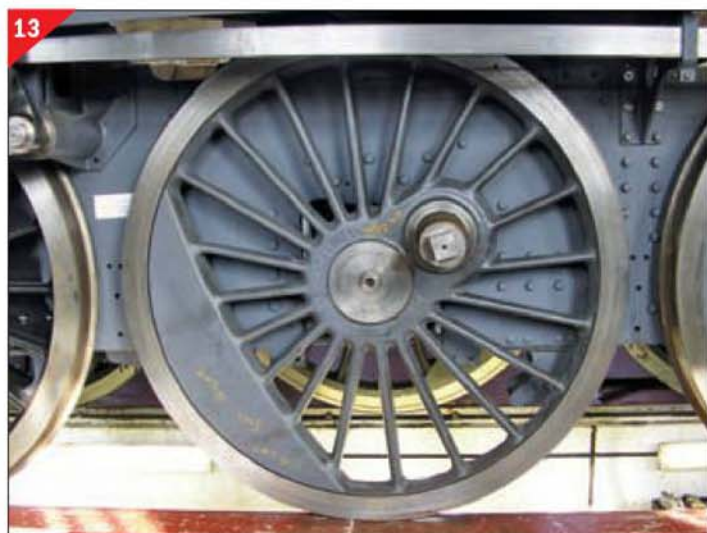
Slide bars, crosshead and piston rod. Note the packing distance piece between the top and bottom slide bars.



One of the cartazzi axleboxes for the trailing axle.



Knuckle joints on the coupling rods - sculpture in steel.



The centre coupled wheel with square-ended crankpin.



The left-hand cast steel crosshead with welded drop arm.



General view of the locomotive before the boiler was delivered, during a covenantor's inspection.



Bits and pieces of valve gear awaiting assembly. Just like a model, only bigger - and a lot heavier!

An Engine Driver's STORIES



HAROLD PEARSON

Harold Pearson concludes his reminiscences about his father's time on the LMS Railway beginning with breakfast on the footplate.

PART 3

*Continued from page 521
(M.E. 4350, 24 April 2009)*

It was the regular practice of footplate crews to cook food whilst on the job, usually during a period of waiting, at the beginning or end of a journey. Food was cooked on the steel shovel used for firing the locomotive; the shovel had a long narrow deep blade and a short handle to enable turning in the cab's rather restricted space. It was made very hot by perching it on the lip of the fire hole with the blade just inside, and then washed off using the fizzle pipe. Food being cooked was generally restricted to some sort of fry up, the favourite being bacon and eggs with the occasional sausage. A lump of cholesterol generating lard would be melted in the shovel, bacon and/or sausage tossed in and the shovel returned to the fire hole. When nearly cooked, eggs would be added along with some thick chunks of bread.

I do remember my dad telling me of an over enthusiastic fireman who turned up the blower sending dad's cooking breakfast over the brick arch and into oblivion. Such a meal nowadays would be looked upon as a potential recipe for a heart attack. I feel there was far less danger to health in those days due to the hard physical activity involved that kept the men fit. It is, however, interesting to note that after the demise of steam dad lost a number of his mates to stress

related illnesses, strokes and heart attacks. He remarked to me that he felt it had something to do with the lack of activity and related boredom in driving diesels and electric trains, mile upon mile of track disappearing under the flat front of the engine, in particular after the second man was dispensed with, leaving the driver on his own in the cab.

Interests

As previously mentioned my father had many interests, including canals, fishing and railways. In his days as a single man he also did a lot of cycle touring. He was a prolific reader enjoying a vast range of subjects, in particular, history and exploration. Astronomy was another subject that fascinated him, though he never owned a telescope as any decent instrument would have been very expensive in those days. I know he considered making his own Newtonian reflector. I well remember, as a young boy, dad giving me basic astronomy lessons as we walked home from our local cinema on frosty nights, bag of hot chips in hand, with dad pointing out Orion's belt and sword. I can't remember how long I have known the speed of light as 186,000m/sec, that the Sun is 93 million miles away and that Proxima Centuri is the nearest star outside our Solar system, but I do know it was he who gave me the information. Today, fine telescopes are available at affordable prices, I own two; a 5in. diameter Masutov-Cassegrain and an 8in. diameter Newtonian both fitted with automatic motor driven tracking mounts. Dad was also responsible for introducing me to model engineering, which has become my lifelong hobby.

When I was 12 years-old he took me to an open day at the **Birmingham SME** track, then Campbell Green and that, as they would say, was that.

A project he took on with success was growing his own tobacco. I'm not sure if it would be allowed these days? The plants were massive, a good 6ft. high with big leaves. He went about the whole process in a professional manner writing to manufacturers and reading everything he could get on the subject. When the leaves were mature they would be picked and suspended on copper wires from beams in the loft to dry. Once dry they needed processing to remove as much nicotine and saltpetre as possible. There was so much saltpetre in a dry leaf it would, if ignited, completely burn up fizzling like a firework fuse. The curing process involved soaking the leaves in a mixture of rum and black treacle plus a dash of fragrance supplied by the tobacco company. After an appropriate period the soaked leaves would be stacked in a pile about 2in. high. Sandwiched between two flat bits of soft pinewood they would be pressed in a screw down paper press, extra pressure was applied every day until all the nasty stuff had been squeezed out, and boy, it was foul! What was left was a thin rock hard slab that dad would slice up with a very sharp knife, this he would rub and blended with his favourite commercial brand Bruno Flake. His 'stock' lasted him several years. But, as they say 'There is no such thing as a free lunch'. When the garden was re-planted with traditional crops of potatoes, onions, carrots and tomatoes, nothing would grow! On consulting the 'experts', some avid gardening mates, the conclusion was that the tobacco plants had drained large amounts of nutrients from the soil. To recover the soil would have to be heavily fertilized and left fallow for at least a year. It was fortunate milk and bread were still delivered by horse-drawn vehicles! (Younger readers can work out for themselves why this was beneficial).



A Black Five locomotive.



A Midland 4-4-0 Compound.

Later years

From 1956 to 1962 I was employed as an apprentice toolmaker at Metro Cammell, Saltley. Amongst other things, Metro Cammell produced Diesel Multiple Unit (DMU) Railcars in 2, 3 and 4-car units. When completed they would be taken for a test and certification on the main line. This required having a regular BR driver onboard, the nearest supply being Saltley locomotive depot just a mile or so down the road. Dad had landed this duty several times but on this occasion both he and I were in for a surprise. I was minding my own business working away in the tool room when the machine shop manager, a tall chap in a nice suite came up to me and said "Hi Harold, you've been selected as today's apprentice to go out with the railcar testing crew, take yourself out to the sidings and report to the bloke in charge of the DMU that's standing there". "Oh and your dad is the designated BR driver for today". That was a very memorable morning for both of us.

Did dad have favourite locomotives? I know he liked the ubiquitous Black Five and also 4-4-0 Compounds (photos 6 and 7) when in good order. **Photograph 8** shows dad on the footplate, 1950s I think. He became disillusioned later in his career as the rail network gradually disintegrated under BR. He was not against change but he did not like to see the steam locomotives and the railway system in general decline into disrepair whilst at the same time crews were expected to keep trains running on time. In the early 1960s he was retrained for diesels and diesel electric engines. In 1971 at 63 he took early retirement. After retirement my parents moved from their house in the Yardley area of Birmingham to a terraced cottage on the outskirts of Huddersfield. This suited them both, bringing my mother closer to her Lancashire roots and giving my father lots to do, with his fishing, canals and railway interests.



Dad sitting on a locomotive footplate - unfortunately I don't know which one.

Between 1984 and 1986 he suffered several strokes that rendered him wheelchair bound, unable to speak and, most distressing to him the loss of his ability to read, though in other respects still very *compos mentis*. His disability forced a move from Huddersfield to a retired railwayman's home in Doncaster. It wasn't long before the increasing demands on my mother become too much, forcing another move to a care home in Haughton. At this time, when I was not overseas, I was living in Solihull with my wife and two young sons. One weekend I brought my mother and father to stay with us in Solihull. One afternoon I was talking with dad, with my 8 year-old son Reg. At the mention of Tyseley Railway Museum dad's eyes lit up. "They have LMS 5X Kolhapur on shed". Great interest was shown by dad via his body language. Continuing the conversation I remarked "You drove that locomotive, didn't you?" In perfectly spoken words my father replied "Yes, many, many times". As far as I could ascertain he had not spoken since his last stroke some 12 months before and never spoke again after. Some years later I was talking to

a neurologist who explained that it was not unknown in such cases for a particularly strong memory to stimulate neurons in the brain into getting their collective acts together resulting in perfect functionality for a few seconds. For me it served to reinforce my belief in just how much my father loved the railway. Dad passed away quietly in his sleep in January 1989 at the age of 81. It was also significant to me that he ended his days in Doncaster and Haughton, considered by many to be the birthplace of steam railways.

Dad's favourite locomotives

4-6-0 Black Five

The Black Fives were a mixed traffic locomotive, a 'do-anything go-anywhere' type, designed by Sir William Stanier, who had previously been with the GWR. In his early LMS days he designed his Stanier Mogul 2-6-0 in which he experimented with the GWR school of thought on locomotive design. A number of details in this design he would never use again realising the superiority of details not used on the GWR. But Stanier realised that there was a need for larger locomotives. These were to be the LMS's version of the GWR Halls.

They shared similar cylinder arrangement (two outside), internal boiler design and size and 6ft. driving wheel diameters. Despite the small driving wheels the Black 5 was capable of speeds up to 90mph.

Fowler 4-4-0 Compound

The 4-4-0 Fowler, built by the LMS after the grouping, and surviving well after nationalisation, was a development of the earlier Deeley design.

Weight: Locomotive 61-tons, 14 cwt

Driving Wheel: 6ft. 9in.

Boil Press: 200lb/sq in Su

Cylinders: Three (Outside) 21 x 26in. (2 low press) (Inside) 19 x 26in. (1 high pressure)

Valve Gear: Stephenson LP: slide valves and HP: piston valves

TE: 22,650 LP cylinders @ 80% boiler pressure.

4-6-0 Kolhapur

Kolhapur is one of the numerous 3-cylinder Jubilee class locomotives designed by Sir William Stanier for express work on the London, Midland & Scottish Railway. Kolhapur was one of a batch built by the North British Locomotive Company in Glasgow in 1934. Locomotive No. 5593 worked all over the LMS system from St. Pancras to Derby, Nottingham and Manchester, from Leeds to Carlisle and from London to Birmingham and Bristol. The locomotives were given the LMS power classification 5XP and were often referred to as 5XPs. In BR days the classification was changed to 6P5F.

Acknowledgments

The author wishes to thank the following people for their help in the preparation of this article. Diesel Multiple Unit (DMU) - Mr. Peter Boggis, www.peterboggis.co.uk LMS 4-6-0 Black Five - John Sherrett, www.black5photos.co.uk Fowler 4-4-0 Compound - Howie Milburn, www.rail.co.uk Also, grateful thanks go to Mr. Ron Isted and Mr. Peter Rich.

ME

The Re-Cycle Engine



DAVE FENNER

Dave Fenner finishes the cylinder head and makes the valve guides, valves, caps, springs, circlips and rockers.

PART 7

Continued from page 507
(M.E. 4350, 24 April 2009)



Work is canted 10deg. by vice then rotated to bring the scribed line vertical.

The remaining work is undertaken on the two flats. First, with each flat set horizontal, drill and tap the positions for the 6BA bolts, and lightly drill the port centre with a small centre or spotting drill. You may choose to leave the 6BA features, and spot through later. The final two operations are to drill the gas passages to intersect with the valve centres. In my case this was done by 'Mark One Eyeball' - well actually a couple of lines were scribed across the top of the head for guidance.

Now that the thing has been measured and drawn, my trusty CAD system tells me that the required angles are 21deg. in one plane, and 10deg. in the other. To set this up, my approach was to set an angle vice to 10deg., then rotate the blank to bring my scribed line vertical (**photo 66**). The passage was then started with a centre drill and continued with a 5mm dia. drill to break into the port.

At this stage, the primary work on the head may be considered complete. Further attention will be needed later,

fitting the valve guides and then cutting valve seats. **Photograph 67** shows a view of the top side of the head with one valve removed. **Photograph 68** gives a 'combustion chamber' view in which carbon deposits are evident in the vicinity of the exhaust valve.

Valve guides

The guides are a simple turning exercise using phosphor bronze bar (**fig 24**). I chose to locate the work in a collet (**photo 69**). To ensure concentricity of the external location diameter and the bore, these should be tackled at one setting. Turn the 4.76mm diameter (adding a bit of a lead chamfer) to be a light interference fit in the head, and drill through with say a 3mm drill. Reverse in the chuck to deal with the 5mm diameter. The guides need to be installed vertically in the head and my approach is to follow full-size practice and make a small double diameter drift which will hold the guide. This can then be held in the drill



View of upper head details.



Detail of combustion chamber (exhaust valve in place).

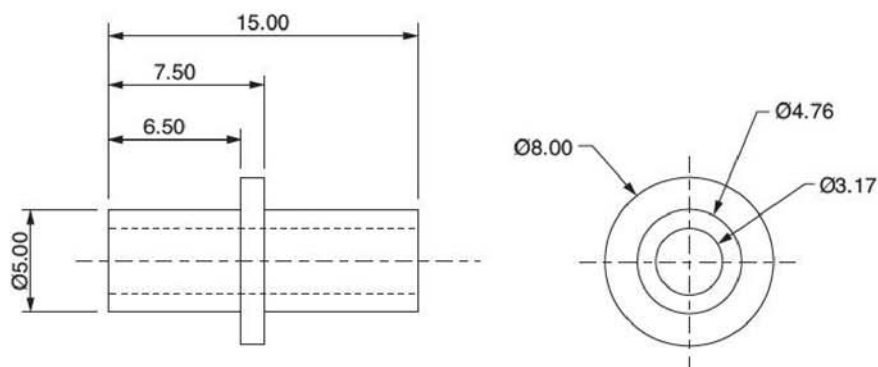
press or mill, and the guides pushed down whilst held vertical. The guides are assembled into the top of the head. It is possible that the drilled bore may have collapsed slightly, so now is the time to ream out for the valve. I have specified 3.175mm because I have a 0.125in. reamer. If you think metric, then go for 3mm and make your valve stems to suit.

Valves

The material used for the valves was a free cutting stainless steel probably 303 (**fig 25**). If you have a really heavy duty machine then you might care to try cutting your valves in one pass. When I made valves for the Bentley BR2 engine, I still had the Herbert 2D capstan lathe, and it proved possible to make up a sort of form tool, and rip the 16mm stainless bar down to stem size in one pass with very good accuracy. Because the work retains its main diameter ahead of the tool, it also maintains its rigidity. The problem is that the cutting load is way in excess of what most of our hobby machines are intended for.

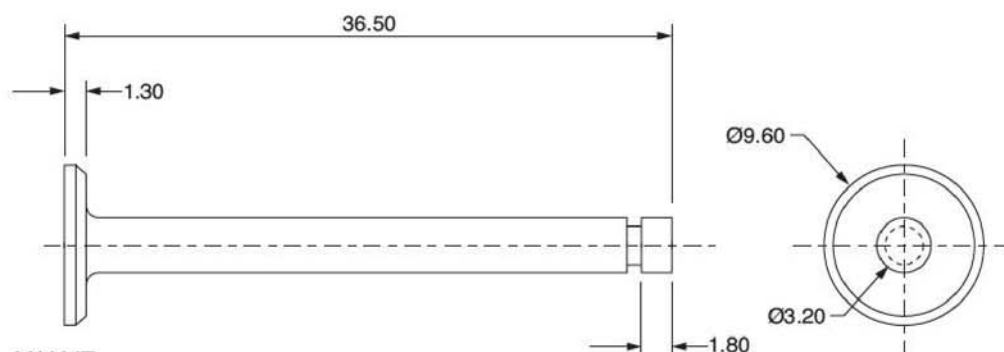
One effective approach is to start by making the valve overlength with a 60deg. point and supporting this point in a female centre. **Photograph 70** shows this set up, where the support is nothing more than a bit of brass bar faced and centred with a small centre drill. Make sure the stem is an easy

Fig 24



VALVE GUIDE
MATERIAL: PHOS. BRONZE
2 OFF REQ'D

Fig 25



VALVE
MATERIAL: STAINLESS STEEL
2 OFF REQ'D



An ER collet chuck was used to turn the valve guides.



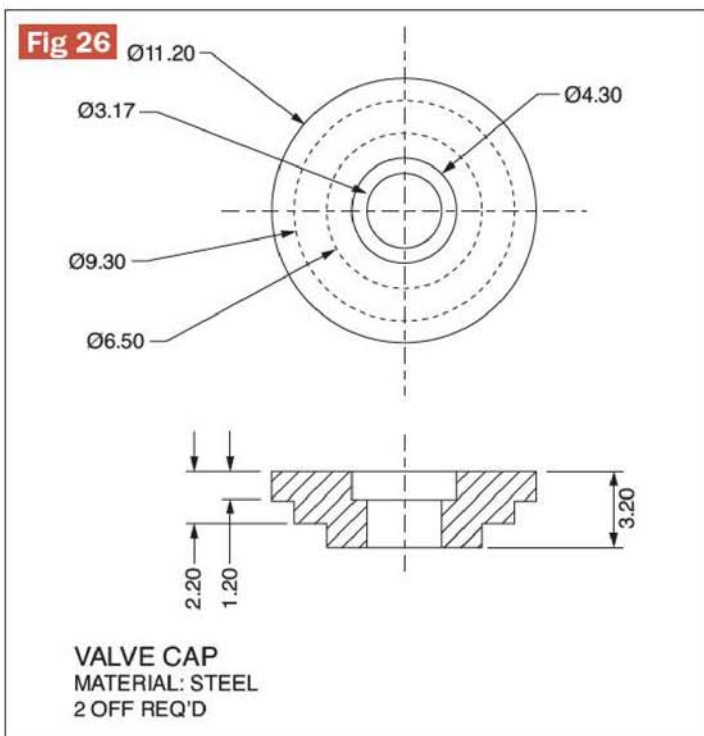
Turning valve using female centre to steady.



Split collet used to hold valve for later operations.



Groove is clearly visible on valve stem.



sliding fit in the valve guide. The embryo valve may then be parted off.

My method of workholding for subsequent operations was to make a split collet as shown in **photo 71**. The key features are that the I/D matches the valve stem, and the O/D exceeds that of the valve head. It was made by turning and drilling a length of steel bar, then adding two grooves. It was then cut by hacksaw or more precise means into three pieces, and here I would suggest identifying the parts 1-2-3. Wire rings were then made and placed in the grooves to keep the parts together.

With the aid of this collet, it is then straightforward to hold the work for facing to length and adding the groove on the

valve stem. This groove should be cut slightly over 0.9mm wide, and 0.45mm deep, as this will then accommodate a home-made wire circlip, made from 0.9mm dia. copper wire. This feature is clearly visible in **photo 72** which shows a completed valve.

Caps, springs and circlips

The cap is shown in **fig 26**. To make the caps, the underside features and central hole were cut on a piece of 12mm dia. free cutting mild steel bar. After parting off a little oversize, it was reversed in the chuck, faced, and the 4.3mm counterbore added. This was cut using a purpose made D bit shown in **photo 73**. This bit has been made very short and



Purpose made D bit to cut recess in valve cap.

stubby, and hence rigid. Thus, provided the lathe tailstock is accurately on centre, it can be relied on to cut a closely tolerated counterbore. Upper and lower views of a finished cap are shown in **photos 74** and **75**.

It would be tempting to say that the choice of spring was made after careful calculation and analysis. It would also be totally untruthful. The valve springs were a find amongst a job lot purchased at Harrogate, and the specification is: outside diameter 10.8mm, wire diameter 0.62mm, free length 19.6mm, number of coils 4.5 plus two half turn flats.

To retain the cap and spring on the valve, wire circlips

were made from 0.9mm copper wire. (A reel of this had been purchased some years earlier from Maplins, to wind an ignition coil for a Villiers-engined Allen Scythe.) Making the circlips was a fiddly job involving pliers and side cutters. Once fitted to the valve stem, the close fit of the counterbore in the cap, ensures that all stays in place. (Those with ready access to an engineering supplier might choose to use small E clips as recommended by Nemett.)

Before finally fitting the circlips, some care should be taken with regard to the valve seats and valve sealing. When it came to getting the valves to seal, I decided to



View of top surface of valve cap.



Valve cap, underside view.

cut angled seats, and to do this made several 'cutters'. As these were made by Loctiting a piece of unhardened steel to a silver steel shaft, (**photo 76**) they may be thought of as 'rubbers' or 'abraders' rather than cutters. Nevertheless, using these, seats were created, closely concentric to the bore of the valve guide. At this stage, perfect sealing was not obtained, even after a fair amount of attention by way of traditional valve grinding and hence when trying to start the engine, means were sought to spin it over smartly. After just a short time running, the compression improved markedly.

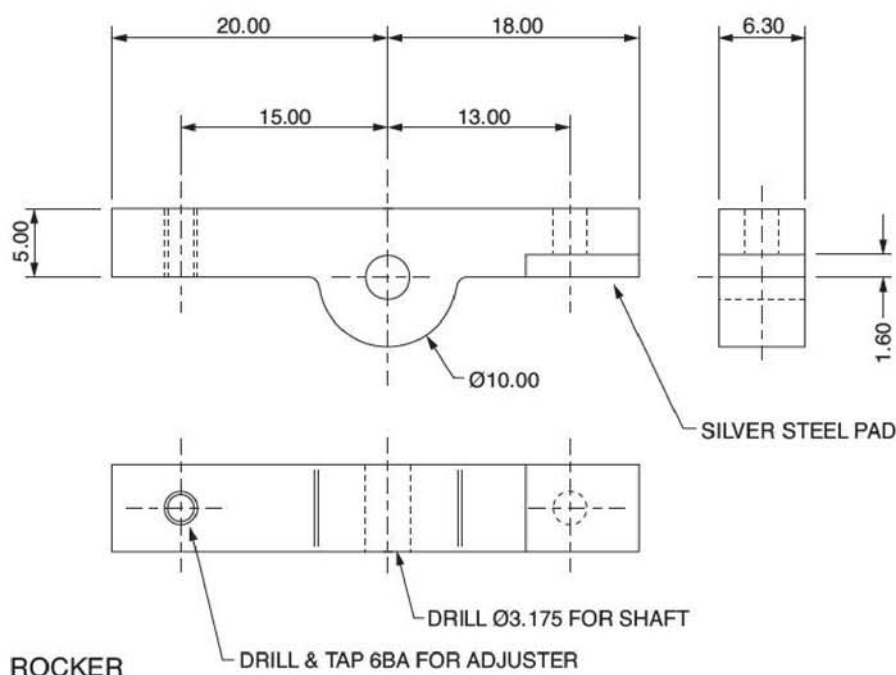
Rockers

Others may choose a different approach here, and perhaps use case hardened steel or even gauge plate or silver steel throughout. I was keen to try and make the rockers in aluminium, though this would imply doing something to give a hard face where the rocker contacts the valve stem (**fig 27**). A further alternative might well be to hard anodise the surface, but I have not experimented with this. The method used was to turn the parts in silver steel, which looked a bit like old-fashioned drawing pins, fit to the arms, file to match the profile, file a slightly radiused surface, then harden and Loctite in place giving the required hardened face.



Three valve seat cutter/abraders.

Fig 27



Making the arms actually came first, and here a strip of aluminium was marked out and the two positions centre drilled for the pivots. The strip was then set in the mill vice, and excess material cleared with a slot drill (**photo 77**).

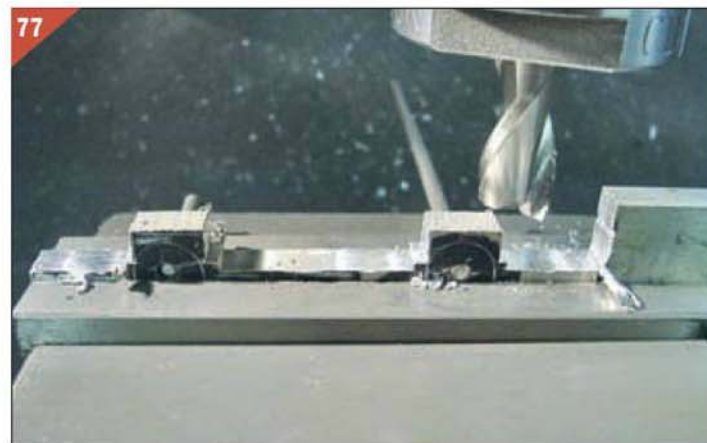
The arm was then roughly filed to shape, drilled and tapped 6BA for the adjuster, then drilled 2.4mm to take the hard pad. **Photograph 78** shows these three elements of the rocker assembly. The adjusters were simply turned from 0.187in. AF hex steel,

with a threaded length of about 13mm and a body of 4 millimetres. The end face was drilled to give a location for the pushrod.

The shaft was just a length of 0.125in. dia. silver steel

threaded at one end to take a single Loctited 5BA nut, and at the other to take two. Later, a flat would be filed to match the clamp screw position in the rocker post.

● To be continued.



Roughing out the rocker arms on the mill.



Parts of the rocker assembly, clearly a bit of tidying still needed.

Shand Mason Steam Fire Engine in 1:6 scale



GÜNTER
KALLIES

Günter Kallies updates Edgar Westbury's original design for a horse-drawn fire engine of 1890.

Editors note: Photographs

1 and 2 show two views of the finished model fire engine. It is a large model and is almost 2ft. long. It is a fully working model with boiler and steam water pump. This series includes drawings in metric. The model was made as a series of nine sub-assemblies. Rather than renumber everything with the possible introduction of errors, I have left well alone and hope the reader is happy with this.

The original imperial drawings on which this model is based are still available from www.myhobbystore.com reference number M28. Or telephone customer services on 0844 8488822.

To give you some idea of how fire fighting may have been in the 1860s let me offer the following scenario. The night watchman calls "fire, fire" on a misty night. Immediately the ringing fire bell wakes people up and the fire station soon becomes lively. Two firemen run into the stable in order to get the horses and harness them up to the fire engine. At the same time another firefighter starts to heat up the steam boiler. Paraffin impregnated wood already lay on the boiler grate so the fire is quickly lit. After a short period of time the first coal was laid on the fire and it was stimulated by a hand-operated blower installed in the chimney.

In the meantime, the doors of the fire station were opened. The fire-fighting team sit on the box while the driver sits on the coachman's seat. Two men stand behind the machine on the footboard with one hand on the pump handrail. The engine then raced out into the night, its iron tires and the horse's hoofs rattling on the cobblestones. In addition to this din the engine's bell soon began to clang. Sparks came out of the chimney, reflected in shining helmets and polished machine parts, a nightmarish picture to the casual observer.

When they arrived at the fire, there was already enough pressure in the boiler. The hoses were laid out and the suction tube was put into a nearby pond or other water source. The steam cocks were opened and the pump started to work. The water was directed



A view of the finished model.

in a high curve by the nozzle into the fire. After a short time only smoke could be seen, the fire extinguished.

Only a few years previously fire brigades were equipped with just a hand pump and leather bucket to fight fires with and their success rate was, understandably, rather poor. The first steam fire engine was built by Braithwaite and Ericsson in London in about 1829. It was an engine with a standing boiler and a recumbent pump. The machine could pump 680 litres per minute approximately 27m high and was pulled by two horses. The weight of the machine was more than 2-tons and it might possibly have looked like the early Merryweather fire engine shown in **photo 3**. The 2-cylinder steam pump is recumbent on top of the front axle and works like a Worthington feed pump,

directly without a crankshaft and flywheel. An original fire engine of this type from 1868 can be visited in the Fire Brigade Museum at Mulhouse, Alsace in France.

Shaky progress

The difficulties that have had to be overcome by the introduction of steam fire engines are shown by the following anecdote: In 1859 the firefighters of New York City were worried about their jobs. Therefore, when attending a fire they first directed the hose upon the chimney of the steam engine before they started firefighting. This was an attempt to extinguish the boiler which they viewed as a threat to their jobs. However, progress cannot be denied and five years later New York had more than 25 fire engines in service.

The development of the steam fire engine seemed to

progress in odd ways at times. Thus developed a range of hand-pulled machines and also automotive steam fire engines that could move about like a street railway or a steam tractor. Also, a steam engine with a weight of more than 10,000kg was built around 1850 in America, which was hardly ever used. More and more the machines pulled by horses asserted themselves. These were small, efficient one or 2-cylinder machines, most of them equipped with a standing boiler.

English engineers Shand and Mason started a company in London where they began producing steam fire engines (**photo 4**). Together they developed a very efficient, light standing boiler which could be heated up very fast due to its high number of water tubes. From around 1889 they produced a 2-cylinder fire engine, which serves here as a prototype for the model version. The machine was equipped with a crankshaft and two small flywheels and the movement can be observed. The steam pump is installed right behind the steam boiler which means that the tube and hose connections can be found at the back of the machine. This fact played a determining role for the procurement of this type of machine for the Hamburg Fire Brigade in Germany. In this seaport town, a lot of goods were transported on the waterways at this time. For this reason the town had many canals, the so-called 'fleets', and many small and narrow streets terminated as dead ends because of them. With the Shand Mason one could easily go up these streets backwards and water for fire fighting could thus be pumped directly from the canal.

An original Shand Mason from the Southgate District Council can be viewed in London's Science Museum (**photo 5**). This original engine was the source for hundreds of photographs and design details to produce the set of drawings accompanying this article.



Another view of the finished model.

The model fire engine

In 1967 a model steam fire engine was introduced in *Model Engineer* by the well-known designer Edgar T. Westbury. He had sketched this machine, based on the Shand Mason. This version was drawn to 2in. scale (1:6) and the model came out with a total length of approximately 570mm, with a wheelbase of 290mm and a total height of around 360 millimetres. The front wheel diameter was of 140mm, while the back wheels show a diameter of 205 millimetres.

Castings are available but the parts are rather small, and could be made without exception from stock material (e.g. brass). This alternative will avoid some of the difficulty of clamping and aligning castings in the lathe and mill.

All the components for this beautiful model were produced

without exception on a very old 3½in. Cromwell centre lathe with standard equipment. However, for some machining, access to a milling machine can be helpful. Maybe your local model engineering club can offer this facility?

In addition to the usual processes used in steam model construction some unusual tasks have to be done as well. For example, construction of the wooden wheels, or spinning of the boiler casing from brass. The painting and lining will also require a steady hand and perseverance. However, the model builder is also recompensed for his efforts. He will get a complete functioning machine that will attract lots of admiration.

Of course divergences from the original cannot be avoided with a functioning model of this size. However, I tried to keep

these divergences as slight as possible and to limit them to hidden areas. Thus the standing boiler is copied, for example, externally exactly as per the original. However, in detail there are some divergences, mostly on the inside. As an example, the cylindrical upper portion and the tapered lower skirt of the full-size boiler is bolted together by means of two corner-shaped flange rings. Nevertheless, in the model version both these parts are firmly soldered and connected by means of a T-shaped ring.

The steam pump is fastened to this ring so that the whole machine can be removed from the chassis, including the boiler and steam pipes. This could prove helpful for servicing or for maintenance work. The boiler is provided with outside insulation and also with an authentic polished brass boiler casing. The internal construction of the boiler could not be made in prototypical fashion. In the original Shand Mason boiler about 100lbs of steam pressure exists. Reduced to the scale of the model the wall strengths of the boiler and tubes would become much too thin. Also, the boiler water would not be able to circulate in such thin tubes. To reach the functionality, a different construction corresponding to model size is chosen here. Also with the operating controls compromises are necessary. For instance, all safety relevant instruments like the water level indicator or the boiler safety valve. The question, to what extent the model builder wants to follow the original, is in the end a question of compromise. ➤



A photograph of an old Merryweather fire engine.



A Shand Mason fire engine used by the City of Chester.



The Southgate fire engine in the Science Museum.

Construction

The general arrangement is shown in **figs 1, 2 and 3**. The construction introduced here was prepared completely using MICRO CADAM, a modern computer CAD software. This software was used, for example, in the design of earlier Airbus aircraft. All drawings are made very

precisely with an accuracy of one hundredth of a millimetre. This gives the guarantee that everything fits well and as a result a fully functional machine can be produced.

All sub-assemblies are described step-by-step so that an interested builder can build this interesting model by himself. The less-skilled

enthusiast can also make this model by following the detailed description of the working steps. Any unusual work will be described precisely. As far as jigs or tools necessary to produce the parts, they will be shown in the drawings or described in the text in detail.

However, it should be noted that building this model will take a lot of time. Off the shelf parts are not available. Every individual part must be made by hand, on the lathe or on the milling machine. Very often one must ask the questions: "How can I most simply produce this part? How do I clamp it? How do I work on it?" But this is the attraction in this hobby and satisfaction will be felt when a component or assembly is finished. Even with a construction time of 1 to 2 years it never became boring, because each

single component was a new challenge.

The whole machine is split into nine sub-assemblies. Every sub-assembly has an assembly drawing and its own bill of materials from which the material data arise. The part numbers are the connection with the respective assembly drawing. The first figure of the part number gives you the information about the respective sub-assembly. Thus, e.g., the part number (425) belongs to the assembly No. 4, which is the steam pump. Normally the individual parts are drawn and often the jigs and tools are shown or the production method is outlined. This will be very helpful for you if you decide to build this engine.

I will start with the chassis assembly, parts 101 to 145. The bill of material for this assembly is included in the table.

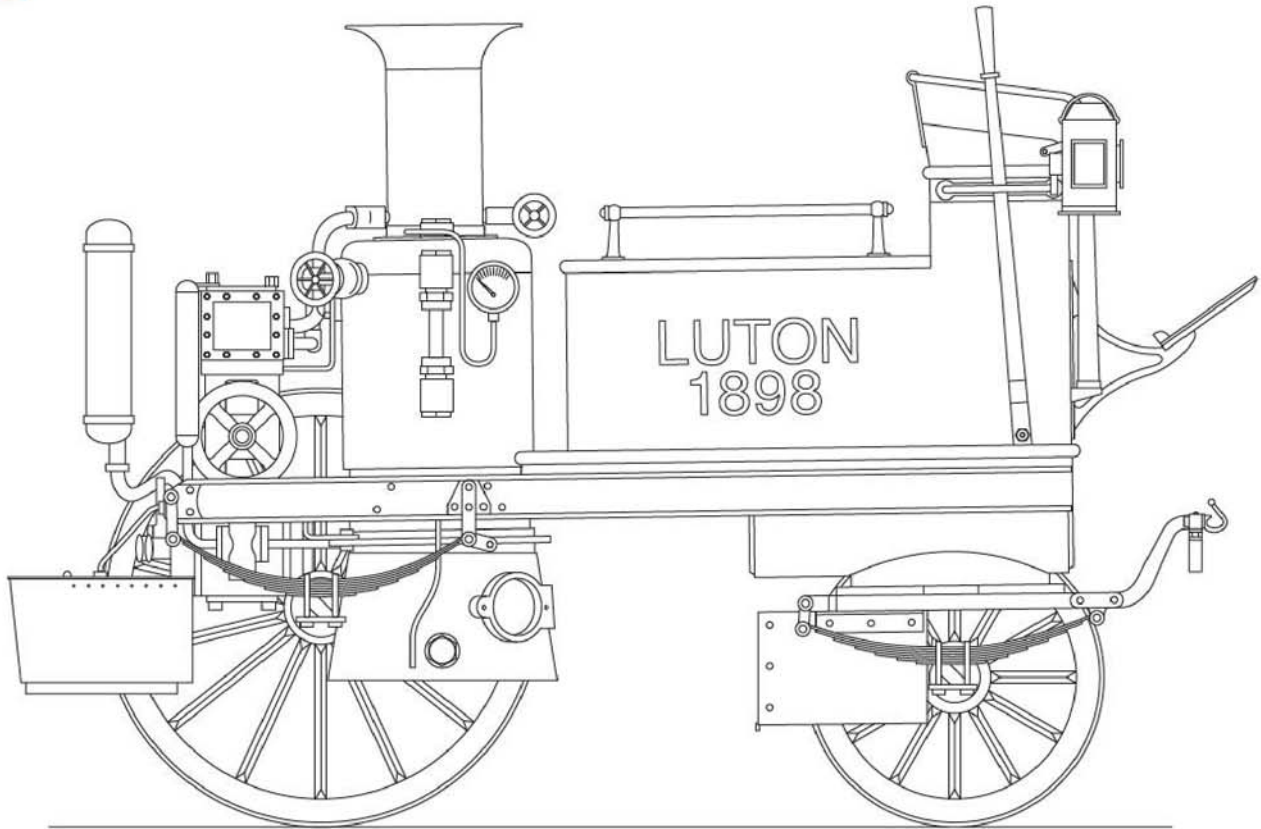
● To be continued.

3.1 Chassis

Part No	Qty	Title	Material	Dimensions
101	2	Girder	Mild steel	20 x 10 x 420
102	2	Sittings	Aluminium	20 x 20 x 8
103	2	Endplate	Copper	140 x 55 x 1
104	1	Turntable	Brass	Ø95 x 25
105	8	Hose brackets	Brass	5 x 1
106	2	Clamp	Brass	20 x 180 x 3
107	1	Strengthening plate	Brass	40 x 12 x 3
108	1	Curved sheet	Brass	150 x 200 x 1
109	3	Cross piece	Brass	5 x 1 x 200
110	4	Spring brackets	Mild steel	20 x 35 x 3
111	2	Sittings	Aluminium	20 x 20 x 8
112	2	Side members	Mild steel	6 x 8 x 220
113	1	Front beam	Mild steel	6 x 6 x 190
114	2	Cross members	Mild steel	6 x 8 x 114
115	4	Spring brackets	Mild steel	25 x 15 x 2,5
116	1	Shaft shoe	Brass	6 x 1,5 x 80
117	1	Turntable	Brass	110 x 130 x 3
118	2	Hook	Brass	15 x 25 x 6
119	2	Eye bold	Brass	Ø6 x 20
120	4	Slope iron	Mild steel	7 x 2 x 20
121	4	Slope iron	Mild steel	7 x 2 x 30

Part No	Qty	Title	Material	Dimensions
122	1	Bunker	Brass	135 x 210 x 1
123	1	Sliding plate	Brass	50 x 105 x 1
124	2	Corner profiles	Brass	10 x 10 x 1 x 50
125	2	Corner profiles	Brass	5 x 5 x 1 x 50
126	2	Shaft bracket	Brass	20 x 20 x 16
127	2	Torque arm	Mild steel	8 x 10 x 40
128	2	Crank arm	Mild steel	Ø8 x 80
129	1	Keep plate	Mild steel	6 x 12 x 2,5
130	2	Shoe	Brass	7 x 10 x 25
131	2	Brake pad	Tufnol	3 x 10 x 25
132	1	Shank	Brass	6 x 3 x 40
133	1	Step plate	Brass	12 x 20 x 1,6
134	2	Eye bolt	Brass	See drawing
135	2	Brake lever	Mild steel	210 x 8 x 2,5
136	2	Handle	Brass	Ø8 x 35
137	2	Bracket	Brass	10 x 20 x 8
138	1	Rotary part	Mild steel	Ø6 x 95
139	1	Rotary part	Mild steel	Ø6 x 65
140	2	Tension rod	Mild steel	Ø2,5 x 220
141	2	Fork head	Brass	6 x 6 x 10
142	2	Bolt	Brass	Ø5 x 10
143	2	Rack	Brass	5 x 10 x 60
144	2	Lamp bracket	Brass	35 x 20 x 3
145	2	Lever guard	Brass	Ø3 x 80

Fig 1



SHAND, MASON & Co. STEAM FIRE ENGINE

Fig 2

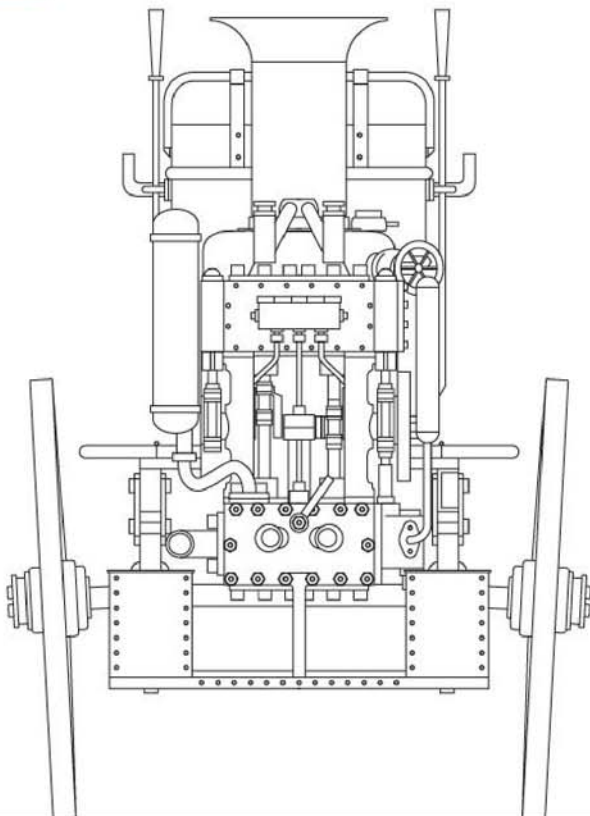
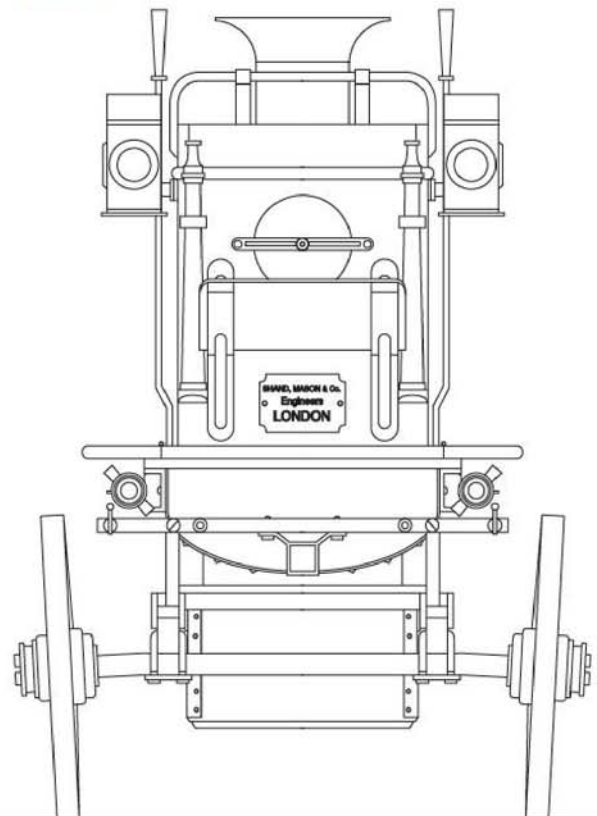


Fig 3



LILLIAN 7¼in. Narrow Gauge Locomotive



KEITH WILSON

Keith Wilson looks at the lubricator and offers a few handy hints.

WILSON'S WORDS OF WISDOM

You are willing to go along only out of ignorance and faith, and are even annoyed with me for trying to find evidence that will remove the ignorance and make mere faith unnecessary. That is superstition.

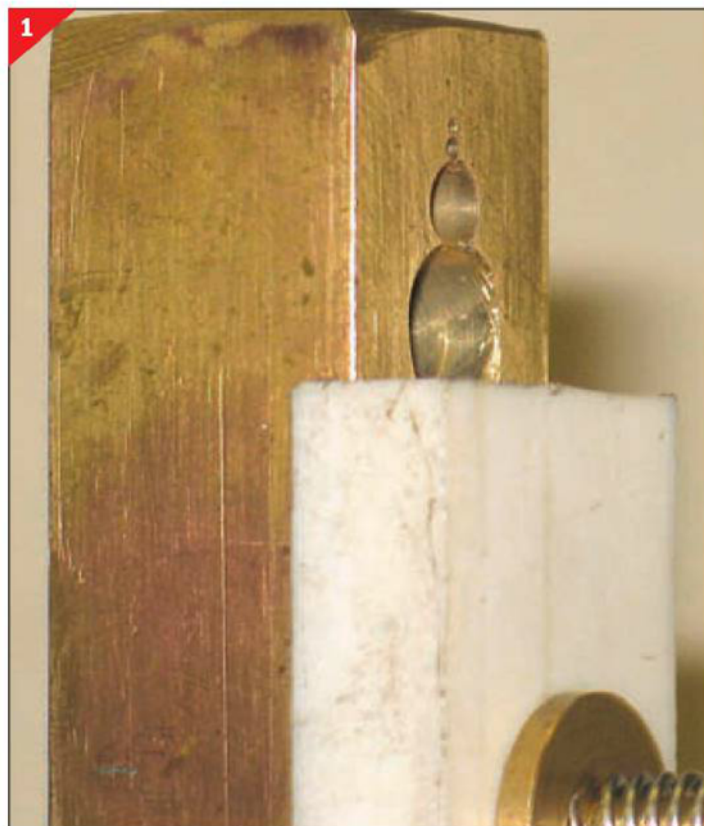
Asimov

Firstly, a few words on lubrication. Most full-size GWR locomotives

used hydrostatic lubrication for cylinders; I am not certain of the date when at least the big ones were provided with mechanical pumps for this purpose, but I think the first one post-war might well have been 5098 *Clifford Castle*, closely followed by 5099 *Compton Castle* unless I am mistaken. Whether the mechanical system was better than the hydrostatic system I don't know; both had advantages and disadvantages. One claim was that the driver would know his engine and could sense exactly how much oil was needed for each cylinder, adjusting if needed. Another claim was that the designer knew best, and could have the pump strokes pre-set.

In our sizes, I prefer (at present!) the mechanical type, because it is far quicker to re-fill and the fact that our sizes use more oil than the full-size ones, in proportion to the square (at least) of the scale factor. I have no experience of making other types, but there is a way of getting the advantages of both!

For this I am indebted to Larry Barker, who uses a small pump with a little pressure-valve that returns any surplus oil over the pressure of 100psi back into the tank or reservoir. Thus while the engine is running there is a steady supply of oil at about 100psi. This is fed into the sight-feed fitting, and it is clear that the oil supply to the cylinders is under the driver's control; and there is no need to spend some time draining water out of the oil reservoir before re-filling with oil, it just needs pouring straight into the tank - rather time-saving.



Regulator ports.

It will be instantly clear that I don't know what I am writing (talking) about for the reservoir could be made large enough to last a whole day's running; however this cannot always be accommodated within the limits on a near-scale locomotive. For a 'narrow-gauge' type of course things are a bit different, for unless you are building a 'scale' replica then there is vast room for larger reservoirs. Even if, as sometimes is the case, a first-class version of, say, a Darjeeling-Himalaya locomotive, or a Leek and Manifold, Tal-y-Llyn, or Ffestiniog is undertaken, there is still room enough for a big reservoir.

There are cases for 'prototype' locomotives where the reservoir has to be 'topped-up' whilst unloading and loading passengers. If of the hydraulic type this could take time as the

reservoir has to be emptied first. At Leyland the station has two 'roads' so any driver wanting to give his iron horse some attention is diverted into Platform Two and the main traffic is not impeded, in fact when busy some trains go into Two anyway to unload and reload. Although I "sez it meself" the occasional 'express-train' (King-hauled) doing the non-stop trick is one of the most impressive sights available on miniature railways.

I am reminded here of an occasion many years ago at the old Echills Wood site (Stoneleigh Agricultural Ground) when there was a minor hold-up on the single track portion of the railway; as a result there was quite a long line-up of trains waiting in the departure platform. During this wait the driver of the one in front spent the time off his engine chatting to the



The 'oojimaflopper'.

operating staff. When after about 15 minutes the 'line clear' was given, he decided that it was time to oil-up his locomotive! Soft uncomplimentary words were heard - censored of course. It was this same locomotive that created a record three-way derailment on the points connecting the arrival platform to departure ditto. The bogie tried to go down into the yard, the driving wheels aimed at the departure platform whereas the tender turned up the line to the sidings!

Spotting sharks!

In some ways similar, I am reminded of a little incident in 1979, Los Angeles. John and I, plus ladies, visited the Hanna-Barbara Marine Land and lined up for a swim in the 'Baja Reef', a pool containing numerous fish of the 3ft. long range. I noticed that about 10% were sharks, and mentioned this to John as we were in the changing room. A few American 'hams' were also present and we heard quiet remarks that could be summed up as "Sharks? Goddamn Limey gits". Shortly afterwards a sweet little 18 year-old came in to usher us to the reef. "There are about 80 sharks, 70 rays, and many other species. If you try to touch any of the fish, you will be taken out of the pool."

It made the hams look a bit sheepish! The shark has a distinctive shape and is easy to recognize, so the Limeys scored.

Lubricator in development

At time of writing I am working on what might be called an instant-attention lubricator system for GWRILLIAN. For if and when a lubricator decides to go wrong it is when it is most needed, especially when passenger-hauling. Therefore, an instant removal system has been devised so that only three nuts need undoing for the lubricator removal; these nuts being the pipe fitting and two mounting bolts.

Experience has shown me that if the lubricator requires removal (they need occasional cleaning), the trickiest job is re-assembling the drive mechanism, so this has been avoided.



GWRILLIAN backhead.

Some useful hints

When you are making several identical items for something-or-other (handrail supports, backhead valve handles come to mind) COUNT them carefully EVERY time you finish one set of operations. It is very easy to miss one; and when it gets near the end of the set, your swear-box will show a profit when you realize that you've got to set up everything again! Not a bad idea to do one or two extras too. Another tip, by all means clean a machine down after an operation is finished, but do not 'reset' the machine, leave the setting alone. For the infamous Sod's Law says that the next operation could well need the same setup as the last; and if you've put everything away you've only got to get it all out again. If the next operation requires the same setup, then time has been saved - sometimes quite a lot. If a different setup is required, then you've saved again. Again, do not leave the chuck key in its socket, the reason I hope is obvious.

If using a toolbox of the portable type, a set of socket spanners being an example, it pays to note that when the tools are used then either the box must be left fully open or closed and latched. It is infuriating to pick a box up and distribute its contents on the floor, also annoyingly time-consuming.

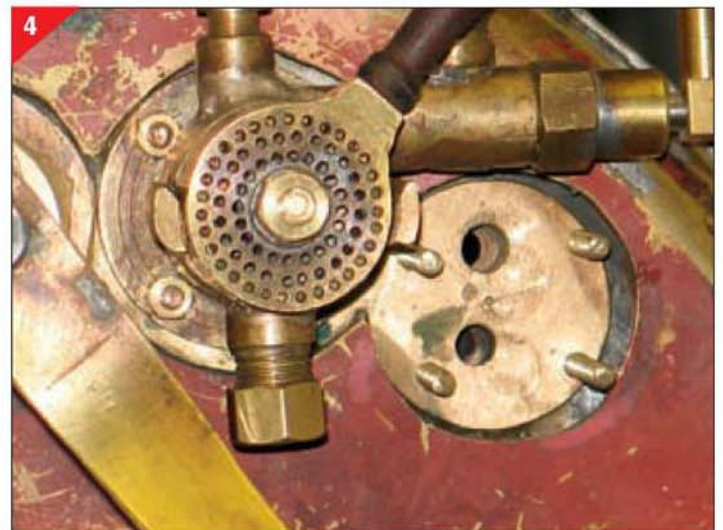
There will come a time when studs firmly set into some

fairly large object need some cleaning up. This has just occurred to me (big surprise?) on the GWRILLIAN boiler. Thirteen ¼ BSF. phosphor-bronze studs required cleaning. I could have done the operation by hand but did a bit of thinking (I can, you know!) and made a little thingamajig to help. It takes a standard 1⅜in. die, and the small end is ½ diameter to fit in a hand-drill chuck.

There are several types of hand-drill; the best for this task is the type with two-speed gear settings, nowadays also with reversal switch and a proportional-to-trigger-pressure on-off switch. In low gear there is plenty of torque, as I noticed when I ran a bit too fast and felt the snatch and jerk when the die ran right to the end. A photo shows this 'oojimaflopper' (thingamajig?) item. It is 1½in. long, 1¼in. diameter, and the bore for the die is ¼in. deep and 1⅜in. diameter. It is made of mild steel, and the adjustment screws for the die are 4BA.

Another useful tool is a tee-shaped die-holder, useful for reaching awkward threads. The backhead is shown but not fully assembled yet 'cos it's got to be stripped down again for painting.

The picture of the regulator ports shows a design that I have used successfully in many locomotives. I have known 'all or nothing' regulators that are not easy to control. A 'jack rabbit' start is not amusing. The idea is roughly logarithmic, in that a half handle movement ➤



The driver's brake valve.



The safety valves.

from zero gives about $\frac{1}{10}$ full opening. Strictly speaking, (writing!) due to the elasticity of steam this does not give perfect 'logarithmic' control, but it's better than all-or-nothing; I've had some! At the very least, gentle control is much easier. It reminds me of my first full-size drive when I took a Castle from the Stafford Road shed (SRD) to Wolverhampton Low Level and put her on her train. It was on this trip that I saw for myself that a good engine with Walschaerts valve gear would actually 'notch up' by herself - of course this cannot happen with Stephenson's gear, but might occur with Baker gear.

With the first port only about $\frac{1}{32}$ in. diameter, enough steam will pass to move slowly, a great advantage; once moving, the second port will pass lots more steam, and when hitting a gradient 'the lot' will take care of a big load - and it will sound nice too. I first experienced this basic lesson on testing my first 5in. locomotive. On air a $\frac{1}{8}$ needle valve and some $\frac{3}{16}$ in. O/D pipe sent the motion into a blur. When it was steamed, $\frac{3}{16}$ in. pipe was used on the outside cylinders and the performance was excellent. Later I changed to $\frac{1}{4}$ in. pipes but did not notice any great improvement.

An interesting matter arising here is the close relationship between the steam supply pipe size and steam chest capacity;

let us do a bit of discussion on this matter.

At first it may appear that there is no connection, however consider the steamchest pressure as the valve opens. There is a big drop in steamchest pressure, and clearly this drop is less if the steamchest is large. Pressure is made up through the supply pipe but of course this takes time. With the shock-drop in the chest, on following the delivery pipe backwards this shock-wave becomes less and less; and on reaching the regulator it is almost non-existent. There is a limit as to what size pipe it is possible to use. From the point of capacity it cannot be too large, but there are limits as to what size regulator can be accommodated. Now I am aware (of course!) that there are at least two cylinders to be considered, but they are at 90deg. to one another so the shocks will be alternate rather than synchronous, and once 'notched-up' within the 50% mark the shocks will be almost completely independent. Notched up more than this means that for part of the time the ports are not open at all in either cylinder. The regulator is still open, so the flow of steam is only that which 'tops up' the steam chest.

It is clear (or should be!) that with a large steam chest there is more likely to be a smooth flow of steam. Since the flow capacity of a pipe is clearly

largest with a smooth flow, a large steamchest is a great improver of performance. In fact I remember an old friend of mine who had worked at Ashford Locomotive works with a railwayman named Irons, whose dictum was "there shall be a cylinderful of steam waiting in the steamchest." Makes sense, and on noting the size of the steamchests on GWR locomotives 'twill be seen that this doctrine formed a good part of design.

Bulldog tips

I am fascinated by friend Alan Crossfield's articles on his Bulldog, and a tip or two comes to mind.

Unfortunately, the quite long guard irons on these bogies are highly susceptible to damage and my two recently completed $7\frac{1}{4}$ in. Bulldogs broke them off very soon; even a minor derailment can prove this. It is then a matter of choice, leave as designed and merely replacing the nuts and studs holding them on, or silver-braze/weld them and risk having to 'bend the bogies straight' after the first (and subsequent) prangs.

A problem raising its head in double-framed locomotives

(you know what I mean!) is that of getting all four driving axle boxes in line. It took me a great deal of thought ere I had thunk-up a method applicable to models. It is not terribly difficult to line-up the horns, the frames are assembled using a close-fitting bar of metal right across.

Leave the 'outer' boxes UNDRILLED and then use the two inner boxes as a jig! A centre-drill in an axle-sized round of steel (silver steel for preference) will meet the case, and only a small centre-mark enables the box to be set up accurately in the 4-jaw for boring to size; depending on choice this could be an axle anyway, finished as an axle later.

I have not the slightest wish to criticize Alan's work in any way, but I do not believe that any full-size locomotive used bolts in its cylinder covers, as studs with nuts on the outside are far better, as well as stronger and easier to assemble too. Imagine having to hold up a cover weighing say a couple of hundredweight whilst faffing around getting the first bolts in place. I am of course aware that covers fit into the bell-mouthed ends of the cylinder, but it is still quite a nightmare.

● To be continued.



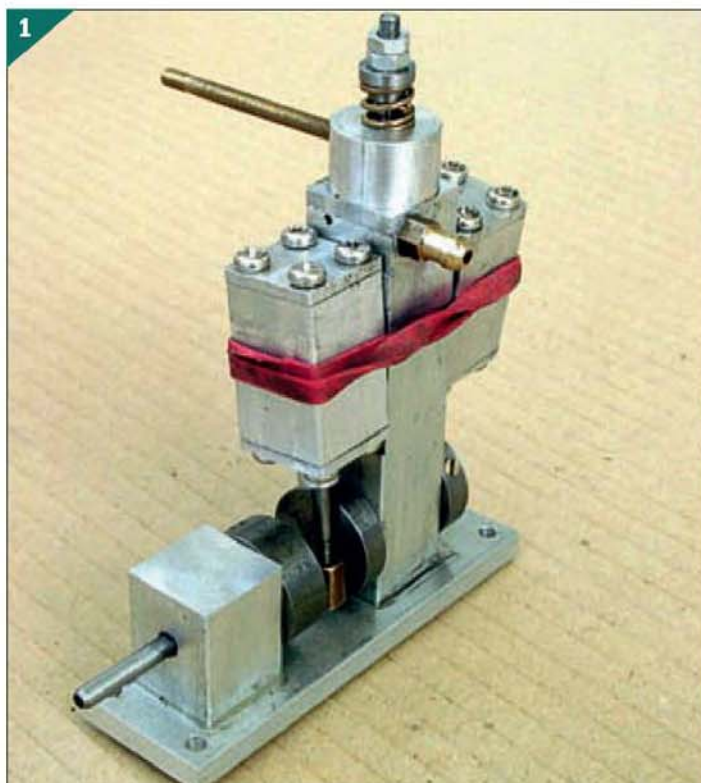
The fountain or turret.



DAVE FENNER

Dave Fenner gives build information for a Mk. 2 version of this simple oscillating engine.

The completed Mk. 2 Postie Motor.



by eye on the lathe and mill. As the intention now is to encourage others to have a go, I have looked at the original, incorporated a few mods, drawn it, and then built a new version to prove the design (**photo 1**). Thus the fasteners are standardised on M3, and in order to accommodate the screw heads and leave a little more meat on the cylinders, the bore has been reduced to 10mm, where it was previously 11 millimetres. The drawings are given in metric units, although some imperial material has been employed. Apropos the topic of metrication, I recently contacted an aluminium stockholder for the price of a length of flat bar. Now it is some time since I ordered such material and I opened the conversation by mentioning this and asking whether it was nowadays all metric. "Oh yes" was the answer, so I asked the price of a length of 32 x 10mm which I assumed would be a stock size. "We can give you 31.75 x 9.5mm" came the response, and surprise, surprise, does this not equate to $1\frac{1}{4} \times \frac{3}{8}$ inch?

The description which follows, discusses the procedure on a 'component' basis. In fact, work was actually organised more on a 'machine operation' approach in that several parts were turned, then milled etc. rather than taking individual items to completion in isolation. Before embarking on the construction, and given that this is a project likely to be built by relative newcomers, I propose to comment on one system of mill set up which proved useful here.

Brief digression on mill set up

Quite a few of the parts feature multiple drilled holes which are probably best cut on the mill. There are several methods of determining the position, ranging from the tried and tested marking out, to the more modern employment of a digital readout system. One requirement which crops up several times is to place holes on the centreline of the square ➤



Nipping a feeler to set a datum.

Regular readers will recall that I gave an overview description of this little project last year (*M.E.* 4330, 18 July 2008). Reaction amongst readers apparently varied from enthusiasm in some to near apoplectic fits in others. The latter provoked by the use of a rubber band. Of course in some circles, rubber is just not an acceptable engineering material, certainly not in band form. Well, at the risk of further offending this brigade, this article aims to give sufficient information to build your own engine.

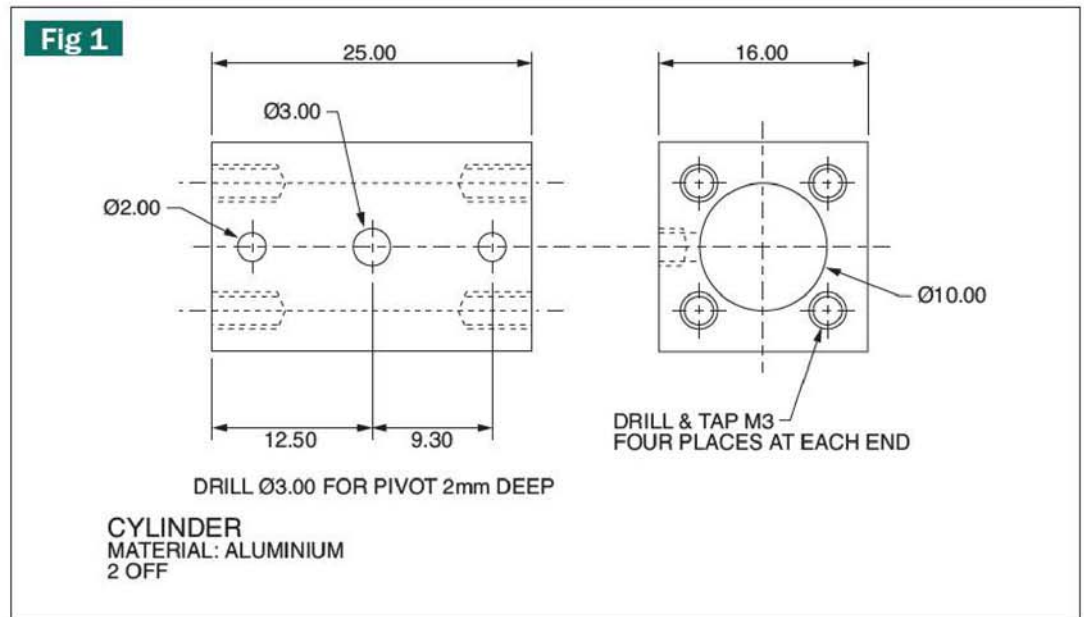
When the prototype was lashed together, the only real drawing was a CAD layout to confirm the porting details. Beyond this, odd pencil sketches were made, but by and large, it was designed

aluminium (notably cylinders and pillar). The method I have adopted works well for me and is as follows. The actual measurement of the aluminium stock was 15.875mm (0.625in.) across the flats. I turned up a short piece of bar having one diameter of 12mm (small enough to fit the drill chuck) and a second diameter of 15.77mm (0.621in.). This bar was gripped in the mill chuck, the quill dropped down and the table moved to just nip a 0.05mm (0.002in.) feeler gauge between the bar and the static rear jaw of the vice. This operation can be seen in **photo 2**. (The vice had previously been set with its jaws parallel to the table.) If the material was then gripped in the vice, any hole drilled at that Y setting, would lie on the material centreline. Using a similar philosophy using other bars and sometimes spacers, in conjunction with the square material, it was also possible to lay out patterns such as the cylinder cover holes and top face ports, without recourse to a rotary table. One note of caution concerns swarf, which must be cleaned away after each operation, as even a small piece can cause a significant positional error.

Cylinders

As a start, two pieces of 16mm aluminium were cut a little over length, centred up in the 4-jaw chuck, faced, centred, drilled and reamed 10mm for the cylinders (**fig 1**). Each was then reversed and faced to 25mm long. Centering was handled by use of a dti, clocking opposite sides to get equal readings (**photo 3**). If you have not yet acquired one of these, placing a piece of faced bar in the toolpost and running in on the cross slide to touch is another method. Subtracting dial readings taken on opposing faces, then halving, gives the amount to move.

Initial work on the mill entailed cutting the pivot bore with a 0.125in. (3.175mm) FC3 cutter, and after this, the two ports were drilled 0.093in. (2.4mm).



Using a 'clock' to centre the work in the 4-jaw chuck.



A piece of rectangular material is set against the rod to set a second axis datum.



This 'Keats' type angle plate from Myford is a good way to hold this kind of stock.



Pillar is pushed against rod then gripped.

To drill the holes for the cover screws, an extension of the mill set up noted above was employed. A piece of 6mm bar was placed in the chuck and backed up to the rear vice jaw. A rectangular piece of material was then slid between the jaws to contact the rod and then gripped in the jaws. **Photograph 4** demonstrates this arrangement. The spindle centreline would then be 3mm forward from the rear jaw and 3mm across from

the material. The cylinder could then be pushed into the corner by hand, so that the centre drill would be correctly positioned for the first hole. The part could then be 'indexed' round for the other three. The holes were then drilled 2.5mm dia. and tapped M3. For these latter stages an angle plate may be found useful. **Photograph 5** shows work held in the excellent 'Keats' type angle plate available from Myford.

Cylinder covers

Next up were the cylinder covers from the same material, but this time I worked from longer stock bar in the lathe, with sufficient projecting to make two plus two parts (**fig 2**). This would save a repeat centering of the stock. The outer end was turned to 0.250in. (note that the drawing gives 6mm diameter) as this size would accurately fit one of the Myford collets. Two were

made this way and parted off a few thous. over length. Each of the second pair of covers was simply faced then parted off to 2mm thick.

Work on the first pair continued by gripping the 0.250in. diameter in a Morse taper collet to turn the 10mm spigot and drill/ream the 3mm hole for the piston rod. Cutting these two features at the same setting would ensure that the piston rod would lie concentric in the cylinder bore.

The covers were then drilled 3mm diameter for the retaining screws, using the same pseudo indexing arrangement as for the cylinders.

Pillar

A further length of the same material was used for the pillar (fig 3), which was faced to 67 millimetres. The mill vice was again set to centre the material, then a length of 8mm rod was then placed in the drill chuck, the quill lowered, the work pushed against it, then the

vice tightened (photo 6). With a centre drill fitted, the table could then be moved 15mm then 35mm to start the holes for the main shaft and cylinder pivots. These could then be drilled through.

To set out the positions for the porting on the top face, a similar mill setting was employed. Here the 8mm rod was fitted to the chuck and arranged to just touch one face of a small angle plate, and just nip a 2.5mm drill between it and the vice. This would space the centreline 4mm from one edge and 6.5mm from the other (photo 7). With a small centre drill in the chuck, the work could be held by hand against the two faces, the hole started, and the work rotated to the next of the four positions. With the work transferred to an angle plate, two holes were drilled down to 31mm using a pecking action to clear the swarf, and the other two, sufficiently to intersect the inlet and exhaust positions.

Fig 3

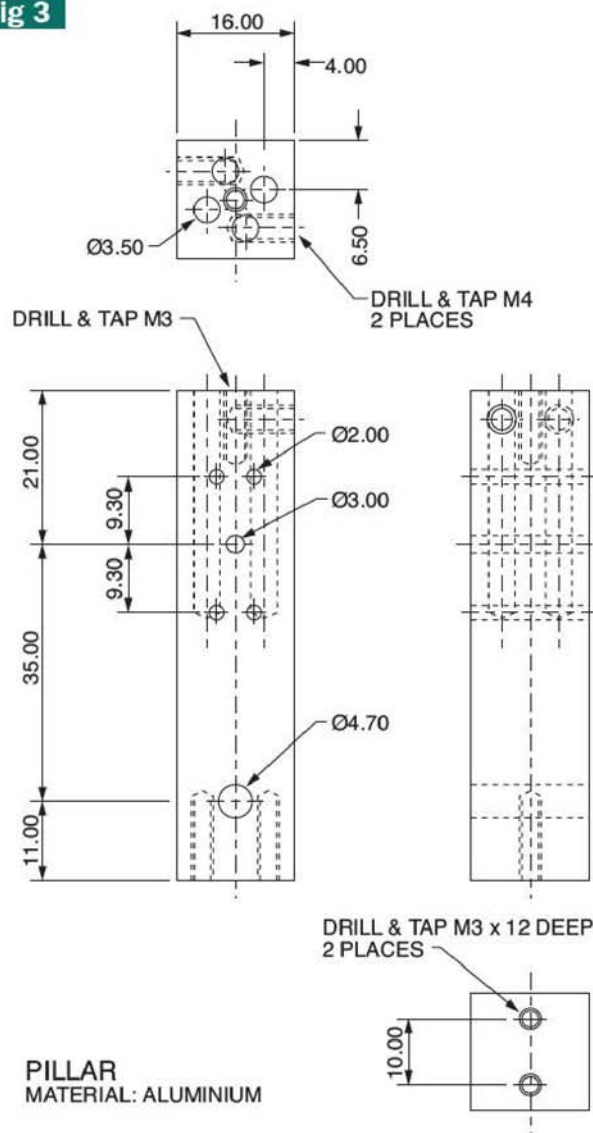
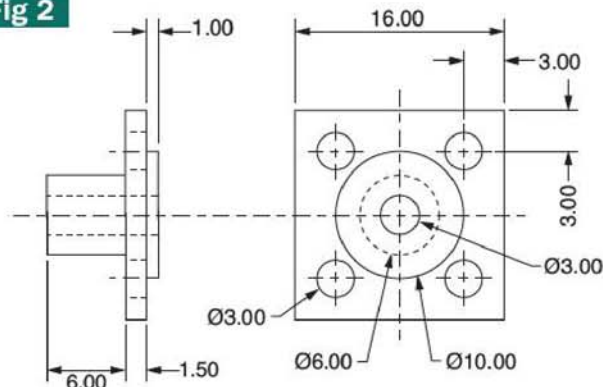
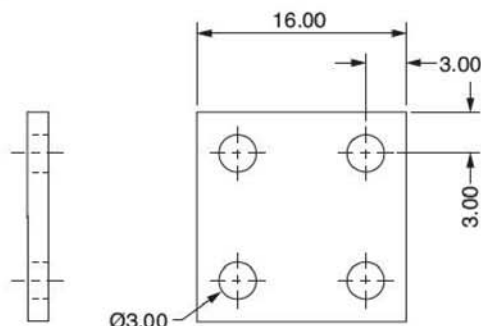


Fig 2



LOWER PISTON COVER
MATERIAL: ALUMINIUM
2 OFF



UPPER CYLINDER COVER
MATERIAL: ALUMINIUM
2 OFF



The setup for centre drilling the valve port positions.

The four small ports on each cylinder face were then drilled to intersect the long 3.5mm bores, working from each side. On the lower surface, two holes were drilled and tapped M3 for attachment screws.

As a 'tuning' measure, material was removed from

the cylinder contact faces, using a 6mm FC3 cutter to relieve the surface, leaving port faces about 6mm wide. The intention here was to reduce the contact area and hence the amount of viscous drag.

● To be continued.

Lesser-known examples of Engineering 1884 to 1891



DAVID
PIDDINGTON

David Piddington visits the distant past in search of unusual artefacts.

Following on from my series on the products of 'Tangyes of Birmingham' published three years ago in *Model Engineer* (Vol. 196), which was originally used as a projector slide show and talk, I took to clubs this alternative, which was also well received. Due to ever-increasing age, which happens to us all, I have discontinued the round the country motorcycle tours even though I enjoyed these immensely and always found a warm welcome awaiting me, so I thought now to give the talk to a wider audience by having it published. I've never owned a car and I still ride a motorcycle and enjoy it, but my present cheaper-to-run machine does not have the luggage capacity of my Kawasaki GT550 tourer.

The objects of this second series are threefold. Firstly, to make known to a wider audience some of the lesser-known artefacts of general engineering that would perhaps no longer be discussed unless one has access to copies of the engineering papers of that long ago era. Almost all of

the pictures and information have been gleaned from the pages of *Engineering*, one of the two great weekly industrial newspapers of that time, *The Engineer* being the other and which, I believe, is still in print? Many full sets were carefully kept and bound for future reference by larger engineering companies, universities and other bodies. With the onset of technical 'progress' - here I use inverted commas - such books or collections have either been pulped for recycling, or sold on the second-hand book market and in most instances have been split up from sets into individual volumes or shorter series. One volume of *Engineering* could, towards the end of the 20th century, command a price of £50 if in good condition and part of a sequence; even an odd worn copy could fetch half of that. It will be appreciated that to students of engineering history and we, as model engineers are indeed engineering historians in a very practical sense, they can prove invaluable.

My second aim is to show how much care and thought went into the actual productions, as the 19th century was a feast of invention. In many instances I hope to demonstrate how much comparable care went into the pictorial and written descriptions and the esthetical beauty too of the artefact. Remember too that an engraver working on a metal plate initially produced most of the pictures. If he had been working on a plate for many days and made a serious mistake, there was no easy eraser - he started all over again.

My final aim with this series is to show, particularly to a model engineering audience, that almost any facet of our

forefather's work can be an excellent subject for making a working engineering model.

Image source

In regard to the images themselves and remembering the original intention was for a slide lecture, most were adequate for that purpose. Also, they were photographed on Agfa B&W positive film, which was still available in the eighth decade of the 20th century. Now that I have computer scanned them for use in a paper publication most have required considerable editing and I have spent a lot of time creating silhouettes to remove a century of damp spots, mould and print marks from the page on the back. Again as much care as possible was taken to get the pages flat for photography but note had to be made not to break the spine of the volumes and true flatness was impossible. With considerable regret I no longer have access to the volumes from which many of the following descriptions were taken and it is now no longer possible to make new images. Inevitably there are distortions in the views, particularly on centrefolds, which my computing abilities lack the skills require to restore the true condition even if this is possible, so I ask for your forgiveness.

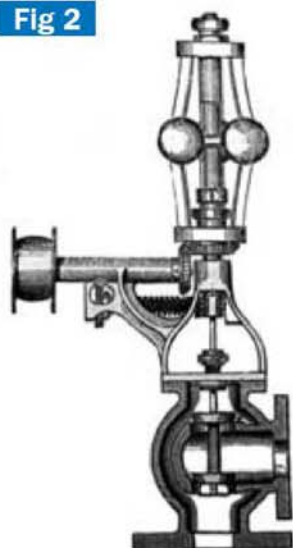
Recreating the past

I fear that to many model engineers if it was not steam-powered, didn't run on rails and was not painted in Great Western Railway Green, or some other railway company's livery, then items of our industrial heritage may not be worthy of consideration. This statement is partly in jest, but there are

Fig 1



Fig 2



such diehards amongst our fraternity, and in other spheres of modelling too. I am hopeful of disproving this notion to you. All, or very nearly all, of our hobby is retrospective. Great Britain is changing from a nation of shopkeepers to a nation of museum proprietors and/or IT specialists. Large numbers of enthusiasts are doing great works in reclamation and rebuilding to show how past industries and crafts worked. However, many artefacts, having reached the ends of their commercial lives, have failed to survive except in documented history, and I firmly believe that we should continue to recreate working miniatures to show how the full-sized machine worked, especially where that original no longer exists.

In my own small way I believe I have lived up to that maxim with my miniature Hall's rotary piston steam engine and the open frame 3-ton steam forging hammer built taking engineering information from the year 1865. Both designs are now copyright of Reeves 2000 and are still available for those who feel unable to research and make patterns etc. to recreate their own version. It is unlikely that prototypical examples of either still exist anywhere in the world, but the miniatures do work and prove the original documentation.

I shall show a number of machine tools, a facet of our hobby that has been only briefly explored by a very few model engineers. Surely there will be inspiration for working models? Take up the challenge and I guarantee that the results will be most rewarding.

In many instances a full description of how the artefact actually worked was not included in published text so what I have typed into this series is all I had available and I have tried not to include conjecture. This drawback was not so much felt in those days for the readers would have known much about their particular trade and an item, for example, on marine practice would have been largely understood without

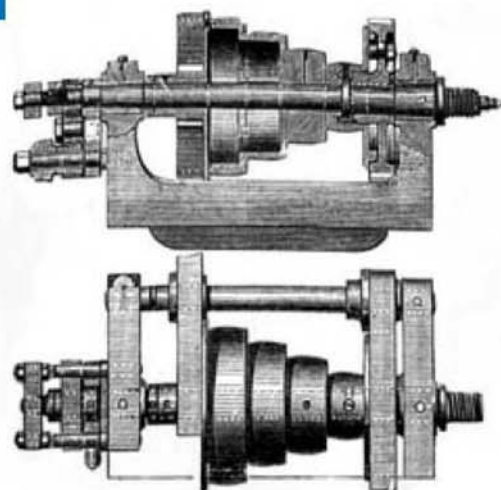
intimate details being given. To 21st century students further research will be necessary.

I have made no attempt to convert the measurements from the Imperial inch standards of those times into modern equivalents and recommend reference to text books and conversion charts for those who particularly wish to make a modern comparison.

Pickering's Patent Governor

To set the scene, **figs 1 and 2** are a view and a section of Pickering's Patent Governor of 1884. I agree that this is far from being a lesser-known artefact, but it was once. Its object was to achieve the necessary centrifugal force applied by the rotation ball weights to throttle the inlet steam to an engine without the use of a spiral spring and instead, using flat plate springs holding the ball weights in a horizontal plane, while the upper and lower plate spring ends were secured to the lower fixed swivel and the upper sliding swivel which operated the internal steam valve. This device is now very well understood, and is seen in regular use at full-size engine rallies, and in miniature form on a number of well-known models such as the 1½in. scale Allchin traction engine, probably the most popular engineering model of all time. In 1884 it was recorded that this governor was manufactured by Messrs. Ransome and Marshall of Liverpool, and was supplied to many firms including Garrett & Son, of Leiston, Suffolk.

Fig 3



Lyon's Lathe Headstock

Shown in **fig 3**, this device was thought out by Mr. James Lyon who was a demonstrator at Cambridge Mechanical School. It will be seen that the back spindle does not project beyond the headstock and so cannot foul any bolts holding work to the threaded-on faceplate. The bull wheel has an extended boss which runs inside a bored-out pulley in which the backgear mechanism is also housed. The bull wheel is also brought up close to the front bearing and thus supports the mandrel over a greater length. The data stated that only the front cone is in tension, so with the 19th century's lack of sophisticated materials this must have been a known weak point of lathe design. Threaded-on chucks can come adrift without due care being taken, but surely not with part of the spindle as well.

Screwcutting and Automatic Sliding Gap Lathe

Dating to 1886 this lathe is shown in **fig 4**. The fast headstock - terminology was different in those days too - was 6ft. long and 6ft. 6in. wide at the base where it is bolted on to the gap frame. The loose headstock, which we now describe as the tailstock, is aligned on the long tee slots and also has Vee lips. Four bolts in the tee slots secured the loose headstock unit in position when the lathe was in use. The steel spindle of the headstock ran in substantial bearings, the front one being 10in. diameter and 15in. long. The cones (belt pulleys) were machined inside and out to achieve good balancing, the largest step being 3ft. 6in. diameter and the smallest 1ft. 10 inches.

The faceplate is 9ft. diameter and has a gear cast into its rear face, the casting made from a machined pattern to give the teeth correct involute form. This ring would take the drive from the backgear. In common with Mr. Lyon's headstock, this machine appears not to have a hole through the spindle and would not have been suitable for machining long bars, only for individual larger castings or assemblies.

The gap frame - inserted machined castings separating the bed and its under-mountings - gave the machine a capacity of machining work

Fig 4

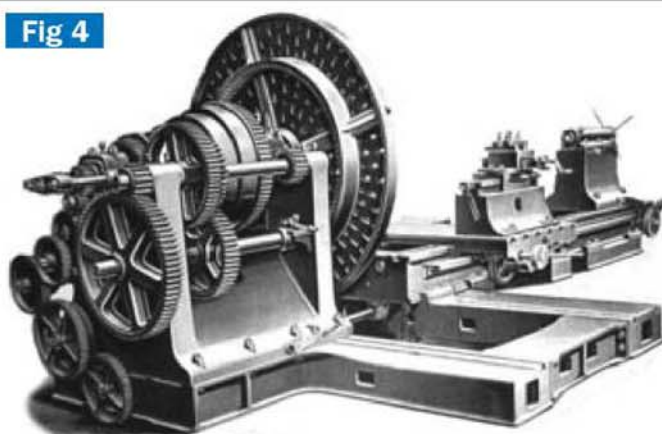
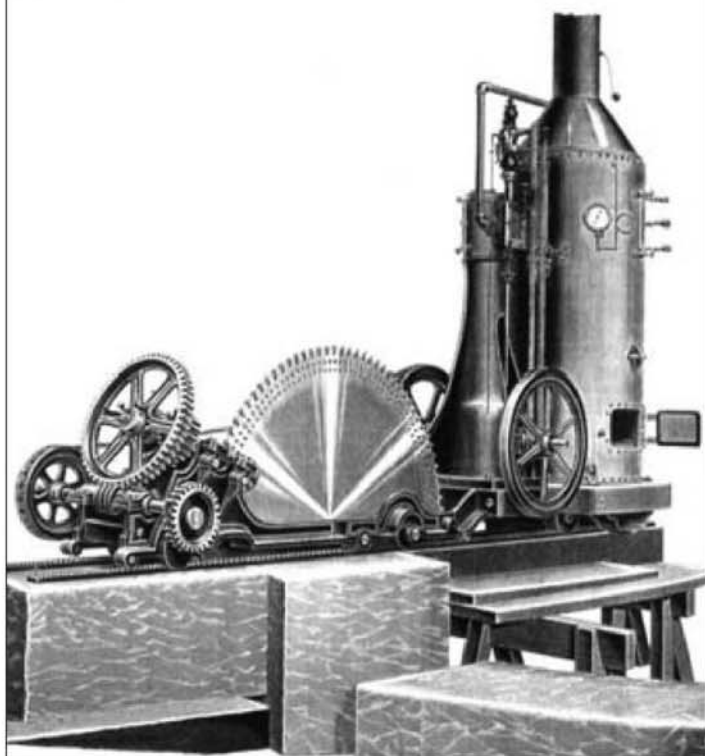


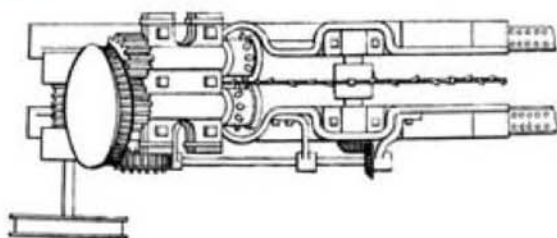
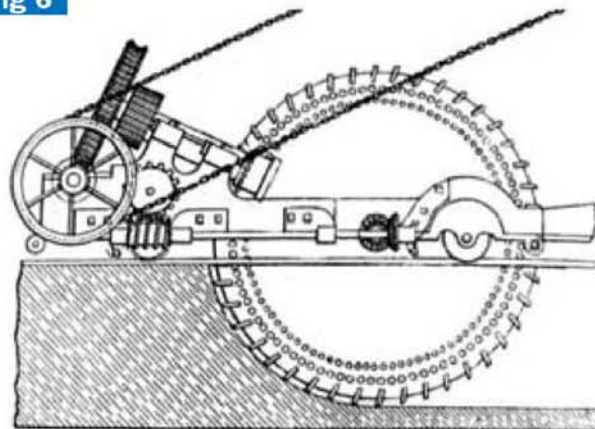
Fig 5

up to 15ft. diameter and up to 4ft. wide measured from the faceplate. The bed itself was 4ft. wide and 20ft. long and could be moved longitudinally to 12in. from the faceplate up to 6ft. 6in. away from it. The leadscrew, which can be seen in the well of the gap, was $4\frac{1}{2}$ in. diameter and cut to a Whitworth thread form and could be used for work up to 10ft. diameter via the shaft and gearing across the gap, and for larger work was driven by additional shafts and bevel gearing around the gap space. The completed machine weighed 45-tons and was made for the Glenfield Company of Kilmarnock.

Stone Dressing Machine

Crump and Brereton's Quarrying and Stone Dressing Machine of

1886 is shown in **figs 5**, and **6**. This machine was introduced into the British Isles from America where it was made in Philadelphia. It is basically a heavy lumber saw with removable teeth in the blade pre-dating the now common inserted tooth cutters by almost a century. As we know from experience, the depth of cut of any circular blade is limited by the diameter of the mandrel and so, in this design, the largest possible was maximised by having a toothed drive in the periphery of the wheel. As shown the cut is clockwise so it can be understood that the blade is kept in tension immediately after a tooth has finished its cut and the tendency for the thin blade to deflect was minimised.

Fig 7**Fig 6**

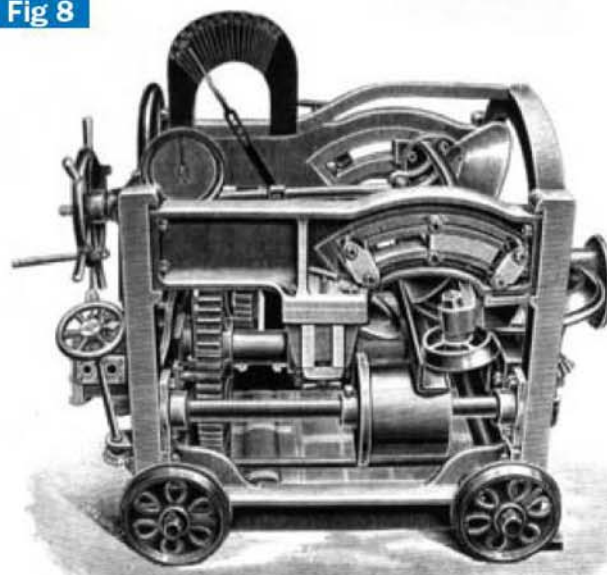
The saw with its gearing is mounted on a travelling frame which advances, as the blade revolves, on a track fitted with holes into which the feed wheel pins engage. The feed is driven by a pair of bevel gears on the blade spindle shaft to a worm and wormwheel as can be seen in the upper illustration of **fig 7**. The lower diagram shows the arrangement with a belt drive from the engine and with the worm and wormwheel drive to equal sized gears driving the drive wheels whose pins engage in the cutting wheel periphery. The engraving appears to show a chain drive, so variations were possible.

The tools were right and left-handed, similar to those used in lathe work though varied according to the type of stone being cut.

As to performance, a block of Portland stone 30in. deep and 36in. long was cut through completely in 13 minutes representing a feed rate of $2\frac{3}{4}$ in. per minute, 60 times faster than with reciprocating saws fed with water and sand in the same stonemason's yard. Smaller driven pulleys could be fitted and feed rates up to 4in. per minute could be achieved, presumably on relatively softer rock.

Bevelling Machine

Next comes Arthur's Angle-iron Bevelling Machine of 1886. It had been noted over many years of iron ship-building that rarely, if ever, did adjacent plates come together so that a 90deg. riveted angle section could be used to hold them together. Evidently Arthur - no

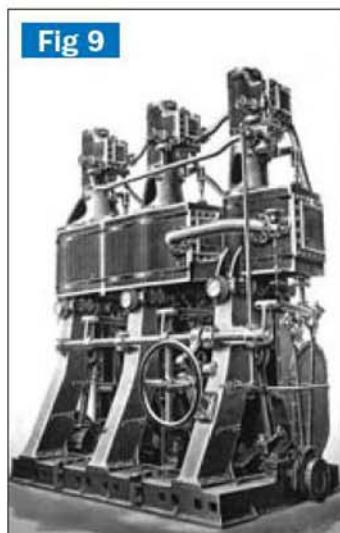
Fig 8

details of this mystery figure were published, possibly even a pseudonym? - were given in *Engineering*. However, he used a lot of Victorian ingenuity to produce this superb little machine shown in **fig 8** which, by various pressure rollers on an accurately set tilting frame, would re-form ordinary angle iron as required for those awkward places in ships' hulls.

The engraver made one omission. The lower roller has yet to be positioned against the angle at its bottom by sliding it towards the angle and securing it at that point though I am doubtful that adequate strength is available by the single locking bolt. As shown the machine is set to open out the angle to greater than 90 degrees. In order to close the angle to a smaller one, the angle is turned through 90deg. anti-clockwise as we look at it and advanced up to the roller flange and the larger bevelled wheel does the necessary forming action. Adjustments could be made at will though I suspect that a lot of practice would be required to generate an exact variation curve. Mention is also made in this same short article that Arthur also invented a machine for forming angles while these were still red-hot.

Quadruple Expansion Disconnective Engine

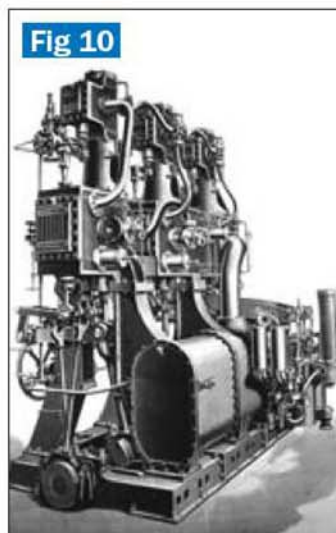
In my talks to clubs I prefaced this next description with a phrase from a very well-known 1980's television comedy series with a phrase still used today on suitable occasions - "Listen very carefully, I shall say this only once!". I would then follow this statement by warning my audience "And I will be asking questions to test your memory later!". My audiences occasionally raised a chuckle or two, but not always. The machine to be described here was a Quadruple Expansion Disconnective Engine of 1886. In this fascinating marine power unit, the three high-pressure cylinders were set tandem-fashion over the second, intermediate and low-pressure cylinders in turn. **Figures 9** and



10 set the scene. The cylinders had a common stroke of 24 inches. Their diameters were 7in., 7in., 7in., 16in., 22in. and 36 inches. The idea of having six cylinders was that the boat's owner - evidently having vast sums of cash available but no common sense whatsoever - wanted his craft to travel very slowly so that he might fish (rod and line?) directly from the yacht instead of from a towed dinghy as was apparently the common practice at that time. I joke not. This is how *Engineering* described the scene. Also by dividing the power output a 'sweeter running' unit was possible, important to a steam yacht.

Although not clear from the engravings the crankshaft would be disconnected, possibly with a system of clutches on the main shaft between the crank throws of the three basic tandem units, and by operating steam supply control valves in the correct sequence a number of operating conditions could be met, as follows:

- 1) As a 6-cylinder quadruple expansion engine working on three cranks.
- 2) As a 5-cylinder quadruple expansion engine with one of the high-pressure cylinders turned off and a minimal amount of lubrication fed to that cylinder.
- 3) As a 4-cylinder quadruple expansion engine with three cranks. Two of the high-pressure cylinders would be turned off and fed



with minimal lubrication. A situation which might be useful if the vessel was short of fuel.

- 4) As a 4-cylinder triple expansion non-condensing engine working on two cranks with one 7in. and its mating 36in. cylinder disconnected and with the 24in. intermediate cylinder exhausting to atmosphere.
- 5) As a 4-cylinder triple expansion condensing engine working on two cranks. As for the above non-condensing selection but the exhaust steam is passed through the 36in. low-pressure cylinder and thence to the condenser. The position of the piston relative to the exhaust valve port being open had to be established in advance for this to happen.
- 6) As a 3-cylinder triple expansion engine working on three cranks. All of the 7in. high-pressure cylinders are cut out leaving them as guides only for their respective piston rods. Steam was admitted to the 16in. cylinder now the high pressure one, through its own supply valve, and not forgetting the minimal lubrication to the upper pistons. The operator did not have the proverbial 'pilot's license' as aircraft had yet to be invented and those with their modern plethora of instruments would come into being a further 4 - 5 decades after that. It is presumed this sailor-engineer was the

first holder of the marine equivalent?

- 7) As a 2-cylinder tandem compound non-condensing engine in which the two aft tandem cylinders are disconnected leaving the forward unit with the 7in. high-pressure with its 16in. low-pressure cylinder to exhaust to atmosphere through another dedicated valve. In regard to this I am unable to determine how the forward unit could drive the propeller shaft unless the rear cranks are hollow with the drive shaft keyed to the front cranks.
- 8) As a 2-cylinder tandem compound condensing engine. A repeat of (7) except that the exhaust steam is passed through the 24in. and 36in. cylinders and thence to the condenser via separate valves. The pistons of these would, perhaps, have to be specially set at mid stroke? That information is not available.
- 9) As a disconnected 2-cylinder tandem compound condensing engine where the aft 7in. high-pressure cylinder exhausts directly into the 36in. low-pressure cylinder and thence to the condenser, the more usual arrangement. The 'magic formula' by which the ideal expansion ratio between high and low-pressure cylinders was calculated seems to have been overlooked, or even totally ignored.

By an arrangement of rocking levers, the valve travel of the high-pressure cylinders was half that of the low-pressure ones. The completed engine was built up in three distinct sections and was fitted into a yacht 170ft. long, 21ft. beam and moulded depth of 13½ feet. Her speed was measured at 11½ knots - NOT while fishing, except possibly for mackerel, tuna or shark? The boiler was 9½ft. diameter and 11½ft. long and working at 180 pounds per square inch. The description may be found in *Engineering* dated 9 April 1886.

● To be continued.

AN ENGINEER'S DAY OUT

A silversmith's workshop



ROGER BACKHOUSE

Roger Backhouse visits a silversmith's workshop in Bermondsey, London - metalwork, but not as we know it!



Steve Wager annealing silver.

Working gold and silver is one of the world's oldest metal crafts. Evidence from archaeology shows gold worked as early as the Bronze Age. Precious metals retain their attraction and many craftsmen in gold and silver remain at work around Britain. I visited the Bermondsey workshops of Steve Wager

and Howard Fenn, where they work with engraver Roy Hood to make a range of bespoke silver. Some metalworking processes like filing, drilling, casting and soldering are common to engineers and silversmiths but as I learned there is a different language and set of skills.

For a start workbenches are different. Most work is done sitting in semicircular

apertures with a leather apron slung across to catch filings or fragments of precious metal for reuse later. With sky-high prices of non-ferrous metals this might be an example model engineers could follow!

For Steve and Howard, the design is usually the first stage. Although they have worked from other's designs they like to develop different drawings from client's ideas or their own inspiration. Howard likes sculpted pieces and Steve prefers complex work as it is more challenging. It can take up to two years from initial design to completion.

Flatware

Many of their pieces are flatware where objects like bowls, spoons or vases are made by hammering up from a flat sheet. However, silversmiths refer to the process as raising or planishing. They develop an amazing range of pieces through their mastery of beating



One of many unusual tools - a snarling iron used to hammer inside a raised piece.



Chasing a piece on a pitch block.

metal. Where engineers use only a few types of hammer, silversmiths use dozens.

The first stage in making flatware is blocking on a wood former or sandbag and then raising to lift the sides. Annealing between stages, at a higher temperature than for copper, softens the metal.

Finally, the pieces are planished to take out most of the hammer marks. Marks can be left to give a slightly mottled appearance or filed to remove final marks followed by the emery, stoning and polishing stages. Unlike model engineers who try to make a surface finish like a prototype silversmiths usually aim for a perfect polished finish, though some like a textured appearance carried out using a chasing hammer.

Hammers are just part of the story. Silversmiths use a variety of stakes (not anvils) for shaping including one I was assured was an artificial

hip joint. It seemed bizarre, but was ideal for the purpose, being hard and highly polished. They have other strange stakes including a 'bull and butcher' and a snarling iron used to expand the body of a hollow object. Other shaping is done using a fly press and a lead former, or, occasionally, steel moulds.

Boxes and caskets

One of the most difficult operations, these are fabricated from flat sheet, scored and bent to an angle and then soldered. Making sure a sheet remains flat is tricky - any distortion will be difficult to remove later. Box making uses a gapping machine, which to the uninitiated looks like a horizontal milling machine. It is used to cut a bevel or groove to make a precise hinge, except that silversmiths refer to joints, never to hinges. Making joints is precise work to ensure the lid opens at the correct angle.



Engraver's tools.

Casting and spinning

Howard and Steve do some casting in the workshop. Most often they make a mould from a cuttlefish skeleton but they have also made lost wax castings. This is one of the oldest casting techniques, known to the ancient Greeks and still used today but with a new twist.

As practised today an original, of any hard material, is put into a silicon mould and a breathing hole added. This mould is then cut open, the original removed and the mould filled with wax. A professional caster takes this mould and spins it at high speed whilst adding hot silver.

Unlike most engineers silversmiths make their own



Examples of raised ware, gilded inside.



A selection of files and hand tools.



'Italian shoe' planishing hammer for flat work.



Just part of the selection of hammers.



9 Ray Hood at work engraving.



10 Roller for forming silver shapes.



11 Drawing silver wire.



12 Silver casting in Plaster of Paris mould.

sections by drawing annealed wire through a swaging block. One bench has a windlass for drawing wire. Examine most old silver and you'll see many different sections used, all made by the same hand drawing process.

The workshop has a Taylor lathe used for metal spinning. This is decidedly heavy duty

to withstand the stresses of spinning. Formers are made from lignum vitae or boxwood screwed directly to the lathe mandrel. Metal is held against the former by a pad pressed by a revolving centre. It is removed frequently for annealing.

Roy Hood, the engraver, has a completely different task. He usually works with an

eyeglass and only one tool, a sharp steel pointer, to cut the precise lettering for plaques and presentations. He knows many different font types. Much engraving is now done by machine but as Roy points out hand engraving lasts far longer.

Variety

I was amazed at the range and quality of the work produced here. There are vases and bowls, architectural models, a scale replica of a human heart and a delightful model train originally made to go on a birthday cake. Relatively few can now produce this range of pieces but thankfully it remains very much alive in this corner of Bermondsey.

State of the trade

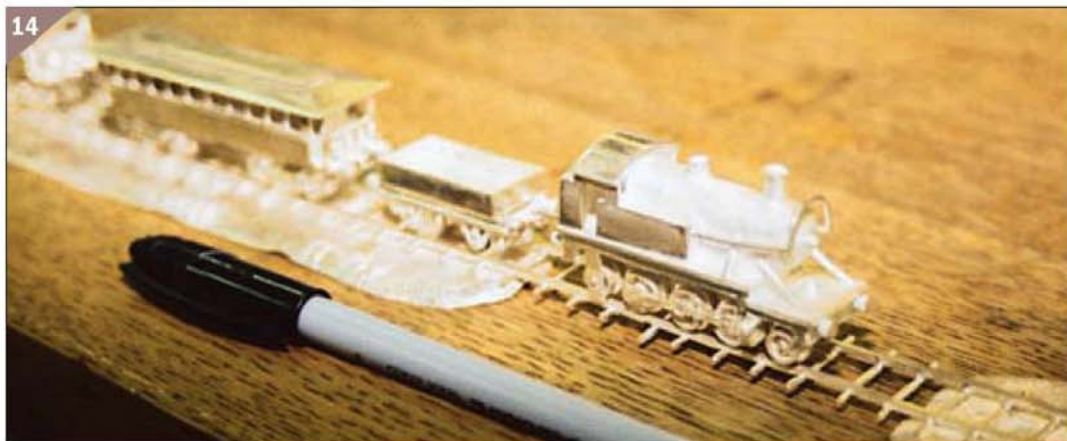
Like many British industries, manufacturing silversmiths

have declined in number. Even Aspreys ceased to be a manufacturing firm at the end of 2008. Work going abroad plus limited apprenticeships means fewer have all round skills. Some continue to make smaller items such as jewellery but fewer can now make the wide range seen here.

Despite this decline Britain still produces first-class silver. Unlike many crafts silversmithing is well promoted by one of the oldest and richest City Livery Companies, the Goldsmith's Company. Every autumn the Goldsmith's Fair is a showplace for some of the finest designer makers and the Company offers bursaries for promising students. Currently the Company plans to set up its own college to train a new generation of silver and goldsmiths.



13 Model coach - made in silver for a birthday cake.



14 Model train - made in silver for a birthday cake.

Goldsmith's promotes British Silver week starting on 8 June 2009 with events around Britain including a display at Chatsworth House. Many designers and makers open their doors to the public and some, like Howard and Steve, demonstrate the craft. Visiting the workshop during Silver Week 2008, it was a revelation to see a small piece of silver transformed into a lovely spoon.

Steve says "We'd like everyone to have silver" and there is certainly something really special about craftsman made pieces. So if your household would like something special to celebrate an occasion or your model engineering society would like a different trophy, why not commission a designer silversmith to produce a truly original work?

Further information

To find out about Goldsmith's Company events and promotions contact Goldsmith's Hall, Foster Lane, London EC2V 6BN. T. 020 7606 7010. W.

www.thegoldsmiths.co.uk

British silver week W.

www.britishsilverweek.co.uk

In London, Sir John Cass

College offers full time courses where Steve lectures part time. Howard and Steve offer taster



15 Bending machine - used in making boxes and caskets.

classes at their workshop where participants can make both a small spoon and a candle holder/small bowl. They take complete beginners, but naturally people with metalworking skills enjoy this new experience more. (For details T. 020 7378 9222 or E. howard@fennpainsilver.demon.co.uk)

ME



16 Gold and silversmith's workbench - the apron catches filings and scrap for recycling.



17 Steve Wager chasing a piece on a pitch block.



18 Gapping machine - similar to a milling machine.



19 Windlass for drawing wire.

MAY

- 8 Polegate & District MEC.**
Mike Wheelwright: Modern Steam Locomotives. Contact D. F. Pratt: 01323 645872.
- 9/10 Romney Marsh MES.**
RMMES Open Weekend. Contact John Wimble: 01797 362295.
- 9 Ryedale SME.** Annual Dinner. Contact David Myers: 01388 661255.
- 10 Bristol SMEE.** Running Days. Contact Trevor Chambers: 0145 441 5085.
- 10 Cambridge MES.** Public Open Day. Contact Tim Coles: 01954 267359.
- 10 Cardiff MES.** Open Day. Contact Don Norman: 01656 784530.
- 10 Leicester SME.** Public Running. Contact John Lowe: 01455 272047.
- 10 Nottingham SMEE.** Running Day. Contact Pete Towle: 0115 987 9865.
- 10 Sutton MEC.** Track Day. Contact Bob Wood: 020 8641 6258.
- 11 Bedford MES.** Bill Davies: LMS Memories. Contact Ted Jolliffe: 01234 327791.
- 11 Erewash Valley MES.** Bits & Pieces. Contact Peter Siddall: 0115 9255397.
- 12 King's Lynn DSME.** Bring & Buy. Contact Mike Coote: 01533 673728.
- 12 Melton Mowbray DMES.** Ladies Night. Contact Norman Smedley: 01664 434349.
- 13 Brighton & Hove SMLE.** Wrinklies Day. Contact Mick Funnell: 01323 892042.
- 13 High Wycombe MEC.** AGM. Contact Eric Stevens: 01494 438761.
- 13 Hull DSME.** Alan Dixon: Computers. Contact Tony Finn: 01482 898434.
- 13 St. Albans DMES.** Andrew Edmondson: Vulcan to Air. Contact Roy Verden: 01923 220590.
- 14 Leyland SME.** Lubricators Night. Contact A. P. Bibby: 01254 812049.
- 14 NW Leicestershire SME.** Mr Wood: Pole lathe turning. Contact Jamie Wilde: 01530 273270.
- 14 Westland & Yeovil DMES.** Track Running Afternoon. Contact Gerald Martyn: 01935 434126.
- 16-18 British Columbia SME.** Spring Meet. Contact Sean Laurence: (604) 931 1547.
- 16 Cardiff MES.** Steam-Up & Family Day. Contact Don Norman: 01656 784530.
- 16 NW Leicestershire SME.** 2½ Gauge Society Running Day. Contact Jamie Wilde: 01530 273270.
- 16/17 Nottingham SMEE.** Diesel Gala. Contact Pete Towle: 0115 987 9865.
- 16/17 Ryedale SME.** Gilling Spring Mainline Rally. Contact David Myers: 01388 661255.
- 16 SM&EE.** Polly course training day 6. Contact Maurice Fagg: 020 8669 1480.
- 16 South Lakeland MES.** Open Day. Contact Adrian Dixon: 01229 869915.
- 16 Southport Model Engineering Club.** Diesel Day. Contact Gwendoline Baguley: 01704 568456.
- 16 York City & DSME.** Exhibition Night. Contact Pat Martindale: 01262 676291.
- 17 Leeds SMEE.** Running Day. Contact Geoff Shackleton: 01977 798138.
- 17 Leicester SME.** Maxtrak Rally & Public Running. Contact John Lowe: 01455 272047.
- 17 NW Leicestershire SME.** Public Running. Contact Jamie Wilde: 01530 273270.
- 17 Otago MES.** Club Running Day. Contact James Woods: 476 1369.
- 17 Rugby MES.** Public Running. Contact Ken Eyre: 01788 842709.
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- 18 Model Steam Road Vehicle Soc.** Model Night. Contact John Bagwell: 01452 304876.
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A visit to The Bournemouth & District Society of Model Engineers

Photograph 1 shows Nick Feast with his 3½in. gauge Q1. This locomotive will be the subject of a build series in the near future. I had a ride behind it and all I can say is that it is a good job there are no speed cameras on the Bournemouth track!

Photograph 2 shows a Regner vertical boiler 16mm scale narrow gauge locomotive. Being a geared locomotive, the Regner will pull as much stock as can be coupled on to it. Bournemouth club has a thriving 16mm narrow gauge group run by Dave White & Gordon Miles and have their own raised track. The layout is a continuous run with sidings to 'steam up' and prepare locomotives. The track is covered with shutters when not in use; they are padlocked to the track baseboards to keep vandals out.

was mentioned but could not confirm this on the website. It uses pre-cast concrete beams and appears to be of a good solid construction. Full details of track construction are on the society's website at www.littledownrailway.co.uk

Photograph 4 shows the pleasant surroundings of the track as it goes through the leafy trees to the curves at the other end. The bendy beam at the left allows locomotives to be placed onto the main track and is based on the one at the Guildford track.

The current project is to build two carriage sheds so that the passenger cars don't need to be lifted on and off at every session. I hope to bring you photographs when they are complete.



Photograph 3 is a general view looking at the station building. Although the track is only a dog bone shape, it is quite long; I believe ⅓rd of a mile



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Tel: 01844 352670 Oxford.

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Nick Feast's Workshop

Nick has built a Bulleid Q1 locomotive and has written a construction series for M.E. First, we take a quick look at his workshop.

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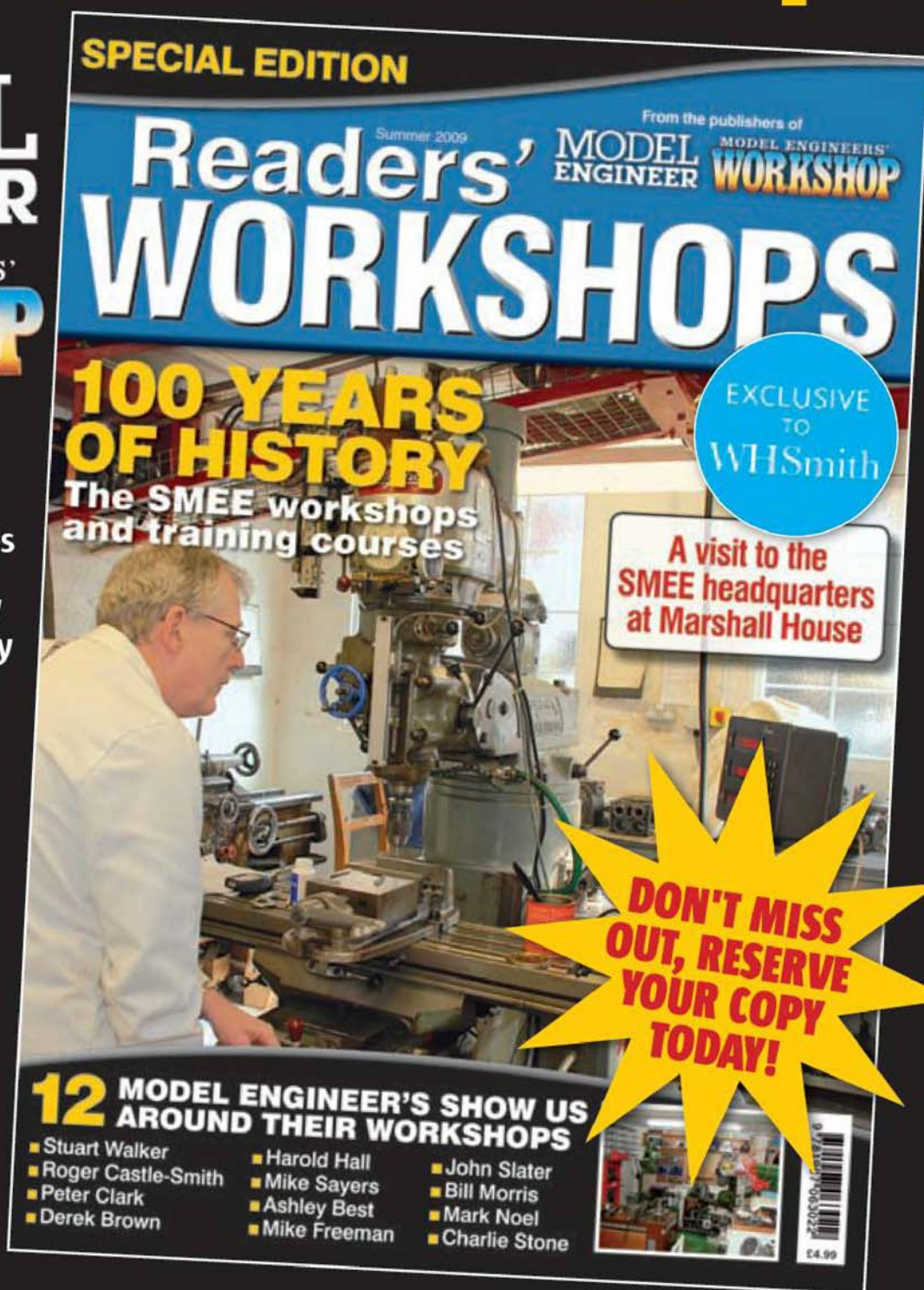
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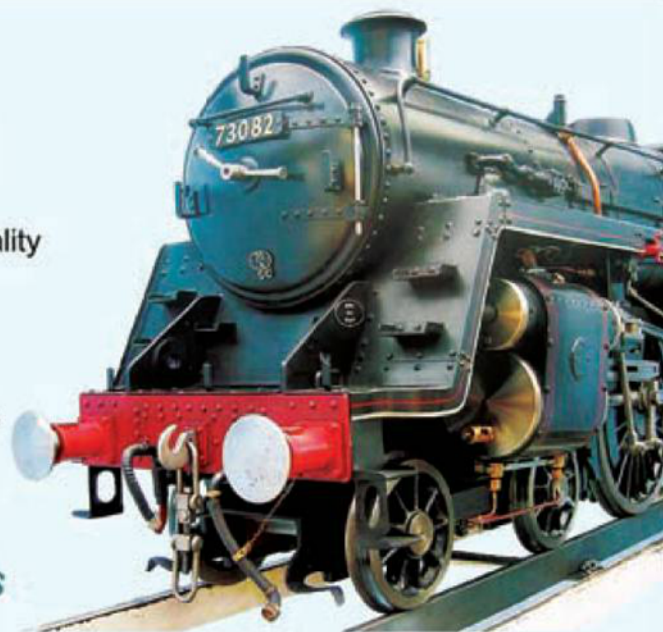
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